

CONTAINER FOR THE TRANSPORT OF A SUBSTANCE
IN SOLID CONDITION

The present invention relates to a container for the transport of a substance in solid condition having a melting point above ambient temperature such as bitumen, comprising an essentially parallelepipedical enclosure which receives said substance in liquid condition, permitting said substance to cool down before or during transport, said container further comprising a means for reheating the substance comprised in said enclosure.

Bitumen has the characteristic to be solid at ambient temperature and to become liquid at a higher temperature such as e.g. 160°C. One may therefore easily transport it at ambient temperature but it needs to be heated in order to flow into a transport container; also, it needs to be heated until liquification in order to be extracted therefrom.

Today, transportation of solidified bitumen is currently carried out in containers. In order to extract the bitumen thereafter from the container, it needs to be liquified. To this end a tube has previously been introduced at the bottom of a standard container before its filling, which permits to pass a heating fluid, which permits to fuse the mass of bitumen within about 24 hours. This method has a low thermal efficiency and needs a long heating time.

European patent application 0101635 describes a container for the transport of bitumen, which comprises a heating tube permanently disposed at the bottom of the container in meander configuration, whereby entry and exit openings of said tube traverse the vertical walls of the container, to permit the mounting of a source of heating fluid at the proximity of the entry opening in the vertical wall near the bottom of the container.

The heating surface of this tube which is in contact with the bitumen is configured such that it creates a positive interlocking of the tube within the solid bitumen, and consequently, the block of solid bitumen stays essentially immobile relative to the tube, during heating up, and the

liquification is carried out such that the dissipated heat from the tube needs to traverse the entire layer of the already liquified portion of the bitumen before reaching the solid bitumen. This represents a very inefficient heat transport because the layer of liquid bitumen acts as a thermal resistance which slows down the heating and, consequently, the liquification of the bitumen.

Fig. 5 represents a graphic of the liquification of the bitumen such as obtained with a container according to the European document described above, whereas Fig. 6 illustrates such a graphic according to the present invention.

In order to eliminate the drawbacks of the prior art, the container of the invention is characterized in that the heating means for the substance comprises a meandering tube for the passage of a heating fluid, which is arranged such that straight portions of the tube are abutting each onto an adjacent one, having a common and continuous upper surface or wall which constitutes a bottom wall of the parallelepipedical enclosure, which surface is essentially flat and extends over the entire bottom of the enclosure.

According to a particular embodiment of the present invention, the upper, essentially flat wall is slightly inclined with regard to the horizontal plane, and the enclosure comprises an exit opening immediately adjacent to the lowest point of the inclined surface.

The upper, essentially flat wall of the meander may comprise at least two flat portions of different inclination forming at least one inclined line of intersection between the two portions of the surface which line has its lowest point near the exit opening.

The meandering tube for the heating fluid may comprise at least one entry opening and at least one exit opening for the heating fluid, which may be a combustion gas.

The entry opening of the meander may be provided with a means for establishing communication with the exit of a gas or oil combustion device, and this means may e.g. be executed as a fixation member for such device.

According to a preferred embodiment of the present invention, the meander comprises, near its entry opening, a combustion chamber having walls which are different from the walls forming the tubes of the heating fluid, which combustion chamber may be constituted of a cylindrical wall, the length of which is at least as long as the flame of the gas or oil burner.

The continuous upper surface or wall of the meander may comprise a rectangular shape, extending across the entire bottom of the enclosure, whereby the exit opening of said enclosure may be located at the center, in corners or at any desired point of the short side of said rectangle.

The exit of said enclosure may be located at a corner of said rectangle and the line of intersection between the two inclined flat portions of the continuous surface, i.e. of the upper wall of the meander, is leading to this same point and has its lowest point also in this corner.

The entry of the meander may be located at the center of the short side of said rectangle and the meander may be constituted of a central conduit which traverses essentially the length of the container, and of at least one return conduit on each side of the central conduit.

