

Translation

European Patent Specification 0 303 796

PRESSURE-RESISTANT TANK

A pressure-resistant tank of the type set forth in the preamble part of claim 1 is known from DE-C-2 253 235. In this container, which is in the form of a tank container, four part-circular cylindrical shell elements forming the tank jacket are inserted between two end frame structures of the container. U- or L-section beams extend between these end frame structures outside the tank jacket, with one flange of each beam protruding into the bead formed between adjacent shell elements. Tie rods traverse the interior of the tank, penetrate the tank jacket in the area of the beads and have their ends welded to the said flanges of opposite beams. There is an indication that the tie rods have a tubular shape inside the tank jacket to increase their stiffness.

The known tank requires heavy end frame structures to fix the massive section beams and therefore has a high tare weight. Moreover, a relatively large number of tie rods is provided which not only further increase the tare weight of the tank but also result in a more difficult manufacture and considerably obstruct a cleaning of the tank interior.

DE-C-2 007 142 discloses another tank container having upper and lower curved jacket shell elements which are joined to upper and lower tubular bars extending in the longitudinal direction of the container and being interconnected by a tension wall which subdivides the whole container into two chambers. This container is again expensive to manufacture and has a high tare weight due to the tension wall extending throughout the length of the container. Also in this case, cleaning of the tank interior is difficult due to the presence of the separation wall.

It is thus the object of the present invention to devise

1 a tank which is highly pressure-resistant at a minimum tare weight, which is easy to clean and inexpensive to manufacture.

2 The solution to this object according to the invention is characterised in claim 1. The tubular longitudinal bars which
5 are provided in accordance with claim 1 and are inserted between respective adjacent jacket shell elements need not be excessively heavy because they are reinforced by inserted sections of a further pipe provided in the areas where the tie
10 rods are connected. Due to this type of reinforcement of the tubular longitudinal bars, a small number of tie rods will suffice. For a given pressure resistance, the forces occurring in the small number of tie rods are readily introduced into the longitudinal bars without causing inadmissible peak stress or bending. A small number of tie rods is favourable from the
15 points of view of manufacture, tare weight and cleaning of the tank interior.

While it is known from DE-A-3 517 289 in connection with a freight container to insert connecting elements into blind
20 holes of U-section reinforcing members that may in turn be reinforced by flat iron plates, the container known from this document is not a pressure-resistant container of the type with which the invention is concerned. Moreover, the feature of the invention, according to which an interior pipe section is inserted into a tubular longitudinal bar at the location
25 where a tie rod is joined to the longitudinal bar, has not been realised in this prior art.

The same applies to the rectangular tank disclosed in CH-A-431 385, in which a tubular tie rod is fixed on the outer
30 side of the planar tank walls by conventional reinforcing disks welded to the tank walls.

The development of the invention according to claim 2 results in the advantage that the reinforcing areas of the pipe sections do not terminate abruptly. Instead, their resilient
35 ends caused by the bevels and facing the tank create a smooth transition.

The embodiments of the invention according to claims 3 and 4 are useful to achieve a high strength of the tie rods

1 themselves and of their connections to the longitudinal bars.
The measure set forth in claim 5 serves to prevent a relative
movement between the tubular longitudinal bar and the pipe
section inserted therein, to take full advantage of the rein-
5 forcing effect of the pipe sections.

The development of the invention according to claim 6 is
favourable with respect to the cleaning of the tank interior
and further permits the tank to be closed at these locations
by means of extended portions of the tank heads; alternative-
10 ly, the ends of the tubular longitudinal bars may be closed
off by separate sheet metal pieces which extend over part of
the respective tank head to form stress-relieving and rein-
forcing elements.

In case the tank jacket is made of special steel or other
15 high-quality material, it may be advantageous to manufacture
not all of the tubular longitudinal bars from such expensive
tank material but only to cover their portions facing the tank
interior with part-cylindrical sleeves made of the tank mate-
rial, as set forth in claim 7. In any case, the reinforcing
20 pipe sections disposed inside the longitudinal bars are made
of a material which is less expensive but instead exhibits
higher strength properties.

The embodiment of claim 8 results in the advantage that,
with the rolling widths nowadays available, and in view of the
25 usual tank profiles, each shell element can consist of one
single piece and does not have to be made up of a plurality of
separate rings extending in the transverse direction, as is
true with conventional cylindrical containers. This results in
a reduced overall welding length and simplifies the assembly.

