

Description

Title of the invention: Sealed and thermally insulating tank

Technical field

5 [0001] The invention relates to the field of sealed and thermally insulating membrane tanks.
In particular, the invention relates to the field of sealed and thermally insulating tanks for
storing and/or transporting liquefied gas at low temperatures, such as tanks for
transporting liquefied petroleum gas (also called LPG) having for example a temperature
of between -50°C and 0°C, or for transporting liquefied natural gas (LNG) at approximately
10 -162°C at atmospheric pressure. These tanks can be installed on shore or on a floating
structure. In the case of a floating structure, the tank can be for transporting liquefied gas
or receiving liquefied gas used as a fuel to propel the floating structure.

[0002] In an embodiment, the liquefied gas is LNG, at atmospheric pressure. Other liquefied
gases can also be envisaged, particularly ethane, propane, butane, hydrogen and
15 ethylene.

Technological background

[0003] The tanks of vessels for transporting liquefied natural gas generally comprise a double
wall comprising in succession, from the inside to the outside of the tank, a primary sealing
membrane, a primary thermally insulating barrier, a secondary sealing membrane and a
20 secondary thermally insulating barrier. The secondary insulating barrier includes a
secondary insulating block comprising a cover plate forming a supporting surface for the
secondary sealing membrane.

[0004] Patent application F 3 090 810 describes a wall of a sealed and insulating tank in which
an anchoring system makes it possible to anchor a primary insulating block to the
25 secondary insulating block. The anchoring system comprises a base fastened to the cover
plate. A movable part is held in the base in the direction of the thickness of the wall and
movably mounted in the base. The movable part includes a tapped hole emerging onto an
upper surface of the movable part. The upper surface of the movable part is flush with an
upper surface of the cover plate and the movable part is mounted in the base free to
30 translate at least parallel to the longitudinal direction of the welding flange.

[0005] However, the proposed anchoring system is not entirely satisfactory. The movable part
is subject to seizing, caused in particular by an excessively high coefficient of friction of

the metal part and by the lack of uniformity of the coefficient of friction on the surface of an untreated metal part.

Summary

[0006] One idea behind the invention is to limit the seizing of the movable part present in the primary anchoring system of a sealed and thermally insulating tank.

[0007] Another idea behind the invention is to promote the sliding of the movable part in the desired directions only.

[0008] According to an embodiment, the invention provides a sealed and thermally insulating tank for storing a fluid, the tank including a tank wall including in succession, in the direction of the thickness thereof, a secondary insulating barrier secured to a load-bearing wall, a secondary sealing membrane resting against the secondary insulating barrier, a primary insulating barrier resting against the secondary sealing membrane and a primary sealing membrane resting against the primary insulating barrier, in which the secondary insulating barrier includes a secondary insulating block comprising a cover plate forming a supporting surface for the secondary sealing membrane, in which said secondary sealing membrane comprises a plurality of metal strakes, the metal strakes having edges raised towards the inside of the tank, said metal strakes being welded in pairs, by their raised edges, on two faces of a welding flange mechanically secured to the secondary block, said welding flange being partially engaged in a groove made in the cover plate and extending in a longitudinal direction, in which the primary insulating barrier includes a primary insulating block anchored to the secondary insulating block by a primary anchoring system, the primary anchoring system including:

a recess made in the cover plate and emerging onto said supporting surface,

a movable part positioned in the recess, the movable part including a body having an upper face flush with the supporting surface, and

a securing part fastened to the cover plate and interacting with the movable part so as to immobilize the movable part in the recess in the thickness direction,

the recess and the securing part being configured to allow the movement of the movable part at least parallel to the longitudinal direction of the welding flange,

in which the movable part includes a sliding layer covering at least one surface of the body, the sliding layer being in contact with the securing part and having a lower coefficient of friction than said body.

[0009] Due to these features, the sliding layer makes it possible to improve the durability of the primary anchoring system. As it has a lower coefficient of friction than said body, the

movable part can thus move in the body, minimizing the friction between these two parts, and thus limit the forces applied to the welds between the primary anchor and the secondary membrane and thus increase the service life of the primary anchoring system. This also makes it possible to maintain the movement of the movable part only in the desired direction and thus prevent the part from jamming.

