

Description

Title of the invention: Insulating block suitable for making an insulating wall in a cold liquid storage tank

Technical domain

- 5 [0001] The invention relates to the domain of sealed and thermally insulating tanks. More specifically, the invention relates to an insulating block suitable for making an insulating wall in a storage tank for a cold liquid, in particular low-temperature liquefied gas.

Technological background

- 10 [0002] In the domain of maritime transportation of low-temperature liquefied gases, a sealed and thermally insulating tank including a tank wall held on a load-bearing structure, in which the tank wall includes, in the thickness direction from the outside to the inside of the tank, a secondary insulating barrier held on the load-bearing structure, a secondary sealed membrane held on the secondary insulating barrier, a primary insulating barrier held on the secondary sealed membrane and a primary sealed membrane held on the primary insulating barrier is known, in particular from document WO 2014/096600 A1. The
15 secondary insulating barrier is formed by juxtaposing identical insulating blocks. The insulating blocks are made by superposing a plywood base plate, a block of insulating foam such as a polyurethane foam, and a plywood cover plate. The insulating blocks are held in place on the secondary sealed membrane and on the load-bearing structure using
20 retaining members. The insulating foam block is glued to the base plate and to the cover plate.

- [0003] As described in document WO 2014/096600 A1, when the tank is filled with liquefied gas, the temperature difference between the outside of the tank and the inside of the tank generates a thermal gradient inside the insulating blocks. This thermal gradient causes a
25 differential contraction phenomenon inside the insulating block on account of the difference between the coefficients of thermal expansion of the plywood and the polyurethane foam. This phenomenon tends to bend the insulating foam block, especially if said block is glued to the base plate and to the cover plate.

- [0004] In order to limit the bending of the insulating foam block, document WO 2014/096600
30 A1 proposes splitting the insulating foam block into two insulating foam sub-blocks separated from one another by a supplementary plywood panel. However, this solution tends to complicate construction of the insulating block.

[0005] Furthermore, when in service, the insulating blocks are subjected to forces caused by deformation of the structure of the ship at sea when the tank is filled with liquefied gas, or caused by the stresses exerted by the ship ballasts when the tank is not filled with liquefied gas, while the ship ballasts are filled to keep the ship seaworthy. These phenomena also
 5 tend to bend the insulating foam block.

Summary

[0006] One idea at the heart of the invention is to propose an insulating block suitable for making a wall of a sealed and thermally insulating tank that helps to limit the bending of the insulating foam block.

10 [0007] According to one embodiment, the invention provides an insulating block suitable for making a wall of a sealed and thermally insulating tank, the insulating block having a parallelepipedic shape and comprising:

- a base plate having first and second pairs of parallel sides,
- a cover plate parallel to the base plate, spaced apart from the base plate in a thickness
 15 direction of the insulating block and having two slots, the slots being parallel to one another and extending in a direction parallel to the first pair of sides of the base plate, each of the slots being intended to receive a welding support for welding a sealing membrane,
- a thermally insulating foam block arranged between the cover plate and the base plate and fastened to the base plate, the foam block having a plurality of lateral surfaces
 20 extending between the base plate and the cover plate and defining a rectangular geometric envelope and a plurality of recesses, each recess extending between two adjacent lateral surfaces and being intended to receive a retaining member,
 and the insulating block having a bearing surface for the retaining member in the recess, and
- a pair of stiffening members rigidly connected to the base plate and extending along the
 25 sides of one of the pairs of sides of the first and second pairs of sides of the base plate, the stiffening members having a larger dimension in a direction perpendicular to the thickness direction of the insulating block, along the sides of said one pair of the pairs of sides, and each stiffening member projecting from the base plate in the thickness direction
 30 of the insulating block and having a surface in free contact with one such lateral surface of the foam block.

[0008] "Surface in free contact" means that the surface is in contact with the lateral surface of the foam block but is not rigidly connected to this lateral surface of the foam block. In particular, the surface is not glued to the lateral surface of the foam block. Thus, when the

insulating block is bent, the surface is liable to slip slightly on the lateral surface of the foam block without exerting any traction or shear stress on the foam block.

5 [0009] Furthermore, since the stiffening members are rigidly connected to the base plate and extend along the sides of one of the pairs of sides of the first and second pairs of sides of the base plate, said stiffening members tend to limit the bending of the insulating block in either the direction parallel or the direction perpendicular to the slots receiving the welding supports for welding the sealing membrane. This in turn limits the bending of the sealing membrane in this direction. This notably prevents the generation of concentrated stresses in the sealed membrane where said sealed membrane crosses the interface between two successive insulating blocks, in particular when the bending in the direction perpendicular to the slots is limited.

[0010] Depending on the embodiment, such an insulating block may have one or more of the following features.

15 [0011] According to one embodiment, each stiffening member comprises a wooden batten, a top surface of the batten that is oriented towards the cover plate forming one such bearing surface.

[0012] According to one embodiment, the insulating block also includes a second pair of stiffening members rigidly connected to the base plate and extending along the sides of the other of the pairs of sides of the first and second pairs of sides of the base plate.

20 [0013] This second pair of stiffening members rigidly connected to the base plate also tends to limit the bending of the insulating block in the other of the directions parallel or perpendicular to the slots.

[0014] According to one embodiment, each stiffening member is received in a corresponding recess in the foam block level with a top side of the base plate.

25 [0015] According to one embodiment, the insulating block comprises a plurality of bearing elements, preferably made of wood, each bearing element being received in a recess and held in said recess by one such stiffening member, a top face of the bearing element that is oriented towards the cover plate forming one such bearing surface.

30 [0016] According to one embodiment, each of the bearing elements has at least one face in free contact with the foam block.

[0017] "Face in free contact" means that the face is in contact with the foam block but is not rigidly connected to the foam block. In particular, the face is not glued to the foam block. Thus, when the insulating block is bent, the bearing elements are liable to slip slightly on the foam block rather than deforming the foam block.

[0018] According to one embodiment, the height of the bearing elements in the thickness direction of the insulating block is between 20 mm and 250 mm.

[0019] According to one embodiment, each stiffening member comprises a wooden batten, the batten having a surface that is in free contact with the foam block.

5 [0020] According to one embodiment, each stiffening member is fastened to the bearing element and to the base plate by stapling, screwing, spot welding, and/or gluing.

[0021] According to one embodiment, the insulating block also includes a second pair of stiffening members rigidly connected to the base plate and extending along the sides of the other of the pairs of sides of the first and second pairs of sides of the base plate, each
10 stiffening member of the second pair of stiffening members comprising a wooden batten, the batten having a surface that is in free contact with a lateral surface of the foam block.

[0022] According to one embodiment, each stiffening member has an L-shaped cross-section such as to present a first surface in free contact with a lateral surface of the foam block and a second surface held rigidly in contact with the base plate.