The exit(s) may be connected to vertical conduits which traverse the container in vertical manner adjacent to the corners thereof which are formed by intersections of the vertical walls of the container which are adjacent and perpendicular to each other, whereby said vertical conduits may have rectangular or round cross sections.

The heating means may comprise a symmetrical deflector which is arranged at the communication between the central conduit and its return conduits in order to avoid excessive turbulences and overheating of the wall portions of the meander in the area of this communication.

In order to better understand the characteristics and the advantages of the present invention, an embodiment will now be described with reference to the drawings wherein

Fig. 1 illustrates a top view of an embodiment of the present invention.

Fig. 2 is a transversel sectional view along line 2-2 of the container of Fig. 1,

Fig. 3 is a longitudinal sectional view along line 3-3 of the same container,

Figs. 4 and 4a represent two other embodiments of a container according to the present invention,

Fig 5 is a graphic of the liquification of bitumen in a container according to the prior art, and

Fig. 6 is a graphic of the liquification of bitumen in a container according to the present invention.

In Fig. 1 one can see a container 1 from above, having the characteristic rectangular parallelepipedical shape, its side walls being designated with reference numbers 5 and 5'.

In the sectional view of Fig. 2, one can see the heating means which comprises an upper surface or wall 2 and a lower wall 3 which form, together with the vertical separation walls 15, a meander-like conduit. The upper wall 2 carries the substance to be transported, such as bitumen, and is supported by the vertical and longitudinal separation walls 15 on the lower wall 3. The free space which forms the meander-like conduit between the upper and lower walls 2 and 3 is adapted to receive the heating fluid. This heating fluid may be created by a (non represented) gas or oil burner which injects the flame or the combustion gases through an entry opening 6 for the heating fluid directly through a short side wall 5' of the container into the meander. Since the meander is constituted of sections 9 arranged side-by-side, the heating fluid is forced to pass under the total surface of the upper wall 2. The combustion gases are preferably evacuated from the end of the meander through a vertical conduit or chimney 8 which is in lateral contact with the material to be heated and which extends beyond the maximum height thereof. The chimney 8 may be in contact with a lateral wall 5. The combustion gases exit through an opening 7 on top of the chimney 8.

In order to save energy, and to obtain, thus, a more rapid and energetic heating for a given type of heating means, the lower wall 3 is covered with a thermal insulation 10.

For the discharge of the liquified material one has provided an opening 4 in the lateral wall 5' of the container 1 at the level of the upper surface of the upper wall 2. Discharge may be facilitated by inclining the bottom such that opening 4 constitutes the lowest point of the bottom. In Fig. 2 one can see the exit opening 4 located at the lowest point of the container on line 63 which is constituted by the bottom of a very flat V, obtained by inclinations 12 which are symmetrical to the center axis, said inclinations being formed by portions 2' and 2" of wall 2. In Fig. 3 one can see that the totality of the meander formed by walls 2 and 3 is laterally inclined, following an inclination 11, to the side where the exit opening 4 is located. Inclinations 11 and 12 may be combined in the same container or only one of them may be provided. Opening 4 is generally closed by a (non-illustrated) stopper and is opened only for discharge of the substance after it has been heated to liquification.

Fig. 4 shows another embodiment of the heating means, wherein the meander is constituted of a central conduit 64, and two return conduits 64' one on each side of the central conduit. Central conduit 64 comprises next to the entry 20 a combustion chamber 21 which is constituted of a cylindrical wall 21', the diameter of which corresponds to the vertical distance between the lower and upper walls of the heating means and its length being dimensioned such as to guarantee that the flame of the (non represented) burner is kept within the combustion chamber 21.

The heating means comprises a deflector 22 which is arranged at the short side of the container and opposite of the entry opening 20 of the combustion chamber, which deflector serves to diminish the turbulences during the change of direction of the gaz flow exiting from the central conduit 64 and turning into the return conduit 64' in the area of the turns 22'.