[0010] According to embodiments, such a tank can include one or more of the following features.

[0011] According to an embodiment, a compressible material is inserted into gaps situated between the securing part and the movable part or between the movable part and the walls of the recess. The compressible material is insulating and is for example selected from polymer foams and mineral wools. Due to the compressible nature of the material, it is possible to adjust the initial position of the movable part to a centred position allowing the movable part good freedom of movement in one direction or the other on commissioning.

[0012] According to an embodiment, the compressible material can be a low-force spring.

[0013] According to an embodiment, the sliding layer is made from a polymer.

[0014] According to an embodiment, the sliding layer is selected from the following polymers: PTFE (polytetrafluoroethylene), PCTFE (polychlorotrifluoroethylene), POM (polyoxymethylene), preferably POM-H (for homopolymer), PEI (polyetherimide), PAEK (polyaryletherketone) and PEEK (polyetheretherketone).

[0015] According to one embodiment, the polymer is fibre-reinforced, for example with glass fibre. This has the advantage of increasing the creep resistance of the material and reducing the coefficient of thermal contraction of the sliding layer.

[0016] According to an embodiment, the polymer sliding layer is made from a polymer filled with particulate fillers, the particulate fillers preferably including nanofillers. Depending on the materials used, this has the advantage of increasing either the hardness of the polymer or its sliding capacity on contact between the stressed surfaces. A nanofiller is defined by its size of between 1 and 100 nanometres. The shape of the particulate fillers, in particular of the nanofillers, can be selected for example from: sheet, fibre, granule and sphere.

[0017] According to an embodiment, the particulate fillers are made from at least one material selected from: carbon, graphite, glass, cellulose and bronze.

[0018] According to an embodiment, the sliding layer is obtained by surface treatment of said at least one surface of the body.

[0019] According to an embodiment, the surface treatment is a nitriding treatment.

[0020] According to an embodiment, the sliding layer is positioned on a surface of the securing part in contact with the movable part.

[0021] According to an embodiment, the sliding layer is positioned on a surface of the securing part in contact with the movable part and on the movable part.

5 [0022] According to an embodiment, the recess has a depth in the thickness direction such that the movable part is flush with the supporting surface and a length in the longitudinal direction and a width in a transverse direction such that the movable part can move at least parallel to the longitudinal direction of the metal strakes.

10 [0023] According to an embodiment, the cover plate includes a counterbore on the edge of the recess, the counterbore receiving the securing part, the counterbore having a depth such that the securing part is flush with the supporting surface, in which the securing part completely covers the recess and the counterbore and has an opening, the upper face of the body emerging through said opening.

15 [0024] According to an embodiment, the movable part includes a base having a larger width than the opening in the securing part.

[0025] According to an embodiment, the movable part includes an upper portion having a width equal to that of said opening, the upper portion being flush with an upper surface of the securing part.

20 [0026] According to an embodiment, at least the base of the movable part includes the sliding layer.

[0027] According to an embodiment, an upper surface of the base is covered by the sliding layer. This makes it possible to reduce the friction between the movable part and a lower surface of the securing part.

25 [0028] According to an embodiment, a side of the upper portion is covered by the sliding layer. This makes it possible to reduce the friction between the movable part and an edge of the opening of the securing part.

[0029] According to an embodiment, the securing part is a retaining plate. According to one embodiment, the securing part is made from steel, for example stainless steel and/or cryogenic steel.

30 [0030] According to an embodiment, the retaining plate is fastened to the cover plate by fasteners placed on the periphery of the retaining plate, so that the fasteners are positioned outside the recess around the recess, and/or by adhesive bonding.

[0031] Due to these features, there is no risk that the fasteners, for example screws or rivets, will come into contact with the movable part.

[0032] According to an embodiment, the movable part includes a tapped hole emerging onto said upper surface of said movable part and the primary anchoring system further includes
5 a stud having a threaded lower portion screwed into the tapped hole.