15 [0023] "Held rigidly in contact with the base plate" means that the surface is in contact with the base plate and that this contact is maintained by a stress exerted on the stiffening member, for example by stapling or by screwing said stiffening member to the base plate.

[0024] According to one embodiment, the foam block has four lateral surfaces, each of the four lateral surfaces defining one side of said rectangular geometric envelope, and each
20 recess extending between two adjacent lateral surfaces such as to be positioned at a corner of the foam block.

[0025] According to one embodiment, the lateral surfaces of the foam block comprise three first lateral surfaces, each of the three first lateral surfaces defining one side of said rectangular geometric envelope, and two second lateral surfaces, the two second lateral
25 surfaces together defining one side of said rectangular geometric envelope, the two second lateral surfaces being parallel to one side of said one of the pairs of sides of the first and second pairs of sides of the base plate.

[0026] According to one embodiment, the insulating block also comprises a supplementary stiffening member, the supplementary stiffening member having a larger dimension in a
30 direction perpendicular to the thickness direction of the insulating block, along said one side of the base plate, the supplementary stiffening member projecting from the base plate in the thickness direction of the insulating block and having a surface in free contact with one such second lateral surface of the foam block.

[0027] According to one embodiment, the recess extends between the two second lateral surfaces receives two such bearing elements, one held in said recess by a stiffening member and the other held in said recess by the supplementary stiffening member.

5 [0028] According to one embodiment, the lateral surfaces of the foam block comprise two first lateral surfaces parallel to the sides of the other of the pairs of sides of the first and second pairs of sides of the base plate, each of the two first lateral surfaces defining one side of said rectangular geometric envelope, and three second lateral surfaces, the three second lateral surfaces together defining one side of said rectangular geometric envelope, the three second lateral surfaces being parallel to one side of said one of the pairs of sides of
10 the first and second pairs of sides of the base plate.

[0029] According to one embodiment, the insulating block also comprises two supplementary stiffening members, said supplementary stiffening members having a larger dimension in a direction perpendicular to the thickness direction of the insulating block, along said one side of the base plate, said supplementary stiffening members projecting from the base
15 plate in the thickness direction of the insulating block and having a surface in free contact with one such second lateral surface of the foam block.

[0030] According to one embodiment, each of the two recesses extending between two of the three second lateral surfaces receives two such bearing elements, one held in said recess by a stiffening member and the other held in said recess by a supplementary stiffening
20 member.

[0031] According to one embodiment, the invention also provides a sealed and thermally insulating tank including a tank wall held on a load-bearing structure, in which the tank wall includes, in the thickness direction from the outside to the inside of the tank, a secondary insulating barrier held on the load-bearing structure, a secondary sealed membrane held
25 on the secondary insulating barrier, a primary insulating barrier held on the secondary sealed membrane and a primary sealed membrane held on the primary insulating barrier, in which the secondary insulating barrier comprises a plurality of juxtaposed insulating blocks according to any one of the embodiments described above, and a plurality of anchoring members, each anchoring member being received in the recesses of adjacent
30 insulating blocks and bearing against the bearing surfaces of said adjacent insulating blocks such as to hold said adjacent insulating blocks on the load-bearing structure, and the secondary sealed membrane being held on said insulating blocks by welding supports received in the slots of said insulating blocks.

[0032] According to one embodiment, the invention also provides a sealed and thermally
35 insulating tank including a tank wall held on a load-bearing structure, in which the tank wall

includes, in the thickness direction from the outside to the inside of the tank, a secondary insulating barrier held on the load-bearing structure, a secondary sealed membrane held on the secondary insulating barrier, a primary insulating barrier held on the secondary sealed membrane and a primary sealed membrane held on the primary insulating barrier, in which the primary insulating barrier comprises a plurality of juxtaposed insulating blocks according to any one of the embodiments described above, and a plurality of anchoring members, each anchoring member being received in the recesses of adjacent insulating blocks and bearing against the bearing surfaces of said adjacent insulating blocks such as to hold said adjacent insulating blocks on the secondary sealed membrane, and the primary sealed membrane being held on said insulating blocks by welding supports received in the slots of said insulating blocks.

[0033] According to one embodiment, the invention also provides a ship used to transport a cold liquid product, the ship having a double hull and a tank as described above arranged in the double hull.

[0034] According to one embodiment, the invention also provides a use for a ship as described above for loading or unloading a cold liquid product, in which a cold liquid product is channeled through insulated pipes to or from an onshore or floating storage facility to or from the tank on the ship.

[0035] According to one embodiment, the invention also provides a transfer system for a cold liquid product, the system including a ship as described above, insulated pipes arranged to connect the tank installed in the hull of the ship to an onshore or floating storage facility and a pump for driving a flow of cold liquid product through the insulated pipes to or from the onshore or floating storage facility to or from the tank on the ship.

Short description of the figures

[0036] The invention can be better understood, and additional objectives, details, features and advantages thereof are set out more clearly, in the detailed description below of several specific embodiments of the invention given solely as non-limiting examples, with reference to the attached drawings.

[0037] [Figure 1] Figure 1 is a partial perspective view of an insulating barrier of a sealed and thermally insulating tank wall.

[0038] [Figure 2] Figure 2 is a perspective view of an insulating block of the insulating barrier in figure 1.

[0039] [Figure 3] Figure 3 is a top view of the insulating block in figure 2, and

[0040] [Figure 4] Figure 4 is a cross-section view of figure 3 taken along the line A-A.

[0041] [Figure 5] Figure 5 is a cross-section view of figure 1 showing two adjacent insulating blocks and an anchoring member of the wall in figure 1.

[0042] [Figure 6] Figure 6 is a perspective view of an insulating block according to another embodiment.

5 [0043] [Figure 7] Figure 7 is a perspective view of an insulating block according to another embodiment.

[0044] [Figure 8] Figure 8 is an exploded view of the insulating block in figure 7 without the cover panel.

10 [0045] [Figure 9] Figure 9 is a magnified front view of the region IX in figure 7 from reference point B.

[0046] [Figure 10] Figure 10 is a perspective view of an insulating block according to another embodiment.

[0047] [Figure 11] Figure 11 is a front view of the insulating block in figure 10 from reference point D.

15 [0048] [Figure 12] Figure 12 is a perspective bottom view from reference point E of a variant of the insulating block in figure 10 excluding the intermediate plate between the base plate and the cover plate.

[0049] [Figure 13] Figure 13 is a perspective view of an insulating block according to another embodiment.

20 [0050] [Figure 14] Figure 14 is a perspective view of an insulating block according to another embodiment.

[0051] [Figure 15] Figure 15 is a cut-away schematic view of a tank in a liquefied natural gas carrier ship and of a loading/unloading terminal for this tank.

