

Temperature-Controlled Tank Container

A temperature-controlled tank container with the features set forth in the first part of claim 1 is known from DE-A-2,917,364. This document is primarily concerned with a structure in which a heat insulating jacket surrounding the tank is disposed on the planar wall surfaces of a generally parallelepiped-shaped container frame, in which the tank is mounted by horizontal and vertical support walls. Through-holes for a temperature control medium are formed in these support walls. The penultimate paragraph of the description of this document further refers to a spiral formation of separating webs without illustrating this structure in any detail.

From SU-A-1,174,344, there is further known a tank car having the tank surrounded by a heat insulating jacket, with helical separating webs extending between the tank jacket and the heat insulating jacket to form a channel for a temperature control medium circulating about the tank jacket. The tank jacket itself appears to be sufficiently self-supported to permit its two ends being strapped to end platforms of the tank car by means of bands placed around them.

GB-A-1,150,365 discloses a conventional tank container with a non-insulated tank having a jacket surrounded by circular reinforcing rings.

From DE-U-1,851,590, it is finally known to dispose wires helically about a double-walled storage container in order to space parts of an external jacket from an internal jacket. Disregarding the fact that the external and internal jackets are spaced apart not everywhere, the wires used do not form continuous and mutually separated channels for the flow of a temperature control medium.

It is an object of the invention to provide a temperature-controlled tank container which does not require a complete container frame, which is of simple structure and mini-

imum tare weight, and which permits a uniform flow of the temperature control medium about the tank surface with good utilization of the medium.

In the solution of this object set forth in claim 1, the temperature control medium is passed as a layer of uniform thickness, of only few centimeters in practice, along a helical path about the cylinder circumference in intimate contact with the tank jacket so that an intensive heat exchange takes place. The frame of the tank container may be reduced to a pair of end frames connected to the bottoms of the self-supported tank, the helical separating webs simultaneously forming section bars which reinforce the tank jacket to improve the self-supporting property of the tank. Similar to the reinforcing section bars, the end rings connecting the tank to the end frames serve to form a continuous flow path for the temperature control medium.

According to claim 2, the end provided with the inlet and outlet openings for the temperature-control medium is provided only with a comparatively narrow channel which leads to the respective opening in the end ring and communicates with the helical channel through a correspondingly limited passage cut in the end ring.

Claims 3 to 5 relate to advantageous embodiments of the temperature insulating jacket and additional reinforcing measures.

Preferred embodiments of the present invention will now be described in detail with reference to the accompanying drawings, in which

Figure 1 is a schematic side view of a temperature-controlled tank container,

Figure 2 is an end view of the tank container, wherein the left half of Figure 2 is an end view of the tank container of Figure 1 as viewed from the left and the right half is an end view as viewed from the right,

Figures 3A and 3B are schematic illustrations of the two end faces of a different embodiment of the tank container.

As shown in Figures 1 and 2 the tank surface is composed of a cylindrical shell 10 and bottoms 11, 12 attached at either end thereof, said bottoms being respectively joined via end rings 13 with diagonal braces 14 of frame end structures 15. Such a purely endwise suspension of a cylindrical tank from two end structures 15 is known from DE-C-3,212,696. In Figure 1, the end structures 15 are shown to be additionally interconnected by lower longitudinal rails 16. The right-hand tank bottom 12 as viewed in Figure 1 is provided with a man-hole 17 and a discharge fitting 18. Also, a filling connection 19 is illustrated near the left-hand (as viewed in Figure 1) tank bottom 11 in the vertex line of the cylindrical tank shell 10.

Two division webs 20, 21 extending along two helices offset by 180° are placed about the cylindrical shell 10 of the tank surface. It is assumed in Figure 1 that each division web 20, 21 surrounds the tank surface twice, all four corner points of said division webs being disposed - in the illustration of Figure 1 - in a horizontal plane including the tank axis. The two division webs 20, 21 may be rectangular-section strips of, for instance, 8 mm x 30 mm which have their narrow edge welded to the tank surface. They thus fulfil the function of reinforcing ring normally provided on cylindrical tanks. In order to avoid peak stresses at the end points of the division webs 20, 21, the webs extend from pipe sections 22 each welded to the tank surface with a closed circular seam.