30 The development of claim 9 is advantageous in that heat-
ing or cooling is made possible without requiring additional
weight-increasing measures on the tank in addition to the ex-
ternal supply lines and connections.

Preferred embodiments of the invention will be explained
35 in mor detail with reference to the drawings, in which

Figure 1 is a side view of a pressure-resistant tank fit-
ted between two container end frame structures,

1 Figure 2 is an end view of the tank shown in Figure 1,
 Figure 3 is an enlarged partial section taken along the
 line III-III of Figure 1, and
5 Figure 4 is a partial section through one longitudinal
 bar according to a modified embodiment.

 According to Figures 1 and 2, the tank is composed of
four parallel part-circular cylindrical shell elements 10 and
two tank end heads 11. As appears from the end view of Figure
2, the tank has a clover-leaf shaped cross-section with the
10 axes of the four shell elements 10 defining the corners of a
rectangle. Lower saddle pieces 12 and upper support elements
13 connect the tank to two container end frame structures 14.

 A tubular longitudinal bar 15 extends parallel to the
tank axis in the bead area between each pair of adjacent shell
15 elements 10. As will be particularly clear from the upper part
of Figure 1, both ends of each tubular longitudinal bar 15 are
bevelled at 45° or less in such a manner that the minimum
length of the bar 15 is next to the tank axis and its maximum
length reaches the location where the respective tank head is
20 attached. Four spandrel-shaped sheet metal pieces 16 are inte-
grally formed at each tank head 11 and bent at the mentioned
angle of 45° or less. Each metal piece engages in the respect-
ive bead area between two jacket shell elements 10 and simul-
taneously closes off that portion of the bevelled end face of
25 each tubular longitudinal bar 15 which is outside the jacket
shell elements 10.

 The tank jacket is further surrounded by two reinforcing
rings 17 which, as shown in Figure 2, follow the substantially
clover-leaf shaped profile of the tank. Tubular tie rods 18,
30 19 extend perpendicular to the tank axis and traverse the tank
interior. One vertical tie bar 18 and one horizontal tie bar
19 are each disposed immediately adjacent so as to contact
each other in the area of intersection and may be joined to
each other for further reinforcement. A total of four tie bars
35 18, 19 are provided at a tank length of 20 feet (6058 mm).

 Each end of each tie rod 18, 19 completely penetrates the
respective longitudinal bar 15, with a short length protruding

1 from the outside thereof. In the area of penetration, the longitudinal bar 15 is reinforced by a pipe section 20 inserted
into the tubular bar 15. As shown in Figure 1, the ends of
each pipe section 20 is bevelled in such a manner that the maximum
5 length of the pipe section 20 is next to the tank axis. A gradual stress transition is thereby achieved from the reinforced portion of the longitudinal bar 15 to the non-reinforced portion, with the longest inner tongue-shaped end portions of the pipe section 20 providing a certain elasticity.

10 As may be seen from the sectional view of Figure 3, the end of the tie bar 18 is welded to the longitudinal bar 15 as well as to the pipe section 20 at both locations of penetration situated inside and outside the tank. Since the reinforcing action of the pipe section 20 is fully achieved only if
15 the pipe section is prevented from moving relative to the tubular bar 15, these two elements are fixed to each other by welds performed along edges of cut-outs 21 that are provided in the tubular bar 15. Both jacket shell elements 10 are welded to the tubular bar 15.

20 While the shell elements 10, tie rods 18, 19 and longitudinal bar 15 consist of tank material, such as special steel if so required according to the usage of the tank, the pipe sections 20 that are not contacted by the load are made of high-strength constructional or fine-grain steel.

25 Further saving of high-quality tank material may be achieved by manufacturing the longitudinal bar 15 of less expensive material and surrounding it, as shown in Figure 4, at the portion inside the tank by a part-cylindrical sleeve 22 of tank material. The longitudinal edges of the sleeves 22 are
30 welded to the respective bar 15 on the outside of the tank. In this case, the jacket shell elements will be welded to the sleeves 22.