[0033] According to an embodiment, the stud includes a collar extending above the movable part, in which the periphery of the collar is sealably welded to the secondary sealing membrane.

[0034] Such a tank can form part of an onshore storage installation, for example for storing
10 LNG, or be installed in an inshore or offshore floating structure, particularly a methane carrier, a floating storage re-gasification unit (FSRU), a floating production storage and offloading unit (FPSO) or other structure. Such a tank can also be used as a fuel tank on any type of vessel.

[0035] According to an embodiment, the primary anchoring system further comprises at least
15 one washer and at least one nut interacting with threaded upper portions of said stud in order to secure said washer pressing on a bottom plate of the primary insulating block.

[0036] According to an embodiment, a vessel for transporting a cold liquid product includes a double hull and an aforementioned tank arranged in the double hull.

[0037] According to one embodiment, the invention also provides a system for transferring a
20 cold liquid product, the system including the aforementioned vessel, insulated pipes arranged so that they connect the tank installed in the hull of the vessel to a floating or onshore storage installation and a pump for conveying a stream of cold liquid product through the insulated pipes from or to the floating or onshore storage installation to or from the tank of the vessel.

[0038] According to an embodiment, the invention also provides a method for loading or
25 unloading such a vessel, in which a cold liquid product is conveyed through insulated pipes from or to a floating or onshore storage installation to or from the tank of the vessel.

Brief description of the figures

[0039] The invention will be better understood, and other aims, details, features and
30 advantages thereof will become clearer, from the following description of a plurality of particular embodiments of the invention, provided solely by way of non-limiting illustration, with reference to the appended drawings.

[0040] [Fig.1] Figure 1 is a cut-away perspective view of a tank wall.

[0041] [Fig. 2] Figure 2 is a diagrammatic cross-sectional view of detail II in Figure 1, illustrating an anchoring system interacting with a stud according to a first embodiment.

[0042] [Fig. 3] Figure 3 is a diagrammatic top view of the anchoring system according to the first embodiment, including in particular a movable part and a securing part.

5 [0043] [Fig. 4] Figure 4 is a diagrammatic perspective view of the movable part in Figure 3.

[0044] [Fig. 5] Figure 5 is a diagrammatic perspective view of the movable part according to a second embodiment.

[0045] [Fig. 6] Figure 6 is a diagrammatic perspective view of the movable part according to a third embodiment.

10 [0046] [Fig. 7] Figure 7 is a diagrammatic perspective view of the movable part according to a fourth embodiment.

[0047] [Fig. 8] Figure 8 is a diagrammatic perspective view of the movable part according to a fifth embodiment.

15 [0048] [Fig. 9] Figure 9 is a diagrammatic perspective view of the movable part according to a sixth embodiment.

[0049] [Fig. 10] Figure 10 is a diagrammatic perspective view of the movable part according to a seventh embodiment.

[0050] [Fig. 11] Figure 11 is a diagrammatic perspective view of a securing part according to a first variant.

20 [0051] [Fig. 12] Figure 12 is a diagrammatic perspective view of the securing part according to a second variant.

[0052] [Fig. 13] Figure 13 is a cut-away diagrammatic representation of a methane carrier tank and a terminal for loading/unloading this tank.

Description of the embodiments

25 [0053] Figure 1 shows the multi-layer structure of a sealed and thermally insulating tank 1 for storing a liquefied fluid, such as liquefied natural gas (LNG). The tank 1 has a generally polyhedral shape and comprises a plurality of walls. The wall of the tank 1 includes in succession, in the direction of the thickness thereof, from the outside to the inside of the tank 1, a secondary thermally insulating barrier 2 secured to a load-bearing structure 3, a
30 secondary sealing membrane 4 resting against the secondary thermally insulating barrier 2, a primary thermally insulating barrier 5 resting against the secondary sealing membrane

4 and a primary sealing membrane 6 suitable for being in contact with the liquefied natural gas contained in the tank 1.