Description of embodiments

25 [0052] Figure 1 is a partial perspective view of a secondary insulating barrier of a sealed and thermally insulating tank wall. Such a structure can be used for large surfaces with various different orientations, for example to cover the side, ceiling and bottom walls of a tank. The orientation shown in figure 1 is therefore not limiting in this regard.

30 [0053] The tank wall is attached to the wall of a load-bearing structure 1. By convention, “above” refers to a position closest to the inside of the tank and “below” refers to a position closest to the load-bearing structure 1, regardless of the orientation of the tank wall in relation to the Earth’s gravitational field.

[0054] The tank wall comprises a secondary insulating barrier 2 held on the load-bearing structure 1 and a sealed membrane omitted.

[0055] The secondary insulating barrier 2 comprises a plurality of juxtaposed parallelepipedic secondary insulating blocks 6 substantially covering the inner surface of the load-bearing structure 1. Figures 2 to 4 show one of these secondary insulating blocks 6 in greater detail.

[0056] As shown in these figures, a secondary insulating block 6 has a base plate 12, a cover plate 11 parallel to the base plate 12, and a block of thermally insulating foam 13.

[0057] The base plate 12 has a first pair of sides 12a that are parallel to one another and a second pair of sides 12b that are parallel to one another. The base plate has an overall rectangular shape, i.e. the sides 12a and 12b are perpendicular to one another.

[0058] The cover plate 11 is parallel to the base plate 12 and is spaced apart from the base plate 12 in a thickness direction of the secondary insulating block 6.

[0059] The cover plate 11 has two slots 14 that are parallel to one another and extend in a direction parallel to the sides 12a of the base plate 12. The slots 14 have a substantially inverted-T shape to receive the square welding flanges. The portion of the welding flanges that projects upwards from the cover plate 11 enables a secondary sealing barrier (not shown) to be anchored. The secondary sealing barrier comprises a plurality of strakes. The raised edges of each strake are welded to the aforementioned welding flanges using a known technique. The strakes are for example made of Invar®, i.e. an alloy of iron and nickel with a coefficient of expansion typically between $1.2 \cdot 10^{-6}$ and $2 \cdot 10^{-6} \text{ K}^{-1}$. In this case, the strakes can have a thickness in the order of 0.7 mm. In a variant, the strakes can be made of an iron alloy with a high manganese content and a coefficient of expansion typically between $7 \cdot 10^{-6}$ and $9 \cdot 10^{-6} \text{ K}^{-1}$. In the case of a tank in a ship, the strakes are preferably oriented parallel to the longitudinal direction of the ship.

[0060] The base plate 11 and/or the cover plate 12 can for example be made of plywood.

[0061] The foam block 13 is arranged between the cover plate 11 and the base plate 12. The foam block 13 is made of a thermally insulating foam, for example a polyurethane foam, optionally reinforced with glass fibers, for example having a density in the order of or greater than $130 \text{ kg} \cdot \text{m}^{-3}$.

[0062] The foam block 13 has an overall parallelepipedic shape. The foam block 13 therefore has four lateral surfaces 13f extending between the base plate 12 and the cover plate 11 and defining a rectangular geometric envelope. The lateral surfaces 13f are arranged in perpendicular pairs.

[0063] The foam block 13 is fastened to the base plate 12 and to the cover plate 11 by gluing.

[0064] There is a recess 15 at each corner of the foam block 13, i.e. between each pair of adjacent lateral surfaces 13f. The recess 15 is intended to receive a retaining member 30 shown in figures 1 and 5. At the end of the recess closest to the base plate 12 in the thickness direction of the secondary insulating block 6, the recess 15 has a bearing surface 16 for the retaining member 30.

[0065] The secondary insulating block 6 also has a pair of stiffening members 20, just one of these stiffening members 20 being visible in figures 1 and 2. Each of the stiffening members 20 extends along one side 12b of the base plate 12 and has a larger dimension in a direction perpendicular to the thickness direction of the secondary insulating block 6, along said side 12b. The stiffening members 20 thus extend in a direction perpendicular to the slots 14. Thus, when the secondary insulating block 6 is subjected to a bending stress, for example caused by deformations of the load-bearing structure and/or by the tightening force of the retaining members 30, the stiffening members 20 limit the deformation in the direction perpendicular to the slots 14, in particular on the edge of the secondary insulating block 6. This edge stiffening, i.e. at the interface between the successively adjacent secondary insulating blocks 6, prevents concentrations of stresses on the welding flanges passing through the slots 14 continuously from one secondary insulating block 6 to the next across these interfaces.

[0066] The stiffening members 20 project from the base plate 12 in the thickness direction of the secondary insulating block 6 towards the cover plate 11. The stiffening members 20 are rigidly connected to the base plate 12. For example, the stiffening members 20 are rigidly connected to the base plate 12 using screws or staples, which are not shown in the figures so as not to overcomplicate the drawing.

[0067] As shown in particular in figures 2 and 4, each of the stiffening members 20 has a surface 20f in free contact with a lateral surface 13f of the foam block 13. "In free contact" means that the surface 20f is in contact with the lateral surface 13f of the foam block 13 but is not rigidly connected to the lateral surface 13f. In particular, the surface 20f is not glued to the lateral surface 13f. Thus, when the secondary insulating block 6 is bent, the surface 20f is liable to slip slightly on the lateral surface 13f without exerting any traction or shear stress on the foam block 13.

[0068] In the embodiment shown in figures 1 to 5, each of the bearing surfaces 16 is formed by a face of a rigid bearing element 40. The bearing elements 40 are particularly visible in figures 1 to 3.

[0069] Each bearing element 40 is received in a recess 15 and is held in said recess 15 by fastening, for example by glue, nails, screws or staples, to the base plate 12 and/or to a

stiffening member 20. The bearing surface 16 is formed by the top face of the bearing element 40, which is oriented towards the cover plate 11.

[0070] The faces 41, 42 (referenced in figure 3) of the bearing element 40 are in free contact with the foam block 13. Thus, when the force of the retaining member 30 on the bearing element 40 tends to tilt the bearing element 40 slightly outwards, while the secondary insulating block 6 is subjected to a bending stress, the bearing element 40 exerts no horizontal shear stress on the foam block 13. The height of the bearing elements 40 in the direction of the secondary insulating block 6 is between 20 mm and 250 mm.

[0071] Each stiffening member 20 can comprise, or preferably consist of, a wooden batten. A surface 20f of the wooden batten is in free contact with the lateral surface 13f of the foam block 13, as mentioned above. Furthermore, the surface 20f is in free contact with or rigidly connected to the bearing element 40. Each stiffening member 20 can be fastened to the bearing elements 40 being held in the recesses 15 and to the base plate 12 by stapling, screwing, spot welding and/or gluing.

