This invention concerns an improvement for a sealed and thermal insulating tank for integration into a bearing structure.

According to documents FR-2 527 544-A, FR-1 376 525-A, FR-1 379 651-A, FR-2 724 623-A and FR-2 798 902-A, there is a known embodiment of a sealed and insulating tank integrated into a bearing structure, in particular on a vessel, with two successive sealing barriers: a primary barrier in contact with the product contained in the tank and a secondary barrier between the primary sealing barrier and the bearing structure. Between these 2 sealing barriers on the one hand, and between the secondary sealing barriers on the other, there is at least one thermal insulating barrier. The primary sealing barrier, according to the documents, is made of metal or of a composite material which can include a metal core. The thermal insulating barriers are built as modules, or panels, arranged in juxtaposition, having a general polygonal shape, with thickness determined according to the desired insulating capability. These modules have a cover and a base, designated indifferently as "panel". The term primary thermal insulating barrier refers to the barrier on which the primary sealing barrier stands and, the term secondary thermal insulating barrier to the one on which the secondary sealing barrier stands.

In use, deterioration of the primary sealing barrier, made of metal ferrules, was observed, caused more especially by sloshing, especially at the tops of the tanks or in the embanked area above them in particular. In addition, the primary thermal insulating barrier can suffer from degradation of the rigid panel forming the support for this primary thermal insulating barrier.

However, deterioration of the secondary sealing barrier and/or the secondary thermal insulating barrier has sometimes been reported.

Accordingly, one of the purposes of this invention is to supply an improvement for such sealed and thermal insulating tanks incorporated into a bearing structure such as the hull of a vessel, to avoid or at least limit damage to the tank as reported above.

Another purpose of the invention is to supply an improvement like this with the least amount of structural modification possible

An additional purpose of such an improvement is not to substantially increase the cost of such a tank.

Another purpose of the invention is to supply an improvement like this which improves, at an acceptable cost, sealed insulating tanks incorporated into a bearing structure.

These purposes, and others that will be revealed subsequently, depend on an improvement of the sealed and thermal insulating tank integrated into a bearing structure consisting of a double wall, said tank being of a type comprising two sealing barriers, primary and secondary, and at least one thermal insulating barrier made integral with the bearing structure in which the secondary sealing barrier is located and on which the primary sealing barrier stands, which improvement according to this invention, is characterized in that it includes a damping device consisting of a layer of damping material arranged between two walls.

According to an initial embodiment of the invention, the thermal insulating barrier consists of a module much in the shape of a rectangular parallelepiped including a first panel, which could be made of plywood for instance, on top of which is a first thermal insulating coat, on top of which there is a sealing barrier itself attached to the second upper secondary insulating panel, on which is arranged a second thermal insulation coat supporting a second plywood panel, and on which, in a known manner, stands the primary sealing barrier consisting of ferrules or metal plates, which damping device is located underneath the primary sealing barrier and consists of a second plate formed by the two walls between which the layer of damping material is arranged.

According to a second embodiment of the invention, the thermal insulating barrier consists of a module, more or less a rectangular parallelepiped in shape, comprising a first panel, for instance of plywood, on top of which there is a first thermal insulating coat, on to of which is placed a sealing barrier on which a second thermal insulating coat is arranged, itself supporting a second panel, for instance of plywood, on which stands in a known manner, the primary sealing barrier consisting of ferrules or metal plates while the damping device is located under the secondary sealing barrier.

According to a third embodiment of this invention, the damping device is arranged between the secondary sealing barrier and the second thermal insulating coat.

According to a fourth embodiment of this invention, the damping device is arranged between the first panel and the first thermal insulating coat.

Advantageously, between the first and second wall, and passing through the damping material coat, a depression deflecting device is arranged.

Preferably, the depression deflecting device is inserted into holes arranged respectively in the two walls, to form a Tee while the free ends of the vertical bar of the Tee face one another and an H shaped bar is arranged in the space thus formed.

According to one alternative embodiment, the depression deflecting device is inserted into the holes arranged respectively, one in one of the walls and the other in the second thermal insulation coat, to form a Tee, while the free ends of the vertical bar of the Tee face one another and an H shaped bar is arranged in the space thus formed.

In an advantageous manner, the junctions between the first walls are offset with respect to that of the second.

Preferably, this junction between the first walls is identical to that found between the strips of an English parquet floor.

In an advantageous manner, the second wall has an elasticity modulus at least ten percent less than that of the current materials.

Preferably, the two walls will have thickness included between 9 and 21 mm.

According to a preferred embodiment of this invention, the two walls will be of fir plywood or of a composite material.

Advantageously, the first panel is attached to the wall of the bearing structure with an interposed cord of mastic having an elasticity modulus of at most 500MPA at a temperature of -25°C and approximately 150MPa at a temperature of 25°C.