5 [0054] The load-bearing structure of the tank 1 can particularly be formed by the hull or double hull of a vessel. The load-bearing structure includes a plurality of load-bearing walls 3 defining the general shape of the tank, which is usually a polyhedral shape.

[0055] The secondary thermally insulating barrier 2 includes a plurality of secondary insulating blocks 7, which are anchored to the load-bearing wall 3 by means of secondary anchoring systems 98. The secondary insulating blocks 7 have a generally parallelepipedal shape and are positioned in parallel rows. Three rows are indicated by the letters A, B and C.
10 Beads of sealant (not shown) are interposed between the secondary insulating blocks 7 and the load-bearing wall 3 in order to compensate for the deviation of the load-bearing wall 3 relative to a reference planar surface. Kraft paper can be inserted between the beads of sealant and the load-bearing wall 3 if desired, in order to prevent the beads of sealant from adhering to the load-bearing wall 3.

15 [0056] It will be observed that the secondary sealing membrane 4 includes a continuous sheet of metal strakes 21, with edges 32 raised towards the inside of the tank. The strakes 21 are welded in pairs, by their raised edges 32, on the two faces of a welding flange. The welding flanges have an L-shaped cross-section. The raised edges 32 of the strakes 21 are welded to one arm of the L shape, while the other arm is engaged in a groove 20 made
20 in the cover plates 10 of the secondary insulating blocks 7. The cover plates 10 comprise a plurality of parallel grooves 20, the distance between two grooves 20 corresponding to the width of a strake 21, while the distance between a free edge of a block and an adjacent groove 20 corresponds to the width of a strake 21, so that a strake forms the join between two adjacent insulating blocks 7. The secondary sealing membrane 4 is thus secured to
25 the secondary thermally insulating barrier 2. The welding flanges and the grooves 20 form sliding joints, making it possible for the strakes 21 to contract and deform relative to the secondary insulating blocks 7.

[0057] The primary thermally insulating barrier 5 includes a plurality of primary insulating blocks 22 superposed straddling two rows of secondary insulating blocks 7. The primary
30 insulating blocks 22 are anchored to the secondary insulating blocks 7 by means of primary anchoring systems 97. The primary anchoring systems 97 are separated and offset from the secondary anchoring systems 98. The primary insulating blocks 22 have a generally parallelepipedal shape and are positioned in parallel rows. In addition, they have identical dimensions to the primary insulating blocks 22, with the exception of their thickness in the
35 direction of the thickness of the tank wall 1, which can be different, and in particular smaller.

The primary thermally insulating barrier 5 is topped by a metal sealing barrier with corrugations. Alternatively, the thermally insulating barrier 5 could be topped by a metal sealing barrier made up of strakes.

[0058] Figure 2 shows the primary anchoring system 97 according to a first embodiment. The primary anchoring system 97 includes a movable part 102 held in place by a securing part 101. The movable part 102 is positioned in a recess 108 made in the cover plate 10 and the securing part 101 is positioned in a counterbore 109, so that the securing part 101 is flush with an upper surface of a cover plate 10. The securing part 101 is fastened to the cover plate 10 using fasteners 34 and/or by adhesive bonding.

[0059] In a preferred embodiment, the cover plate 10 comprises in particular a layer of plywood of a thickness of between 15 and 24 millimetres, in which the recess is made.

[0060] In line with a tapped hole 104 of the movable part 102, the sealing membrane 4 is pierced to allow a stud 35 to pass through. The stud 35 then makes it possible to fasten the secondary insulating block 7 to the primary insulating block 22.

[0061] Figure 3 shows the primary anchoring system 97 according to the first embodiment, viewed from above. An opening 103 in which the movable part 102 emerges is also filled with a part made from a compressible insulating material 105. In Figure 3, the compressible insulating material part 105 is shown on a single side of the movable part 102, but another identical part can also be placed on the other side in order to centre the movable part 102 initially relative to the opening 103. A sliding layer 106 covers at least one side of the movable part 102.