[0072] Each bearing element 40 can comprise, or preferably consist of, a wooden pillar of sufficient section to withstand the force of the retaining member 30 without causing shear failure in the base plate 12. The shape of the section of the pillar can be rectangular or otherwise, depending on the shape of the retaining member 30. As shown in figure 4, the bearing element 40 has an asymmetrical chevron shape.

[0073] As shown in figures 1 to 5, in addition to the stiffening members 20, the secondary insulating block 6 comprises a second pair of stiffening members 21. Just one of these stiffening members 21 is visible in figures 1 and 2. Each of the stiffening members 21 extends along one side 12a of the base plate 12 and has a larger dimension in a direction perpendicular to the thickness direction of the secondary insulating block 6, along said side 12a. The stiffening members 21 thus extend in a direction parallel to the slots 14. Thus, when the secondary insulating block 6 is subjected to a bending stress, for example caused by deformations of the load-bearing structure and/or by the tightening force of the retaining members 30, the stiffening members 22 limit the deformation in the direction parallel to the slots 14, in particular on the edge of the secondary insulating block 6.

[0074] Each stiffening member 21 can comprise, or preferably consist of, a wooden batten. A surface 21f of the wooden batten is in free contact with a lateral surface 13f of the foam block 13. In particular, the surface 21f is not glued to the lateral surface 13f. Thus, when the secondary insulating block 6 is bent, the surface 21f is liable to slip slightly on the lateral surface 13f without exerting any traction or shear stress on the foam block 13.

Furthermore and preferably, the surface 21f is in free contact with or rigidly connected to the bearing element 40.

[0075] The cooperation of the retaining member 30 with the bearing surfaces 16 formed by the bearing elements 40 is described below with reference to figures 1 and 5.

5 [0076] The retaining member 30 described here is of the type described in document WO 2014/096600 A1. However, in a variant, the retaining member 30 can have a different design, provided it is able to hold the insulating blocks 6 on the load-bearing structure 1 by bearing against the bearing surfaces 16.

10 [0077] As shown in figure 5, the retaining member 30 has a socket 22, the base of which is welded to the load-bearing structure 1 in a position that corresponds to the recesses 15 of four adjacent secondary insulating blocks 6. The socket 22 carries a first rod 23 linked to the socket by a ball joint coupling. The rod 23 passes between the adjacent secondary insulating blocks 6. A fastening part is mounted on the rod 23 to clamp the modules 6 against the load-bearing structure 1 at the free surfaces 21 of the intermediate panel 14.

15 The fastening part comprises a lower metal plate 24, an upper plate 26 and a plywood block 25 mounted on the plate 24 to act as spacer between the plate 24 and the upper plate 26 and to reduce the heat bridge to the load-bearing structure 1. The height of this arrangement is determined such that the upper plate 26 is flush with the cover panels 11 to bear the secondary membrane.

20 [0078] The wooden block 25 has a seat 47 in which the upper end of the rod 23 is engaged by passing through a central hole in the lower plate 24. The lower plate 24 is held on the rod 23 by a nut 48 with a plurality of Belleville washers 49 interposed to provide elastic play.

25 [0079] At least one rigid spacer 29, for example made of wood, can be positioned between the lower metal plate 24 to bear against the bearing surfaces 16 of the adjacent secondary insulating blocks 6. Thus, the compressive force applied by the retaining member 30 on the secondary insulating blocks 6 is absorbed by the bearing elements 40 via the bearing surfaces 16. In a variant that is not shown, the spacer 29 can be omitted, and the bearing elements 40 can be in direct contact with the lower metal plate 24 at the bearing surfaces

30 16.

[0080] A shim 28 (shown in figures 1 and 5) can be positioned between the load-bearing structure 1 and the base plates 12, the socket 22 being then received in a through-hole (not shown) in the shim 28.

[0081] The secondary insulating barrier on which a secondary sealed membrane (not shown) is held has been described to this point. The tank wall can also comprise a primary insulating barrier (not shown) held on the secondary sealed membrane, which in turn holds a primary sealed membrane (not shown) intended to be in contact with the liquefied gas.

5 The primary insulating barrier can be made of juxtaposed primary insulating blocks superposed on and in line with the secondary insulating blocks 6. In this case, a first portion 27 of the retaining members 30 shown in figures 1 and 5 holds the primary insulating blocks on the secondary sealed membrane. The structure of the primary insulating blocks can be similar to or different from the secondary insulating blocks 6. The structure of the

10 primary sealed membrane can be similar to or different from the secondary sealed membrane.

[0082] Figure 6 is a perspective view of an insulating block 106 according to another embodiment. The elements of the insulating block 106 that are identical to the elements of the insulating block 6 are indicated using the same reference numbers increased by

15 100.

[0083] As shown in figure 6, the insulating block 106 differs from the insulating block 6 in that there are no stiffening members 21. In other words, the insulating block 106 only has one pair of stiffening members 120 extending perpendicular to the slots 114. Just one of the stiffening members 120 is visible in figure 6. Each of the stiffening members 120 is in free

20 contact with a lateral surface 113f of the foam block 113 and in free contact with or rigidly connected to a bearing element 140. The insulating block 106 is otherwise identical to the insulating block 6 and is therefore not described in greater detail for the sake of conciseness.

[0084] Figures 7 to 9 show an insulating block 206 according to another embodiment. The

25 elements of the insulating block 206 that are identical to the elements of the insulating block 6 are indicated using the same reference numbers increased by 200.

[0085] As shown in these figures, the insulating block 206 has a pair of stiffening members 250 playing a role similar to the stiffening members 20, except that each of the stiffening members 250 forms two bearing surfaces 216.

30 [0086] More specifically, each of the stiffening members 250 (only one of which is shown in figures 7 and 9) extends along one side 212b of the base plate 212 and has a larger dimension in a direction perpendicular to the thickness direction of the insulating block 206, along said side 212b. The stiffening members 250 thus extend in a direction perpendicular to the slots 214.

[0087] The stiffening members 250 project from the base plate 212 in the thickness direction of the insulating block 206 towards the cover plate 212. The stiffening members 250 are rigidly connected to the base plate 212. For example, the stiffening members 250 are rigidly connected to the base plate 212 using screws or staples and/or gluing, which are not shown in figures 7 to 9 so as not to overcomplicate the drawing.

[0088] Each of the stiffening members 250 has a surface 20f in free contact with a lateral surface 213f of the foam block 213. "In free contact" means that the surface is in contact with the lateral surface 213f of the foam block 213 but is not rigidly connected to the lateral surface 213f. In particular, the surface is not glued to the lateral surface 213f. Thus, when the insulating block 206 is bent, the surface is liable to slip slightly on the lateral surface 213f without exerting any traction or shear stress on the foam block 213.