The division webs 20, 21 keep an insulating jacket generally referenced 23 in spaced relationship from the tank surface. As indicated in the partially sectional view at the bottom of Figure 1, the insulating jacket 23 is composed of an inner skin 24, an outer skin 25 and an insulating material 26 sandwiched therebetween. In areas between the division webs 20, 21 the inner skin 24 of the insulating jacket 23 may be supported on the tank surface by additional spacer members in the form of bead- or socket-like shaped portions 27.

Preferably, the insulating material 26 is formed large-sized foamed polyurethane slabs which are pre-slotted on their surfaces facing the inner skin 24 so that they can be given

the required cylindrical shape.

The insulating jacket 23 extends with the cylindrical shape defined by the division webs 20, 21 along the entire length of the tank container right to the end structures 15 to terminate on flat or curved insulating plates 28 which are inserted in said end structures 15 and may have a design similar to the insulating jacket 23. Thus the tank is insulated on all sides.

As will be apparent from the left-hand part of the end view of Figure 2, the left-hand (as viewed in Figure 1) bottom 11 of the tank is provided with the two openings 31, 32 for connection to a supply system for the temperature control medium. Such supply systems are common especially in container ships where the temperature control medium is especially cooling air which is available in large flow volumes at small pressure differences. Similar supply systems are also provided in container yards in ports.

In such a cooling system the openings 31, 32 of the tank container are also called "port-holes", the lower opening 31 forming an inlet port-hole and the upper opening 32 forming an outlet port-hole. The flow of cooling medium is caused by an overpressure existing at the inlet port-hole 31 and a corresponding negative pressure existing at the outlet port-hole 32.

As will be further apparent from Figures 1 and 2, the space enclosed between the left-hand tank bottom 11, the insulating jacket 23 and the end structure 15, which terminates in an insulating plate 28, is divided both inside and outside of the end ring 13 by means of a division plate 33 extending in the horizontal centre plane. The division plate 33 starts from the two pipe sections 22 where the division webs 20, 21 terminate on the two opposite sides of the tank surface. The end ring 13 is provided with through-holes 34 both above and beneath the division plate 33. Corresponding through-holes may alternatively or additionally be provided in the flanges of the diagonal braces 14, which flanges extend in the longitudinal direction of the tank. A further possible modification resides in passing the cooling medium about the diagonal braces 14 provided a sufficient distance is maintained between said

braces and the insulating plate 28 as well as between the braces and the insulating jacket 23.

In this way a flow passageway for the temperature control medium is defined which extends from the lower inlet port-hole 31 through the lower through-holes 34 in the end ring 13, one of the two helical flow passageways defined between the two division webs 20, 21 to the area of the right-hand tank bottom 12 (as viewed in Figure 1), thence back through the other of the two helical flow passageways and through the upper through-holes 34 in the end ring 13 to the outlet port-hole 32. Since the flow passageways between the two division webs 20, 21 have a relatively small uniform height, the temperature control medium flows around the entire tank surface in intimate contact therewith. The helical design of the flow passageways simultaneously causes continuous rotation of the temperature control medium whereby the generation of a laminar flow, which would be detrimental to heat transfer, is prevented.

As will be apparent from Figure 1 and 2, the end ring 13 which joins the right-hand tank bottom 12 to the end structure 15, is continuous and is interrupted only in the vicinity of the discharge fitting 18. The diagonal braces 14, which connect this end ring 13 to the end structure 15, also are formed with small through-holes. On the other hand, the two division webs 20, 21 end at a distance from the end ring 13 so that there is room for the passage of the temperature control medium. In this embodiment the temperature control medium does not flow across the portion of the tank bottom 12 disposed inwardly of the end ring 13. Normally, temperature control of the inner portions of the tank bottoms 11, 12 need not be provided in view of the extensive flow of medium especially around the entire cylindrical shell 10. If, however, temperature control for this portion is required, the division webs 20, 21 will be extended to the right-hand end ring 13, and the latter of the corresponding diagonal braces 14 will be provided with through-holes 34 similar to those indicated in the left-hand part of Figure 1.