[0062] The pre-positioning of the movable part 102, for example centred pre-positioning, obtained by means of the compressible insulating material parts 105, ensures that a certain range of mobility exists in one direction or the other in the longitudinal direction of the strakes 21. This mobility makes it possible to adjust the position of the stud 35 if necessary, either when the secondary sealing membrane 4 is welded in order to compensate for the positioning tolerances, or during the use of the tank in order to absorb deformations having various causes.

[0063] Figures 4 to 10 show different embodiments of the movable part 102-702 of the primary anchoring system, while Figures 11 and 12 show two variant embodiments of the securing part 101-201.

[0064] Figure 4 shows the movable part 102 according to the first embodiment. The movable part 102 comprises an upper portion 114 and a lower portion 110. The lower portion 110 is a rectangular parallelepipedal base and the upper portion 114 has a rectangular cross-

section and is shorter than the lower portion 110. The movable part 102 comprises a tapped hole 104 made in an upper surface of the upper portion 114, which makes it possible for a stud 35 to pass through. The movable part 102 is surrounded by a sliding pad 106 that is a polymer layer. The lower portion 110 and the upper portion 114 are for example made from stainless steel. The sliding pad 106 is positioned on an edge of the upper surface of the upper portion 114, on sides 115 of the upper portion 114 and on an upper surface 111 of the lower portion 110 not covered by the upper portion 114. The sliding pad 106 can consist of a single block.

[0065] In a variant, not shown, the sliding pad 106 can be replaced by a nitriding treatment applied to the movable part 102 on the sides 115 of the upper portion 114 and on the upper surface 111 of the lower portion 110.

[0066] Figure 5 shows the movable part 202 according to a second embodiment. The second embodiment is distinguished from the first embodiment in that the upper portion 214 is cylindrical with a tapped hole 204. The lower portion 210 is a base with a rectangular cross-section. In this embodiment, an upper surface 211 of the lower portion 210 includes a sliding layer. A side 215 of the upper portion 214 can also include a sliding layer. The sliding layer 206 is obtained either by surface treatment of the upper surface 211 (and optionally of the side 215) or by covering the upper surface 211 (and optionally the side 215) with a sliding pad.

[0067] Figure 6 shows the movable part 302 according to a third embodiment. The third embodiment is distinguished from the second embodiment in that the upper portion 314 has a rectangular cross-section with rounded edges, with smaller dimensions in a longitudinal direction and in a transverse direction than the lower portion 310. In this embodiment, the sliding layer 306 is obtained by surface treatment of an upper surface 311 of the lower portion 310 and, optionally, of the sides 315 of the upper portion 314, or by covering said upper surface 311 and, optionally, said sides 315, with a sliding pad.

[0068] Figure 7 shows the movable part 402 according to a fourth embodiment. The fourth embodiment is distinguished from the second embodiment in that the upper portion 414 has a rectangular cross-section and an identical dimension in a longitudinal direction to the lower portion 410. In this embodiment, the sliding layer 406 is obtained by surface treatment of an upper surface 411 of the lower portion 410 and, optionally, of the sides 415 of the upper portion 414, or by covering said upper surface 411 and, optionally, said sides 415, with a sliding pad.

[0069] Figure 8 shows the movable part 502 according to a fifth embodiment. The fifth embodiment is distinguished from the fourth embodiment in that the upper portion 514 has

rounded edges. In this embodiment, the sliding layer 506 is obtained by surface treatment of an upper surface 511 of the lower portion 510 and, optionally, of the sides 515 of the upper portion 514, or by covering said upper surface 511 and, optionally, said sides 515, with a sliding pad.

5 [0070] Figure 9 shows the movable part 602 according to a sixth embodiment. The sixth embodiment is distinguished from the first embodiment in that the polymer sliding pad 606 has larger dimensions in the longitudinal direction and in the transverse direction than the lower portion 610.

10 [0071] Figure 10 shows the movable part 702 according to a seventh embodiment. The seventh embodiment is distinguished from the second embodiment in that the polymer sliding pad 706 has a parallelepipedal shape with rounded edges and an identical dimension in the longitudinal direction to the lower portion 710. The lower portion 710 is also covered by the sliding pad 706.