[0089] Each stiffening member 250 can comprise, or preferably consist of, a wooden batten. A surface of the wooden batten is in free contact with a lateral surface 213f of the foam block 213. Furthermore and as shown in figure 7, at each of the two ends of the batten, a top surface of the batten oriented towards the cover plate 211 forms a bearing surface 216 for a retaining member 30.

[0090] In addition to the stiffening members 250, the insulating block 206 can comprise a second pair of stiffening members 251. Just one of these stiffening members 251 is visible in figures 1 and 2. Each of the stiffening members 251 extends along one side 212a of the base plate 212 and has a larger dimension in a direction perpendicular to the thickness direction of the insulating block 206, along said side 212b. The stiffening members 251 thus extend in a direction parallel to the slots 214.

[0091] Each stiffening member 251 can comprise, or preferably consist of, a wooden batten. A surface of the wooden batten is in free contact with or rigidly connected to a lateral surface 213f of the foam block 213.

[0092] Figure 8 is an exploded view of the insulating block 206, the cover plate 211 having been omitted to enhance the view of the foam block 213. As shown in this figure, the foam block 213 has a pair of recesses 270 and a pair of recesses 271 level with a top side of the base plate 212. Just one of the recesses 270 and 271 is visible in figure 8. The recesses 270 receive the stiffening members 250 and the recesses 271 receive the stiffening members 251.

[0093] Figure 9 is a magnified front view of the region IX in figure 7 from reference point B. As shown in this figure, the recess 271 and the stiffening member 251 are dimensioned such that the lateral surface 213f projects slightly beyond the stiffening member 251, such as to create a clearance, which may be approximately equal to 1 mm. Similarly, the recess

270 and the stiffening member 250 are dimensioned such that a lateral surface 213f projects slightly beyond the stiffening member 250, such as to create a clearance, which may be approximately equal to 1 mm. These clearances provide a degree of tolerance that facilitates assembly of the insulating block 206 by insertion of the foam block 213 into the assembly consisting of the base plate and the stiffening members 250 and 251. Preferably, each of the lateral surfaces 213f projects slightly beyond the corresponding stiffening member 250, 251 such as to create the same clearance in relation to the corresponding stiffening member 250, 251.

[0094] The stiffening members 250 and 251 are rigidly connected to the base plate 212, for example using screws or staples and/or gluing, which are not shown in the figures so as not to overcomplicate the drawing. Furthermore, the stiffening members 250 and 251 can be rigidly connected to each other, for example using staples, which are not shown in the figures so as not to overcomplicate the drawing.

[0095] In a variant that is not shown, only the stiffening members 251 are provided, i.e. the stiffening members 250 are absent. In this case, a top surface of the batten of the stiffening member 251 that is oriented towards the cover plate 211 forms a bearing surface 216 for a retaining member 30.

[0096] Figures 10 and 11 show an insulating block 306 according to another embodiment. The elements of the insulating block 306 that are identical to the elements of the insulating block 6 are indicated using the same reference numbers increased by 300.

[0097] As shown in these figures, the insulating block 306 has a pair of stiffening members 380 playing a role similar to the stiffening members 20 and four bearing elements 390 playing a role similar to the bearing elements 40. The height of the bearing elements 390 in the direction of the insulating block 306 is between 20 mm and 250 mm.

[0098] More specifically, each of the stiffening members 380 (only one of which is shown in figure 10) extends along one side 312b of the base plate 312 and has a larger dimension in a direction perpendicular to the thickness direction of the insulating block 306, along said side 312b. The stiffening members 380 thus extend in a direction perpendicular to the slots 314.

[0099] The stiffening members 380 project from the base plate 212 in the thickness direction of the insulating block 306 towards the cover plate 312. The stiffening members 380 are rigidly connected to the base plate 312. For example, the stiffening members 380 are rigidly connected to the base plate 312 using screws or staples and/or gluing, which are not shown in figures 10 to 12 so as not to overcomplicate the drawing.

[0100] As shown in particular in the magnification in figure 11, each stiffening member 380 has an L-shaped cross-section such as to present a surface 380f in free contact with a lateral surface 313f of the foam block 313 and a surface 380g held rigidly in contact with the base plate. "In free contact" means that the surface 380f is in contact with the lateral surface 213f of the foam block 313 but is not rigidly connected to the lateral surface 313f. In particular, the surface 380f is not glued to the lateral surface 313f. Thus, when the insulating block 306 is bent, the surface 380f is liable to slip slightly on the lateral surface 313f rather than deforming the foam block 313. "Held rigidly in contact with the base plate" means that the surface 380g is in contact with the base plate 312 and that this contact is maintained by a stress exerted on the stiffening member 380, for example by stapling or by screwing and/or by gluing said stiffening member to the base plate 312.

[0101] Each stiffening member 380 has a bearing element 390 at each of the ends thereof. Furthermore and as shown in figures 10 and 11, each bearing element 390 is held by a stiffening member 380 in a recess 316 in the foam block 313. Each bearing element 390 comprises, and preferably consists of, a wooden pillar with a top face oriented towards the cover plate 313 that forms a bearing surface 316 for an anchoring member 30.

[0102] Preferably, the faces of the bearing element 390 in contact with the foam block 313 are in free contact with the foam block 313.

[0103] As shown in figures 10 and 11, the insulating block 306 comprises an intermediate plate 395, for example made of plywood, and a second foam block 396 positioned between the cover plate 311 and the intermediate plate 395. The foam block 313 is positioned between the base plate 312 and the intermediate plate 396, and is fastened, for example by gluing, to the base plate 312 and to the intermediate plate 396. The second foam block 396 is fastened, for example by gluing, to the cover plate 311 and to the intermediate plate 395. The second foam block 396 does not have any recesses at the corners thereof, which simplifies manufacture and assembly thereof. The second foam block 396 is substantially thinner than the foam block 313, for example approximately one third of the thickness of the foam block 313. The lateral surfaces 313f of the foam block 313 are flush with the ends of the intermediate plate 395. The recesses 315 at each corner of the foam block 313 extend through the entire thickness of the foam block 313 in the thickness direction of the insulating block 306 between the base plate 312 and the intermediate plate 395.

[0104] The second foam block 396 is made of a thermally insulating foam, for example a polyurethane foam, optionally reinforced with glass fibers, for example having a density greater than $130 \text{ kg}\cdot\text{m}^{-3}$. In order to simplify the manufacture of the insulating block 306,

the thermally insulating foam of the foam block 396 can be identical to the thermally insulating foam of the foam block 313.

[0105] As shown in figure 10, the second foam block is shorter than the foam block 313. Thus, the two longitudinal ends of the intermediate plate 395 are exposed and provide a strip-shaped free top surface 395d. This surface 395d can form a supplementary bearing surface for the retaining members 30. Thus, the retaining members 30 hold the insulating block 306 on the load-bearing wall 1 by bearing on the bearing surface 316 and on the surface 395d.