The following description, which is not limitative in any way, should be read with reference to the attached illustrations among which:

- figure 1 is a sectional view, perpendicular to the wall of a bearing structure consisting of a double wall or of a double transversal bulkhead of a vessel, and in an exploded view, schematically depicting the assembly of the various parts of a tank, according to the prior embodiment, in an area of the tank away from a tank angle;

- figure 2 is a sectional view, perpendicular to the wall of a bearing structure consisting of a double wall or of a double transversal bulkhead of a vessel, and in an exploded view, schematically depicting the assembly of the various parts of a tank, according to the prior embodiment of this invention, in an area of the tank away from a tank angle;

- figure 3 shows an alternative embodiment of this invention according to figure 2;

- figure 4 represents a second embodiment of this invention;

- figure 5 represents a third embodiment of this invention;

- figure 6 represents a fourth embodiment of this invention;

The identical items of the figures are referred to by the same references.

Referring in particular to figure 1, reference 1 applies to the wall of the double hull of the vessel where the tank according to the invention is installed. It is a known fact that a vessel's hull also has transversal bulkheads subdividing the hull into compartments and that these transversal bulkheads are also double: in this description, the term "double wall 1" will be used to refer to both the double hull wall and the above transversal bulkheads, delimiting such a tank. Double walls 1 form the bearing structure of the described tank.

The tank is of a type comprising two sealing barriers, one primary 10 and the other secondary 5, and at least one thermal insulating barrier consisting of a module, more or less a rectangular parallelepiped in shape, and comprises a third panel 3 of plywood on top of which is a first coat of thermal insulation 6, itself supporting a second plywood panel 7, on which rests, in a known manner, the primary sealing barrier 10. The secondary sealing barrier 5 and the primary sealing barrier 10 are comprised of ferrules, preferably of invar, or by metal plates which can be waffled. The assembly including first panel 3 and first thermal insulation coat 4 forms the secondary thermal insulating barrier module 2b; the assembly comprising the second panel 7 while the second thermal insulation coat 6 forms the primary thermal insulating barrier 2a.

As will be evident to the man of the art, the modules 2a and 2b are approximately rectangular parallelepipeds in shape. Seen as a plan view, the module 2a is a rectangular shape with sides parallel to those of the module 2b: seen as a plan view, the 2 modules 2a and 2b are in the form of offset rectangles designed to limit thermal leaks and ensure the better sharing of forces.

According to a first embodiment of this invention as shown in figures 2 and 3, the damping device is arranged under the primary sealing barrier 10 and consists of a second panel 7 on which stands the primary sealing barrier 10, itself consisting of a sandwich structure comprising:

- a first wall 8 consisting of plywood and/or a composite material and supporting the primary sealing barrier;
- a coat 11 of a damping material; and,
- a second wall 9 consisting of plywood arranged above the coat of thermal insulation 6.

The plywood forming first wall 8 and second wall 9 is between 9 and 21 mm thick. This second wall 9 has a cold bending elasticity modulus included between 10 000 and 13 000 MPA. Plywood conforming to this invention is, for instance, fir plywood or made of a composite material. The elasticity modulus of second wall 9 is at least 10 percent less than that of the current material walls.

As far as the insulating material 11 is concerned, placed between the two walls 8 and 9 above, it is between 2 and 15 mm thick, and for instance 8 mm: this thickness is chosen so that under the solicitation of the shocks in question, they are damped on the one hand, while the crushing of this damping material does not lead to ruin, on the other hand. This material may be felt, a material based on woven fibers filled or not filled with insulating materials such as, for instance an aerogel: this assembly is bonded or mechanically assembled.

According to a second embodiment of this invention, the damping device is arranged under a secondary sealing barrier 5. It is formed of the two walls 8' and 9' as described previously and between which a damping material coat 11 is inserted. In this case, one of the walls, referenced 9' in this case, stands on a first insulating material coat 4, and the other wall 8' is topped by a secondary sealing barrier 5.

The junctions between the first walls 8 or 8' are offset with respect to the second walls 9 or 9' to ensure better mechanical continuity of the insulating block. This junction between the first walls 8 or 8' is, for instance, identical to the one between the strips of an English parquet floor.

According to an alternative embodiment of this invention, a depression deflecting means is inserted between the first wall 8 and the second wall 9, and therefore passes through damping material coat 11. In this typical embodiment, the latter have two holes, respectively 12a and 12b, forming a Tee and interconnected by

the vertical bar of the Tee and a H shaped bar 13 arranged within the space thus formed.

According to an alternate embodiment as shown in figure 3, the hole 12b is not located in the second wall 9, but in the second thermal insulation coat 6 of the module 2a forming the primary thermal insulating barrier.

The same may apply when the damping device according to this invention is located under the secondary sealing barrier 5.

