

Watertightness barrier for a wall of a tank

The invention relates to the field of watertightened thermally insulating tanks, notably for storing or transporting hot or cold liquids and in particular to tanks for low-temperature liquefied gases.

FR-A-2798358, FR-A-2709725, FR-A-2549575 or FR-A-2398961 for example disclose storage or transport tanks for low-temperature liquefied gases, in which the or each watertightness barrier, notably a primary watertightness barrier in contact with the product contained in the tank, consists of thin sheet metal plates joined together in a watertight manner by turned-up edges that define bellows that can be deformed on each side of a welding flange.

In order to create watertight welded seams joining sheet metal plates with turned-up edges to the welding flanges over long lengths it is possible to use electric welding machines, for example as described in FR-A-2172837 or FR-A-2140716. Such a welding machine, which is relatively heavy, travels along the welding line while being held pressed against the sheet metal plates, the turned-up edges of which it is welding together. This holding is achieved by inclining the axis of the machine drive rolls towards the front of the machine in its direction of travel. The welding machine is thus able to weld along all the walls of the tank, even the vertical walls and the roof, while remaining constantly and firmly pressed against the layer of sheet metal plate, the turned-up edges of which it is welding together.

In a tank of the abovementioned type, there are regions in which the progress of the welding machine that is creating the welded seams between the turned-up edges of the sheet metal plates and the welding flange has to be interrupted, for example at the end of a wall near a corner of the tank. There then arises the problem of ensuring the continuity of the metal membrane in such a region, in the knowledge that the watertightness barrier may be subjected to high tensile stresses resulting, where appropriate, from thermal contraction, deformation of the bearing structure at sea and/or movements of the cargo at sea such as sloshing.

In accordance with a first aspect, there is provided a method of creating a watertightness barrier for a wall of a watertight and thermally insulating tank, comprising:
arranging, on a thermally insulating barrier that has a flat support surface for the watertightness barrier, a repeating structure comprising alternately strips of sheet metal and elongate welding flanges connected to the support surface and projecting with respect to the latter so that the welding flanges run parallel to the strips of sheet metal over at least part of the length of the strips of sheet metal and so that lateral edges of the strips of sheet metal which are turned up with respect to the support surface are positioned against the adjacent welding flanges.
for respectively a first and a second adjacent strip of sheet metal arranged on either side of a welding flange, watertightly welding the turned-up lateral edge of the strip of sheet metal to the welding flange using a straight welded seam parallel to the support surface along a first longitudinal portion

of the strip of sheet metal, the straight welded seam being each time arranged beneath an upper ridge of the turned-up lateral edge of the respective strip of sheet metal, characterized by the steps of:

continuing each time the straight welded seam with an end portion of the welded seam which is deviated with respect to the support surface in the direction of the upper edge corner of the turned-up lateral edge and which meets the upper edge corner of the turned-up lateral edge, and producing a watertight edge corner welded seam between the upper edge corner of the turned-up lateral edge of the first strip of sheet metal and the upper edge corner of the turned-up lateral edge of the second adjacent strip of sheet metal along a second longitudinal portion of the two strips of sheet metal so that the edge corner welded seam watertightly meets the end portion of the respective welded seam of each of the two strips of sheet metal.

In accordance with another aspect, there is provided a watertight and thermally insulating tank arranged inside a bearing structure comprising a bearing wall, the tank comprising a tank wall positioned along the bearing wall, the tank wall comprising a watertightness barrier and a thermally insulating barrier positioned between the watertightness barrier and the bearing wall, the thermally insulating barrier having a flat support surface for the watertightness barrier, the watertightness barrier having a repeated structure comprising alternately strips of sheet metal arranged on the support surface and elongate welding flanges connected to the support surface, projecting with respect to the latter and running parallel to the strips of sheet metal over at least part of the length of the strips of sheet metal, the strips of sheet metal comprising lateral edges which are turned up with respect to the support surface, arranged against the adjacent welding flanges, each of the two strips of sheet metal arranged on either side of a welding flange comprising a first longitudinal portion in which the turned-up lateral edge of the respective strip of sheet metal is watertightly welded to the welding flange by a straight welded seam parallel to the support surface, the straight welded seam being each time arranged beneath an upper ridge of the turned-up lateral edge of the respective strip of sheet metal, characterized in that each of the two strips of sheet metal arranged in either side of a welding flange furthermore comprises: a second longitudinal portion in which the turned-up lateral edge is watertightly welded to the turned-up lateral edge of the other adjacent strip of sheet metal by an edge corner weld, and an intermediate portion in which the edge corner weld of the second portion and the straight welded seam of the first portion are connected watertightly, the welded seam each time having an end portion which is deviated with respect to the support surface in the direction of the upper edge corner and meeting the upper edge corner of the turned-up edge in the intermediate portion of the respective strip of sheet metal, the edge corner weld being continued in the intermediate portion of each of the two strips of sheet metal in such a way as to create a watertight joint with the end portion of the respective welded seam of each of the two strips of sheet metal.