[0106] In another variant shown in figure 12, the intermediate plate 395 and the second foam block 396 can be omitted. The foam block 313 then extends over the entire thickness of the insulating block 306 between the base plate 312 and the cover plate 311, and is fastened, for example by gluing, to the base plate 312 and to the cover plate 311. The recesses 315 at each corner of the foam block 313 extend through the entire thickness of the foam block 313 in the direction of the insulating block 306.

[0107] Like the insulating block 6, the insulating blocks 106, 206 and 306 are suitable for making a secondary insulating barrier on which a secondary sealed membrane is held. However, the insulating blocks 106, 206 and 306 can also be used to make a primary insulating barrier held on the secondary sealed membrane, which in turn holds a primary sealed membrane intended to be in contact with the liquefied gas.

[0108] Up to this point, insulating blocks 6, 106, 206, 306 with a recess 15, 115, 215, 315 at each of the corners thereof, each recess 15, 115, 215, 315 extending between two adjacent lateral surfaces 13f, 113f, 213f, 313f, in which each lateral surface is positioned on one side of the foam block 13, 113, 213, 313, have been described. However, one or more recesses in the insulating block can be positioned elsewhere instead of at the corner of the insulating block. Two embodiments illustrating this option are described below.

[0109] Figure 13 shows an insulating block 406 according to one embodiment. The elements of the insulating block 406 that are identical to the elements of the insulating block 6 are indicated using the same reference numbers increased by 400.

[0110] As shown in this figure, the foam block 413 has a recess 415A at three of the four corners thereof, and a recess 415B in one of the sides thereof next to the fourth corner. The recess 415B therefore extends between two adjacent lateral surfaces 413f1, 413f2 positioned on the same side of the foam block 413, while the recesses 415A extend between two adjacent lateral surfaces 413f or 413f1 positioned on different sides of the foam block 413.

[0111] Figure 13 also shows that the insulating block 406 has two stiffening members 420A and 420B.

[0112] The stiffening members 420A and 420B extend along one side 412b of the base plate 412 and have a larger dimension in a direction perpendicular to the thickness direction of the insulating block 406, along said side 412b. The stiffening members 420A and 420B thus extend in a direction perpendicular to the slots 14. Although not visible in the drawings, a stiffening member identical to one of the stiffening members 20 extends along the other side of the base plate 412, which is parallel to the side 412b shown in figure 13.

[0113] The stiffening members 420A and 420B project from the base plate 412 in the thickness direction of the insulating block 406 towards the cover plate 411. The stiffening members 420A and 420B are rigidly connected to the base plate 412. For example, the stiffening members 420A and 420B are rigidly connected to the base plate 412 using screws or staples, which are not shown in the figures so as not to overcomplicate the drawing.

[0114] The stiffening member 420A has a surface in free contact with the lateral surface 413f2 of the foam block 413, and the stiffening member 420B has a surface in free contact with a lateral surface 413f1 of the foam block 413. The term "in free contact" has the meaning given above.

[0115] Each of the recesses 415A and 415B is intended to receive a retaining member 30.

[0116] At the end of the recess closest to the base plate 412 in the thickness direction of the insulating block 406, the recess 415A has a bearing surface 416A for a retaining member 30. The bearing surface 416A is formed by a face of a rigid bearing element 440A seated in the recess 415A and fastened, for example by glue, nails, screws or staples, to the base plate 412 and/or to the stiffening member 420A. The faces of the bearing element 440A facing the walls of the recess 415A are in free contact with the foam block 413.

[0117] At the end of the recess closest to the base plate 412 in the thickness direction of the insulating block 406, the recess 415B has two bearing surfaces 416B for another retaining member 30. Each bearing surface 416B is formed by a face of a rigid bearing element 440B seated in the recess 415B. The bearing elements 415B can be fastened, for example by glue, nails, screws or staples, to the base plate 412 and/or to the stiffening members 420A or 420B. The faces of the bearing element 440B facing the walls of the recess 415B are in free contact with the foam block 413.

[0118] The stiffening members 420A and 420B can each comprise, or preferably consist of, a wooden batten. Each of the stiffening members 420A and 420B can be fastened to the

bearing elements 440A or 440B being held in the recesses 415A or 415B and to the base plate 412 by stapling, screwing, spot welding and/or gluing.

[0119] The bearing elements 440A and 440B can comprise, or preferably consist of, a wooden pillar of sufficient section to withstand the force of the retaining member 30 without causing shear failure in the base plate 412. The shape of the section of the pillar can be rectangular or otherwise, depending on the shape of the retaining member 30.

[0120] According to a variant not shown in the drawings, the insulating block 406 comprises a pair of stiffening members, identical to the stiffening members 21, extending along the sides 412a of the base plate 412.

[0121] Figure 14 shows an insulating block 506 according to one embodiment. The elements of the insulating block 506 that are identical to the elements of the insulating block 406 are indicated using the same reference numbers increased by 100.

[0122] The insulating block 506 is identical to the insulating block 406 except that the foam block 513 includes, on two opposing sides thereof parallel to the sides 512b of the base plate 512:

- on a first side shown in figure 14, two recesses 515B identical to the recess 415B. As shown in figure 14, the recesses 515B therefore extend between the adjacent lateral surfaces 513f1, 513f2 positioned on the same side of the foam block 513. A stiffening member 520A similar to the stiffening member 420A holds a bearing element 516B in the recesses 515B, while two stiffening members 520B each identical to the stiffening member 420B hold the other bearing element 516B in the recesses 515B,
- on the second side not shown in figure 14, a recess 515A identical to a recess 415A at one of the corners of the foam block 513, a recess 515B identical to the recess 415B, and two stiffening members (not shown) identical to the stiffening members 420A and 420B.

[0123] According to a variant not shown in the drawings, the insulating block 506 comprises a pair of stiffening members, identical to the stiffening members 21, extending along the sides 512a of the base plate 512.

[0124] Like the insulating blocks 6, 106, 206, 306, the insulating blocks 406 and 506 are suitable for making a secondary insulating barrier on which a secondary sealed membrane is held. However, the insulating blocks 406 and 506 can also be used to make a primary insulating barrier held on the secondary sealed membrane, which in turn holds a primary sealed membrane intended to be in contact with the liquefied gas.

[0125] The techniques described above for making a sealed and insulating wall may be used in different types of reservoirs, for example to form the wall of an LNG tank in an onshore facility or in a floating structure such as a liquefied natural gas carrier, inter alia.