According to figure 5 relative to a third embodiment, the damping device 7 is placed above a second sealing barrier 5 and therefore under the second thermal insulating coat 6.

According to the fourth embodiment as shown in figure 6, the damping device 7 is located between the first panel 3 of the secondary thermal insulating barrier 2b and the first thermal insulating coat 4 of said module 2b.

To improve shock damping, the first panel 3 is attached to the wall 1 of the bearing structure with an interposed cord of mastic 14 having an elasticity modulus of at most 500MPA at a temperature of -25°C and approximately 150MPa at a temperature of 25°C.

The damping of a tank including the improvement according to this invention is at least 3 times greater than according to current structures thanks to the effect thus obtained on the shipped liquid side.

CLAIMS

1. Improvement for a sealed and thermal insulating tank integrated into a bearing structure (1) consisting of a double wall which tank is of a type comprising two sealing barriers, primary (10) and secondary (5), and at least one thermal insulating barrier made integral with the bearing structure in which a secondary sealing barrier (5) is located and on which a primary sealing barrier (10) stands, characterized in that it includes a damping device consisting of a layer of damping material arranged between two walls.

2. An improvement according to claim 1 characterized by the fact that the thermal insulating barrier consists of a module much in the shape of a rectangular parallelepiped including a first panel, which could be made of plywood for instance, on top of which is a first thermal insulating coat, on top of which there is a sealing barrier itself attached to the secondary insulating panel, on which is arranged a second thermal insulation coat supporting a second panel of plywood, and on which, in a known manner, stands the primary sealing barrier consisting of ferrules or metal plates, which damping device is located underneath the primary sealing barrier (10) and consists of a second plate comprising the two walls between the which the layer of damping material is arranged

3. An improvement according to claim 1, characterized in that the thermal insulating barrier consists of a module, more or less a rectangular parallelepiped in shape, comprising a first plywood panel, on top of which there is a first thermal insulating coat, on top of which is placed a second thermal insulating coat, itself supporting a second panel, for instance of plywood, on which stands in a known manner, the primary sealing barrier consisting of ferrules or metal plates while the damping device is located under the secondary sealing barrier (5).

4. An improvement according to claim 1, characterized in that the thermal insulating barrier consists of a module, more or less a rectangular parallelepiped in shape, comprising a first plywood panel, on top of which there is a first thermal insulating coat, on top of which is placed a second thermal insulating coat, itself supporting a second plywood panel, on which stands in a known manner, the primary sealing barrier consisting of ferrules or metal plates while the damping device is located between a secondary sealing barrier (5) and a second thermal insulating coat (6).

5. An improvement according to claim 1, characterized in that the thermal insulating barrier consists of a module, more or less a rectangular parallelepiped in shape, comprising a first plywood panel, on top of which there is a first thermal insulating coat, on top of which is placed a second thermal insulating coat, itself supporting a second plywood panel, on which stands in a known manner, the primary sealing barrier consisting of ferrules or metal plates while the damping device is located between a first panel (3) and a first thermal insulating coat (4).

6. An improvement according to the any of claims 1 to 5, characterized by the fact that between the first (8,8') and the second wall (9,9') and passing through the damping material coat (11 ,11') a depression deflecting means is arranged.

7. 7. An improvement according to claim 6, characterized by the fact that the depression deflecting means is inserted into the holes (12a) and (12b) arranged respectively in the walls (8,8') and (9,9'), forming a Tee while the free ends of the vertical bar of the Tee face one another and an H shaped bar (13) is arranged in the space thus formed.

8. An improvement according to claim 7, characterized by the fact that the depression deflecting means is inserted into the holes (12a) and (12b) arranged respectively in the first wall (8,8') and in the second thermal insulation coat (6), forming a Tee while the free ends of the vertical bar of the Tee face one another and an H shaped bar (13) is arranged in the space thus formed.

9. An improvement according to any of claims 1 to 8, characterized by the fact that the junctions between the first walls (8,8') are offset with respect to those of the second walls (9,9').

10. An improvement according to claim 9, characterized in that the junction between the first walls (8,8') is identical to that found between the strips of an English parquet floor.

11. An improvement according to any of claims 1 to 10, characterized in that second wall (9,9') has an elasticity modulus at least ten per cent less than that of current materials.

12. An improvement according to one of claims 1 to 11, characterized by the fact that the two walls (8,8') and (9,9') have a thickness included between 9 and 21 mm.

13. An improvement according to one of claims 1 to 12, characterized by the fact that the two walls (8,8') and (9,9') are of fir plywood or of a composite material.

14. An improvement according to any of claims 1 to 13 characterized by the fact that the first panel (3) is attached to the wall of the bearing structure with an interposed cord of mastic (14) having an elasticity modulus of at most 500MPA at a temperature of -25°C and approximately 150MPa at a temperature of 25°C.