15 [0072] According to variants, not shown, the sliding pad 606 or 706 can be replaced by a surface treatment of an upper surface of the lower portion 610 or 710 and, optionally, of the side of the upper portion 614 or 714.

20 [0073] Figure 11 shows the securing part according to a first variant. According to this first variant, the securing part 101 is a rectangular retaining plate, with a rectangular opening in which the movable part 102-702 emerges and with four tapped holes 119 at the ends for fastening the fasteners 34 thereto.

[0074] Figure 12 shows the securing part according to a second variant. This second variant is distinguished from the first in that the retaining plate 201 is circular.

[0075] The two retaining plate variants are in particular compatible with all of the embodiments of the movable part.

25 [0076] In other variants, not shown, the securing part can be made in a variety of other ways, for example having a different shape and a different number of tapped holes.

30 [0077] With reference to figure 13, a cut-away view of a methane carrier 70 shows a sealed and insulated tank 71 with a generally prismatic shape assembled in the double hull 72 of the vessel. The wall of the tank 71 includes a primary sealing barrier suitable for being in contact with the LNG contained in the tank, a secondary sealing barrier arranged between the primary sealing barrier and the double hull 72 of the vessel, and two insulating barriers respectively arranged between the primary sealing barrier and the secondary sealing barrier and between the secondary sealing barrier and the double hull 72.

[0078] In a manner known *per se*, loading/unloading pipes 73 arranged on the upper deck of the vessel can be connected, by means of appropriate connectors, to a marine or harbour terminal in order to transfer a cargo of LNG from or to the tank 71.

5 [0079] Figure 13 shows an example of a marine terminal including a loading and unloading station 75, a subsea pipeline 76 and an onshore installation 77. The loading and unloading station 75 is a fixed offshore installation including a mobile arm 74 and a tower 78 that supports the mobile arm 74. The mobile arm 74 holds a bundle of insulated flexible hoses 79 that can be connected to the loading/unloading pipes 73. The orientable mobile arm 74 is suitable for all sizes of methane carrier. A connecting pipeline, not shown, extends inside
10 the tower 78. The loading and unloading station 75 makes it possible to load and unload the methane carrier 70 from or to the onshore installation 77. The latter includes liquefied gas storage tanks 80 and connecting pipelines 81 connected by the subsea pipeline 76 to the loading or unloading station 75. The subsea pipeline 76 makes it possible to transfer liquefied gas between the loading or unloading station 75 and the onshore installation 77
15 over a long distance, for example 5 km, which makes it possible to keep the methane carrier 70 a long distance from the coast during the loading and unloading operations.

[0080] In order to generate the pressure necessary for transferring the liquefied gas, pumps on board the vessel 70 and/or pumps provided at the onshore installation 77 and/or pumps provided on the loading and unloading station 75 are implemented.

20 [0081] Although the invention has been described with reference to several specific embodiments, it is obvious that it is in no way limited thereto and that it includes all technical equivalents of the means described and any combinations thereof if these fall within the scope of the invention.

[0082] The use of the verb "have", "comprise" or "include" and conjugated forms thereof does
25 not exclude the presence of elements or steps other than those stated in a claim.

[0083] In the claims, any reference sign between parentheses cannot be interpreted as limiting the claim.

Claims

[Claim 1] Sealed and thermally insulating tank (1) for storing a fluid, the tank (1) including a tank wall including in succession, in the direction of the thickness thereof, a secondary insulating barrier (2) secured to a load-bearing wall (3), a secondary sealing membrane (4) resting against the secondary insulating barrier (2), a primary insulating barrier (5) resting against the secondary sealing membrane (4) and a primary sealing membrane (6) resting against the primary insulating barrier (5), in which said secondary insulating barrier (2) includes a secondary insulating block (7) comprising a cover plate (10) forming a supporting surface for the secondary sealing membrane (4), in which said secondary sealing membrane (4) comprises a plurality of metal strakes (21), the metal strakes (21) having edges (32) raised towards the inside of the tank, said metal strakes (21) being welded in pairs, by their raised edges (32), on two faces of a welding flange mechanically secured to the secondary insulating block (7), said welding flange being partially engaged in a groove (20) made in the cover plate (10) and extending in a longitudinal direction, in which the primary insulating barrier (5) includes a primary insulating block (22) anchored to the secondary insulating block (7) by a primary anchoring system (97), the primary anchoring system (97) including:

- a recess made in the cover plate and emerging onto said supporting surface,
- a movable part (102, 202, 302, 402, 502, 602, 702) positioned in the recess, the movable part including a body, and
- a securing part (101, 201) fastened to the cover plate (10) and interacting with the movable part (102, 202, 302, 402, 502, 602, 702) so as to immobilize the movable part in the recess in the thickness direction,

the recess and the securing part (101, 201) being configured to allow the movement of the movable part (102, 202, 302, 402, 502, 602, 702) at least parallel to the longitudinal direction of the metal strakes, in which the securing part (101) has an opening (103), the body including a base (110, 210, 310, 410, 510, 610, 710) and an upper portion (114, 214, 314, 414, 514, 614, 714), the upper portion having an upper surface flush with an upper surface of the securing part through said opening, the base having a larger width than the opening in the securing part (101, 201), in which the movable part (102, 202, 302, 402, 502, 602, 702) includes a polymer sliding layer (106, 206, 306, 406, 506, 606, 706) covering at least an upper surface (111, 211, 311, 411, 511) of the base (110, 210, 310, 410, 510, 610, 710) of the body,

the sliding layer (106, 206, 306, 406, 506, 606, 706) being in contact with the securing part (101, 201) and having a lower coefficient of friction than said body, in which the cover plate (10) includes a counterbore on the edge of the recess, the counterbore receiving the securing part (101), the counterbore having a depth such that the securing part (101) is flush with the supporting surface, the securing part (101) completely covering the recess and the counterbore, and in which the polymer sliding layer (106, 206, 306, 406, 506, 606, 706) also covers a side (115, 215, 315, 415, 515) of the upper portion of the body.

[Claim 2] Tank according to Claim 1, in which the polymer sliding layer is made from a polymer filled with particulate fillers, the particulate fillers preferably including nanofillers.

[Claim 3] Tank according to Claim 2, in which the particulate fillers are made from at least one material selected from: carbon, graphite, glass, cellulose and bronze.

[Claim 4] Sealed and thermally insulating tank (1) for storing a fluid, the tank (1) including a tank wall including in succession, in the direction of the thickness thereof, a secondary insulating barrier (2) secured to a load-bearing wall (3), a secondary sealing membrane (4) resting against the secondary insulating barrier (2), a primary insulating barrier (5) resting against the secondary sealing membrane (4) and a primary sealing membrane (6) resting against the primary insulating barrier (5), in which said secondary insulating barrier (2) includes a secondary insulating block (7) comprising a cover plate (10) forming a supporting surface for the secondary sealing membrane (4),

in which said secondary sealing membrane (4) comprises a plurality of metal strakes (21), the metal strakes (21) having edges (32) raised towards the inside of the tank, said metal strakes (21) being welded in pairs, by their raised edges (32), on two faces of a welding flange mechanically secured to the secondary insulating block (7), said welding flange being partially engaged in a groove (20) made in the cover plate (10) and extending in a longitudinal direction,

in which the primary insulating barrier (5) includes a primary insulating block (22) anchored to the secondary insulating block (7) by a primary anchoring system (97), the primary anchoring system (97) including:

- a recess made in the cover plate and emerging onto said supporting surface,
- a movable part (102, 202, 302, 402, 502, 602, 702) positioned in the recess, the movable part including a body, and
- a securing part (101, 201) fastened to the cover plate (10) and interacting with the movable part (102, 202, 302, 402, 502, 602, 702) so as to immobilize the movable part

in the recess in the thickness direction,
the recess and the securing part (101, 201) being configured to allow the movement
of the movable part (102, 202, 302, 402, 502, 602, 702) at least parallel to the
longitudinal direction of the metal strakes,