5 [0126] With reference to figure 15, a cut-away view of a liquefied natural gas carrier ship 70 shows a sealed and insulated tank 71 having an overall prismatic shape mounted in the double hull 72 of the ship. The wall of the tank 71 has a primary sealed barrier intended to be in contact with the LNG contained in the tank, a secondary sealed barrier arranged between the first sealed barrier and the double hull 72 of the ship, and two insulating barriers arranged respectively between the first sealed barrier and the second sealed barrier, and between the second sealed barrier and the double hull 72.

[0127] In a known manner, the loading/unloading pipes 73 arranged on the upper deck of the ship can be connected, using appropriate connectors, to a sea or port terminal to transfer a cargo of LNG to or from the tank 71.

15 [0128] Figure 15 shows an example sea terminal comprising a loading/unloading point 75, an undersea line 76 and an onshore facility 77. The loading/unloading point 75 is a static offshore facility comprising a moveable arm 74 and a column 78 holding the moveable arm 74. The moveable arm 74 carries a bundle of insulated hoses 79 that can connect to the loading/unloading pipes 73. The orientable moveable arm 74 can be adapted to all sizes of liquefied natural gas carrier ships. A connecting line (not shown) extends inside the column 78. The loading/unloading point 75 makes loading and unloading of the liquefied natural gas carrier ship 70 possible to or from the onshore facility 77. This facility has liquefied gas storage tanks 80 and connection lines 81 connected via the undersea line 76 to the loading/unloading point 75. The undersea line 76 enables liquefied gas to be transferred between the loading/unloading point 75 and the onshore facility 77 over a large distance, for example 5 km, which makes it possible to keep the liquefied natural gas carrier ship 70 a long way away from the coast during loading and unloading operations.

[0129] To create the pressure required to transfer the liquefied gas, pumps carried on board the ship 70 and/or pumps installed at the onshore facility 77 and/or pumps installed at the loading/unloading point 75 are used.

30 [0130] Although the invention has been described in relation to several specific embodiments, it is evidently in no way limited thereto and it includes all of the technical equivalents of the means described and the combinations thereof where these fall within the scope of the invention.

35 [0131] Use of the verb "comprise" or "include", including when conjugated, does not exclude the presence of other elements or other steps in addition to those mentioned in a claim.

[0132] In the claims, reference signs between parentheses should not be understood to constitute a limitation to the claim.

Claims

[Claim 1] An insulating block (6; 106; 206; 306; 406; 506) suitable for making a wall of a sealed and thermally insulating tank, the insulating block having a parallelepipedic shape and comprising:

- 5 - a base plate (12; 112; 212; 312; 412; 512) having first and second pairs of parallel sides (12a, 12b, 112a, 112b; 212a, 212b; 312a, 312b; 412a, 412b; 512a, 512b),
- a cover plate (11; 111; 211; 311; 411; 411) parallel to the base plate, spaced apart from the base plate in a thickness direction of the insulating block and having two slots (14; 114; 214; 314; 414; 514), the slots being parallel to one another and extending in a direction
- 10 parallel to the first pair of sides (12a; 112a; 212a; 312a; 412a; 512a) of the base plate, each of the slots being intended to receive a welding support for welding a sealing membrane,
- a thermally insulating foam block (13; 113; 213; 313; 413; 513) arranged between the cover plate and the base plate and fastened to the base plate, the foam block having a
- 15 plurality of lateral surfaces (13f; 113f; 213f; 313f; 413f, 413f1, 413f2; 513f, 513f1, 513f2) extending between the base plate and the cover plate and defining a rectangular geometric envelope and a plurality of recesses (15; 115; 215; 315; 415A, 415B; 515A, 515B), each recess extending between two adjacent lateral surfaces and being intended to receive a retaining member (30),
- 20 and the insulating block having a bearing surface (16; 116; 216; 316; 416a, 416b; 516b) for the retaining member in the recess (15; 115; 215; 315; 415A, 415B; 515A, 515B), and
- a pair of stiffening members (20, 21; 120; 250, 251; 380; 420a; 520a) rigidly connected to the base plate and extending along the sides of one of the pairs of sides of the first or
- 25 second pairs of sides (12b, 12a; 112b, 112a; 212b, 212a; 312b, 312a; 412a, 412b; 512a, 512b) of the base plate, the stiffening members having a larger dimension in a direction perpendicular to the thickness direction of the insulating block, along the sides of said one pair of the pairs of sides, and each stiffening member projecting from the base plate in the thickness direction of the insulating block and having a surface in free contact with one such lateral surface (13f; 113f; 213f; 313f; 413f2; 513f2) of the foam block.

30 [Claim 2] The insulating block (206) as claimed in claim 1, in which each stiffening member (250) comprises a wooden batten, a top surface of the batten that is oriented towards the cover plate (211) forming one such bearing surface (216).

[Claim 3] The insulating block (206) as claimed in either one of claims 1 or 2, also comprising a second pair of stiffening members (251) rigidly connected to the base plate and extending along the sides of the other pair of sides (12a; 112a; 212a; 312a) of the first and second pairs of sides of the base plate (212).

35

- [Claim 4] The insulating block (206) as claimed in any one of claims 1 to 3, in which each stiffening member (250, 251) is received in a corresponding recess (270, 271) in the foam block (213) level with a top side of the base plate (212).
- 5 [Claim 5] An insulating block (6; 106; 306; 406; 506) as claimed in claim 1, comprising a plurality of bearing elements (40; 140; 390; 440A, 440B; 540B), preferably made of wood, each bearing element being received in a recess (15; 115; 315; 415A, 415B; 515B) and held in said recess by one such stiffening member (20, 21; 250, 251; 380; 420A; 520A), a top face of the bearing element (40; 140; 390; 440A, 440B; 540B) that is oriented towards the cover plate (11; 111; 311; 411; 511) forming one such bearing surface (16; 116; 316; 10 416A, 416B; 516B).
- [Claim 6] The insulating block (6; 106; 306; 406; 506) as claimed in claim 5, in which each of the bearing elements (40; 140; 390; 440A, 440B; 540B) has at least one face in free contact with the foam block (13; 113; 313; 413; 513).
- 15 [Claim 7] The insulating block (6; 106; 306) as claimed in claim 5 or 6, in which the height of the bearing elements (40; 140; 390) in the thickness direction of the insulating block (6; 106; 306) is between 20 mm and 250 mm.
- [Claim 8] The insulating block (6; 106; 406; 506) as claimed in any one of claims 5 to 7, in which each stiffening member (20, 21; 120; 420A; 520A) comprises a wooden batten, the batten having a surface that is in free contact with the foam block (13; 113; 413; 513).
- 20 [Claim 9] The insulating block (6; 106; 406; 506) as claimed in claim 8, in which each stiffening member (20, 21; 120; 420A; 520A) is fastened to the bearing element (40; 140; 390; 440A, 440B; 540B) and to the base plate (12; 112; 212; 312; 412; 512) by stapling, screwing, spot welding, and/or gluing.
- [Claim 10] The insulating block (6) as claimed in claim 8 or 9, also comprising a second 25 pair of stiffening members (21) rigidly connected to the base plate (12) and extending along the sides of the other of the pair of sides (12a) of the first and second pairs of sides of the base plate (12), each stiffening member of the second pair of stiffening members (21) comprising a wooden batten, the batten having a surface that is in free contact with a lateral surface (13f) of the foam block (13).
- 30 [Claim 11] The insulating block (306) as claimed in any one of claims 5 to 7, in which each stiffening member (380) has an L-shaped cross-section such as to present a surface (380f) in free contact with a lateral surface (313f) of the foam block (313) and a surface (380g) held rigidly in contact with the base plate (312).
- 35 [Claim 12] The insulating block (6; 106; 206; 306) as claimed in any one of claims 1 to 11, in which the foam block (13; 113; 213; 313) has four lateral surfaces (13f; 113f; 213f; 313f), each of the four lateral surfaces defining one side of said rectangular geometric envelope,