In accordance with yet another aspect, there is provided a ship for transporting a cold liquid product, the ship having a double hull and a tank as disclosed in the second aspect arranged in the double hull.

5 In accordance with a further aspect, there is provided a use of a ship as disclosed in the above aspect, in which use a cold liquid product is carried through insulated pipes from or to a floating or shore-based storage installation to or from the ship's tank in order to load or offload the strip.

10 In accordance with another aspect, there is provided a system for transferring a cold liquid product, the system comprising a ship as disclosed in the above aspect, insulated pipes arranged in such a way as to connect the tank installed in the hull of the ship to a floating or shore-based storage installation, and a pump for driving a flow of cold liquid product through the insulated pipes from or to the floating or shore-based storage installation to or from the ship's tank.

15 According to one embodiment, the invention provides a method of creating a watertightness barrier for a wall of a watertight and thermally insulating tank, notably a bottom wall of the tank, comprising:

arranging, on a thermally insulating barrier that has a flat support surface for the watertightness barrier, a repeating structure comprising alternately a strip of sheet metal and an elongate welding flange connected to the support surface so that the welding flange runs parallel to the strip of sheet metal over at least part of the length of the strip of sheet metal

The cover plates 12 are connected to the strakes 8 at an overlap region 21 in which the opposite edge 22 of the cover plates to the edge 13 is welded continuously and watertightly to the strakes, while the turned-up edges 16 of the cover plates envelop the turned-up edge ends 20 of the strakes. The watertight welded seam at the edge corners of the cover plates 12 is continued into this region and then at the upper edge corner of the turned-up edges 20 of the strakes 8 in the direction of the weld support 9.

The weld support 9 interposed between two strakes 8 ends at the region of overlap 21 or slightly before this region. However, starting from an end point 11, the upper portion 25 of this support is levelled off so that the height of the weld support 9 is the same as the height of the turned-up edges 20, making it easier to create a watertight edge corner welded seam between them.

All along the central portion of the wall of the tank and right up to near the end region 10, the watertight connection between the turned-up edges 20 of the strakes 8 and the weld supports 9 is performed using straight welded seams 26 which extend more or less mid-way up the height of the turned-up edges 20 on each side of the weld support 9. These welded seams 26 run strictly parallel to the support surface on which the watertightness barrier rests, because the welding machine that is performing them progresses running along this surface and firmly pressed against it. However, because of a lack of space, the welding machine with electrode wheels has to be stopped short before it reaches the corner of the tank. It is therefore necessary to establish a watertight connection between the end portion of the welded seam 26 situated on the middle-of-tank side and the edge corner welded seam created at the cover plates 12 and the region of overlap 21.

To do that, one possible technique is to cut the turned-up edges 20 of the strakes 8 locally in line with the end of the welded seam 28, to lower their upper edge corner until it meets the welded seam 26. It is then possible to continue the edge corner welded seam into the bottom of this cut until a continuous joint is made with the welded seam 26. However, given that the welded seam 26 is made more or less mid-way up the height of the turned-up edges 20, this local cut constitutes a considerable region of weakness of the turned-up edges 20 of the strakes 8 likely to concentrate stresses and to break prematurely through fatigue.

~~A preferred technique is depicted in Figure 2. The same numerals are used to denote the same elements as in Figures 1 and 8. The end of the welded seam 26 is produced here with a straight portion 27 that continues the seam produced in the central part of the tank, followed by a deviated portion 28 which rises up with respect to the support surface until it meets or skims the upper edge corner 32 of the turned-up edges 20, followed by a final~~

Figure 5 depicts another variant of this method, in which the first step is performed in a region in which the weld support 9 is absent or has already been levelled off. A protective plate 38 positioned above the upper edge corner 32 of the turned-up edges 20 protects the welding electrodes from short-circuiting at the end of the creation of the deviated portion 28. The thickness of the plate 38 may be the combined thickness of the weld support 9 and of two strakes 20.

Figure 6 illustrates a second embodiment of a method for the watertight joining of strakes at the end portion 10 of the watertightness barrier.

In a first step, the welded seam with the portions 27, 28 and 29 is produced by the machine as described earlier. The deviated portion 28 is created here after the end point 11 of