5 in which the securing part (101) has an opening (103), the body including a base (110,
210, 310, 410, 510, 610, 710) and an upper portion (114, 214, 314, 414, 514, 614,
714), the upper portion having an upper surface flush with an upper surface of the
securing part through said opening, the base having a larger width than the opening in
the securing part (101, 201),

10 in which the movable part (102, 202, 302, 402, 502, 602, 702) includes a sliding layer
(106, 206, 306, 406, 506, 606, 706) in contact with the securing part (101, 201) and
having a lower coefficient of friction than said body,

the sliding layer (106, 206, 306, 406, 506, 606, 706) being obtained by surface
treatment of at least one surface of the body, in which the sliding layer (106, 206, 306,
15 406, 506, 606, 706) forms an upper surface (111, 211, 311, 411, 511) of the base (110,
210, 310, 410, 510, 610, 710) of the body and a side (115, 215, 315, 415, 515) of the
upper portion of the body,

and in which the cover plate (10) includes a counterbore on the edge of the recess,
the counterbore receiving the securing part (101), the counterbore having a depth such
20 that the securing part (101) is flush with the supporting surface, the securing part (101)
completely covering the recess and the counterbore.

[Claim 5] Tank according to Claim 4, in which the surface treatment is a nitriding
treatment.

[Claim 6] Tank according to one of Claims 1 to 5, in which a compressible material (105)
25 is inserted into gaps situated between the securing part (101, 201) and the movable
part (102, 202, 302, 402, 502, 602, 702) or between the movable part and walls of the
recess.

[Claim 7] Tank according to one of Claims 1 to 6, in which the recess has a depth in the
thickness direction such that the movable part (102, 202, 302, 402, 502, 602, 702) is
30 flush with the supporting surface and a length in the longitudinal direction and a width
in a transverse direction such that the movable part can move at least parallel to the
longitudinal direction of the metal strakes.

[Claim 8] Tank according to one of Claims 1 to 7, in which the upper portion (114, 214,
314, 414, 514, 614, 714) with the sliding layer is the same width as said opening.

35 [Claim 9] Tank according to one of Claims 1 to 8, in which the securing part (101, 201)
is a retaining plate.

- [Claim 10] Tank according to Claim 9, in which the retaining plate is fastened to the cover plate (10) by fasteners (34) placed on the periphery of the cover plate, so that the fasteners (34) are positioned outside the recess around the recess, and/or by adhesive bonding.
- 5 [Claim 11] Tank according to one of Claims 1 to 10, in which the movable part (102, 202, 302, 402, 502, 602, 702) includes a tapped hole (104, 204, 304, 604, 704) emerging onto said upper face of the movable part (102, 202, 302, 402, 502, 602, 702) and the primary anchoring system (97) further includes a stud (35) having a threaded lower portion screwed into the tapped hole (104).
- 10 [Claim 12] Tank according to Claim 11, in which the stud (35) includes a collar extending above the movable part (102, 202, 302, 402, 502, 602, 702), in which the periphery of the collar is sealably welded to the secondary sealing membrane (4).
- [Claim 13] Tank according to Claim 11 or 12, in which the primary anchoring system (97) further comprises at least one washer and at least one nut interacting with threaded
- 15 upper portions of said stud (35) in order to secure said washer pressing on a bottom plate of the primary insulating block (22).
- [Claim 14] Vessel for transporting a cold liquid product, the vessel comprising a double hull and a tank positioned in the double hull, the tank being a tank according to one of Claims 1 to 13.
- 20 [Claim 15] System for transferring a cold liquid product, the system including a vessel according to Claim 14, insulated pipes arranged so that they connect the tank installed in the hull of the vessel to a floating or onshore storage installation and a pump for conveying a stream of cold liquid product through the insulated pipes from or to the floating or onshore storage installation to or from the tank of the vessel.
- 25 [Claim 16] Method for loading or unloading a vessel according to Claim 14, in which a cold liquid product is conveyed through insulated pipes from or to a floating or onshore storage installation to or from the tank of the vessel.