35 Given the typical dimensions of a land tank container, i.e. a height of 2600 mm and a width of approximately 2500 mm, and using tubular longitudinal bars 15 of a diameter of approximately 200 mm, the clover-leaf type configuration shown in Figure 2 requires jacket shell elements having an arc

1 length of slightly less than 2000 mm. Sheet metal of this
width may be manufactured in a modern cold-rolling process.
The use of the tubular bars 15 in the manner shown thus per-
mits to curve the jacket shell elements 10 transversely to the
5 rolling direction with the result that four integral jacket
shell elements 10 extending over the entire tank length may be
used, in contrast to conventional tank jackets that are made
up of a plurality of transversely extending rings.

The tubular longitudinal bars 15 and tubular tie rods 18,
10 19 may be used for circulating a cooling or heating fluid
which is supplied by external inlet pipes and connectors (not
shown). In this case the tie rods 18, 19 will be provided with
openings 23 (Figure 3) at those locations at which they pene-
trate the longitudinal bars 15 in order to form a coherent
15 tube system.

Claims

1. A pressure-resistant tank the jacket of which is composed
of a plurality of parallel part-cylindrical shells (10) in-
20 serted between longitudinal bars (15), opposite longitudinal
bars (15) being interconnected by individual tie rods (18, 19)
extending through the tank interior, characterized in that the
longitudinal bars (15) are formed as tubes having reinforcing
type sections (20) inserted within the connecting areas of the
25 tie rods (18, 19).

2. The tank of claim 1, characterized in that the pipe sec-
tions (20) are bevelled at both ends in such a manner that
their maximum length faces the tank.

3. The tank of claim 1 or 2, characterized in that the tie
30 rods (18, 19) are tubular.

4. The tank of any of claims 1 to 3, characterized in that
the tie rods (18, 19) completely penetrate the longitudinal
bars (15) and the pipe sections (20) inserted therein, and are
welded thereto at both locations of penetration.

length of slightly less than 2000 mm. Sheet metal of this width may be manufactured in a modern cold-rolling process. The use of the tubular bars 15 in the manner shown thus permits to curve the jacket shell elements 10 transversely to the rolling direction with the result that four integral jacket shell elements 10 extending over the entire tank length may be used, in contrast to conventional tank jackets that are made up of a plurality of transversely extending rings.

The tubular longitudinal bars 15 and tubular tie rods 18, 19 may be used for circulating a cooling or heating fluid which is supplied by external inlet pipes and connectors (not shown). In this case the tie rods 18, 19 will be provided with openings 23 (Figure 3) at those locations at which they penetrate the longitudinal bars 15 in order to form a coherent tube system.

Claims

1. A pressure-resistant tank the jacket of which is composed of a plurality of parallel part-cylindrical shells (10) inserted between longitudinal bars (15), opposite longitudinal bars (15) being interconnected by individual tie rods (18, 19) extending through the tank interior, characterized in that the longitudinal bars (15) are formed as tubes having reinforcing type sections (20) inserted within the connecting areas of the tie rods (18, 19).

2. The tank of claim 1, characterized in that the pipe sections (20) are bevelled at both ends in such a manner that their maximum length faces the tank.

3. The tank of claim 1 or 2, characterized in that the tie rods (18, 19) are tubular.

4. The tank of any of claims 1 to 3, characterized in that the tie rods (18, 19) completely penetrate the longitudinal bars (15) and the pipe sections (20) inserted therein, and are welded thereto at both locations of penetration.



1 5. The tank of any of claims 1 to 4, characterized in that the pipe sections (20) are fixed within the longitudinal bars (15) by being welded along the edges of cut-outs (21) provided in the longitudinal bars (15).

5 6. The tank of any of claims 1 to 5, characterized in that the longitudinal bars (15) are bevelled at both ends in such a manner that their smallest length faces the interior of the tank, and are closed by sheet metal pieces (16) integrally formed on the tank heads (11).

10 7. The tank of any of claims 1 to 6, characterized in that the longitudinal bars (15) have their portions facing the interior of the tank surrounded by part-cylindrical sleeves (22) consisting of tank material, the longitudinal edges of the sleeves located outside the tank jacket being welded to the longitudinal bars (15).

15 8. The tank of any of claims 1 to 7, characterized in that the tank jacket is composed of four shells (10) the axes of which define the corners of a rectangle, and that the jacket shells (10) are made of rolled metal sheets which are curved transversely of the rolling direction and extend as single pieces across the entire length of the tank jacket.

20 9. The tank of any of claims 3 to 8, characterized in that the tubular longitudinal bars (15) and tie rods (18, 19) are parts of a closed tube system for conducting a heating or cooling medium.

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