Whereas the embodiment illustrated in Figure 1 is provided with only two helical division webs 20, 21 offset by 180°,

it is basically possible to provide four or a larger even number of division webs which result in a correspondingly increased number of helical flow passageways so that the entire flow path for the temperature control medium along the tank surface is extended.

Figure 3A schematically shows the end face of a tank container provided with the inlet and outlet port-holes 31, 32, said tank container being provided with four helically disposed division webs 35, 36, 37, 38. Figure 3B shows the opposite end face of the same tank container. Along the end face illustrated in Figure 3A the division webs 35 to 38 extend right to the end ring 13. Also, each of the two port-holes 31, 32 opens into a communicating passageway 40 defined by two limiting webs 39 extending at an acute angle, said communicating passageway 40 being in connection communicated via through-holes in the end ring 13 with the respective flow passageway defined between a pair of division webs 35, 36 and 37, 38, respectively. Outside the communicating passageways 40 the end ring 13 is provided with further through-holes which communicate the flow passageway defined between the division webs 36, 37 across the hemispherical portion of the bottom to the opposite flow passageway defined between the division webs 35, 38. At the other end face shown in Figure 3B, the division webs 35, 37 extend right to the end ring 13 provided therein, while the other two division webs 36, 38 terminate in spaced relationship therefrom. With this structure, the temperature control medium flows from the inlet port-hole 31 along the path indicated by the arrows A, B, C, D and E towards the outlet porthole 32, said path winding four times helically around the tank.

Claims

1. A temperature-controlled tank container comprising
a tank having a jacket formed of a cylindrical shell (10)
and a pair of end bottoms (11, 12),
an insulating jacket (23) surrounding the tank on all
sides, two openings (31, 32) for introducing and discharging a
temperature control medium being formed above one another in



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Claims

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an insulating jacket (23) surrounding the tank on all sides, two openings (31, 32) for introducing and discharging a temperature control medium being formed above one another in



one end face of the insulating jacket (23), and

at least two separating webs (20, 21) disposed between the tank jacket and the insulating jacket (23) and helically surrounding the shell (10) of the tank jacket for enforcing a flow of the temperature control medium round the tank jacket, characterized in

that the separating webs (20, 21) are formed of section bars reinforcing the tank jacket in a self-supporting manner,

that the tank is connected to end frames (15) via end rings (13) fitted to the tank bottoms (11, 12),

that, at the said one end face provided with the introducing and discharge openings (31, 32), at least some of said separating webs (20, 21) are joined to the end ring (13), with flow channels each formed between two separating webs being connected to the openings (31, 32) via through-holes (34) in the end ring (13), and

that, at the other end face, at least some of the separating webs (20, 21) terminate at a distance from the end ring (13).

2. The tank container of claim 1, characterized in that, at the said one end face, communicating channels (40) leading from the through-holes (34) in the end ring (13) to the openings (31, 32) are formed by limiting webs (39) which diverge at an acute angle from the respective opening towards the end ring (13).

3. The tank container of claim 1 or 2, characterized in that the insulating jacket (23) comprises an inner skin (24), an outer skin (25) and an insulating mass (26) disposed therebetween.

4. The tank container of claim 3, characterized in that the inner skin (24) is provided with bead- or socket-shaped portions (27) to provide additional support relative to the tank jacket.

5. The tank container of claim 3 or 4, characterized in that the insulating mass (26) is applied in the form of plates of foamed material which are preslotted on their surfaces facing the inner skin (24).