and each recess extending between two adjacent lateral surfaces (13f; 113f; 213f; 313f) such as to be positioned at a corner of the foam block (13; 113; 213; 313).

[Claim 13] The insulating block (406) as claimed in any one of claims 5 to 10, in which the lateral surfaces of the foam block (413) comprise three first lateral surfaces (413f), each of the three first lateral surfaces defining one side of said rectangular geometric envelope, and two second lateral surfaces (413f1, 413f2), the two second lateral surfaces together defining one side of said rectangular geometric envelope, the two second lateral surfaces being parallel to one side (412b) of said one of the pairs of sides of the first and second pairs of sides of the base plate (412).

10 [Claim 14] The insulating block (406) as claimed in claim 13, also comprising a supplementary stiffening member (420B), the supplementary stiffening member (420B) having a larger dimension in a direction perpendicular to the thickness direction of the insulating block (406), along said one side (412b) of the base plate (412), the supplementary stiffening member projecting from the base plate (412) in the thickness direction of the insulating block and having a surface in free contact with one such second lateral surface (413f1) of the foam block (413).

[Claim 15] The insulating block (406) as claimed in claim 14, in which the recess (415B) extends between the two second lateral surfaces (413f1, 413f2) receives two such bearing elements (440B), one held in said recess (415B) by a stiffening member (420A) and the other held in said recess by the supplementary stiffening member (420B).

[Claim 16] The insulating block (506) as claimed in any one of claims 5 to 10, in which the lateral surfaces of the foam block (513) comprise two first lateral surfaces (513f) parallel to the sides of the other of the pairs of sides (512a) of the first and second pairs of sides of the base plate (512), each of the two first lateral surfaces defining one side of said rectangular geometric envelope, and three second lateral surfaces (513f1, 513f2), the three second lateral surfaces together defining one side of said rectangular geometric envelope, the three second lateral surfaces (513f1, 513f2) being parallel to one side (512b) of said one of the pairs of sides of the first and second pairs of sides of the base plate (512).

30 [Claim 17] The insulating block (506) as claimed in claim 16, also comprising two supplementary stiffening members (520B), said supplementary stiffening members (520B) having a larger dimension in a direction perpendicular to the thickness direction of the insulating block (506), along said one side (512b) of the base plate (512), said supplementary stiffening members (520B) projecting from the base plate (512) in the thickness direction of the insulating block and having a surface in free contact with one such second lateral surface (513f1) of the foam block (513).

[Claim 18] The insulating block (506) as claimed in claim 17, in which the two recesses (515B), each extending between two of the three second lateral surfaces (513f1, 513f2), receive two such bearing elements (540B), one held in said recess (515B) by a stiffening member (520A) and the other held in said recess by a supplementary stiffening member (520B).

[Claim 19] A sealed and thermally insulating tank including a tank wall held on a load-bearing structure (1), in which the tank wall includes, in the thickness direction from the outside to the inside of the tank, a secondary insulating barrier held on the load-bearing structure (1), a secondary sealed membrane held on the secondary insulating barrier, a primary insulating barrier held on the secondary sealed membrane and a primary sealed membrane held on the primary insulating barrier, in which the secondary insulating barrier comprises a plurality of juxtaposed insulating blocks (6; 106; 206; 306; 406; 506) as claimed in any one of claims 1 to 18 and a plurality of anchoring members (30), each anchoring member (30) being received in the recesses (15; 115; 215; 315; 415A, 415B; 515A, 515B) of adjacent insulating blocks and bearing against the bearing surfaces (16; 116; 216; 316; 416A, 416B; 516B) of said adjacent insulating blocks such as to hold said adjacent insulating blocks on the load-bearing structure (1), and the secondary sealed membrane being held on said insulating blocks by welding supports received in the slots (14; 114; 214; 314; 414; 514) of said insulating blocks.

[Claim 20] A sealed and thermally insulating tank including a tank wall held on a load-bearing structure (1), in which the tank wall includes, in the thickness direction from the outside to the inside of the tank, a secondary insulating barrier held on the load-bearing structure (1), a secondary sealed membrane held on the secondary insulating barrier, a primary insulating barrier held on the secondary sealed membrane and a primary sealed membrane held on the primary insulating barrier, in which the primary insulating barrier comprises a plurality of juxtaposed insulating blocks (6; 106; 206; 306; 406; 506) as claimed in any one of claims 1 to 19 and a plurality of anchoring members (30), each anchoring member being received in the recesses (15; 115; 215; 315; 415A, 415B; 515A, 515B) of adjacent insulating blocks and bearing against the bearing surfaces (16; 116; 216; 316; 416A, 416B; 516B) of said adjacent insulating blocks such as to hold said adjacent insulating blocks on the secondary sealed membrane, and the primary sealed membrane being held on said insulating blocks by welding supports received in the slots (14; 114; 214; 314; 414; 514) of said insulating blocks.

[Claim 21] A ship (70) used to transport a cold liquid product, the ship having a double hull (72) and a tank (71) as claimed in claim 19 or 20 placed inside the double hull.

[Claim 22] A transfer system for a cold liquid product, the system including a ship (70) as claimed in claim 21, insulated pipes (73, 79, 76, 81) arranged to connect the tank (71)

installed in the hull of the ship to an onshore or floating storage facility (77) and a pump for driving a flow of cold liquid product through the insulated pipes to or from the onshore or floating storage facility to or from the tank on the ship.

5 [Claim 23] The use of a ship (70) as claimed in claim 21 for loading or unloading a cold liquid product, in which a cold liquid product is channeled through insulated pipes (73, 79, 76, 81) to or from an onshore or floating storage facility (77) to or from the tank (71) on the ship.