At the ends of the return conduits 64' are indicated the vertical conduits 8, the exact position of which may be selected in order to optimally locate the (non-represented) exit from the

enclosure which is arranged at the level of the upper wall of the heating means.

Fig. 4a shows an embodiment of the present invention similar to Fig. 4, however, having the meander slightly modified. Here, the central conduit 64 is followed by two return conduits 64' which are in turn followed by two second return conduits 64''. This geometry permits to arrange the chimneys 8, through which the heating fluid may escape, close to the rear wall 5b, which is oppositely located to wall 5a through which the heating fluid is introduced by means of the burner.

Fig. 5 schematically illustrates consecutive phases of the re-liquification of the solid material 52 within the enclosure 50. As illustrated in phase a, the enclosure is filled with solid material 52 with the exception of a free space 51. The enclosure 50 comprises a heating tube 54, whose snake-like configuration produces three sections such as illustrated in all phases a-e of Fig. 5.

Phase b illustrates a point in time shortly after the beginning of the heating whereby only a thin layer 55 is liquified around the tubes 54.

In phase c the liquified layers around conduits 54 have become thicker, such that the non liquified portions between the parallel sections of the conduit 54 reach their minimum thickness. Until here, the block 52 of solid material has not moved and is still in intimate contact with the side walls of the enclosure.

Continuation of the heating will completely liquify portions 56 (phase c) and at that moment, block 52 of solid material which has always been supported on the bottom of the enclosure will begin to seek its lowest point due to the fact that the specific density of the solid material is higher than the one of the liquid material. This downward movement of the solid block 52 is only possible after formation of interstices 57 at the interface between the block 52 and the vertical side walls of the enclosure, which interstices permit that the liquified material passes on top of the solid block.

In phase e, block 52 is shown in its lower position in which a layer 59 of liquid material which has passed on top of

the solid block through the interstices 57 has been formed above the block.

It is evident that the heat which is dissipated from the conduits 54, is destined to be absorbed within the block 52 in order to obtain its liquification, has always to cross a relatively thick layer of already liquified material such as layer 55 which acts as thermal resistance to the transport of heat from the conduit 54 to the solid block 52. Liquification of a solid material within an enclosure having heating tubes arranged at random location within the enclosure is therefore always of low efficiency and requires excessive energy consumption as well as a long duration.

Fig. 6 illustrates the same phases in the liquification of solid material in an enclosure 50 having a heating means 62 according to the present invention which is schematically illustrated as having a perfectly flat upper wall 2, it being understood that liquification occurs in exactly analogous manner on an upper surface comprising slightly inclined portions.

In phase a one can see the solid block 52 which fills the enclosure 50 except for a small free space 51.

Phase b shows the conditions within the enclosures after a certain initial heating time during which a thin layer 60 between upper wall 2 and block 52 has been formed as well as small interstices 57 at the interface between block 52 and the vertical side walls of the enclosure, which interstices 57 have been formed by the passage of liquified material formed in layer 60. Since the lower surface of the block 52 is uniformly heated over its entire surface, the liquid material which is present within slot 60 is immediately subjected to a pressure created by the weight of the block 52, which facilitates the passage of the liquid material through existing crevisses between the block 52 and the vertical side walls of the enclosure, whereby this forced passage quickly creates interstices 57, the increase of which permits the essentially free passage of liquid material from the lower surface of the block 52 toward the top of the enclosure.

Phases c, d and e show the diminishing of block 52 during continuation of the heating, during which the lower surface of

the block 52 will always stay in very good thermal contact with the upper wall 2 of the heating means 62, thanks to which the heat which is dissipated from the wall 2 is transmitted into the block 52 in the most rapid and efficient way. Thus, the required duration for liquifying the block 52 within an enclosure 50 according to Fig. 6 is considerably shorter than the time required for a heating means such as illustrated in Fig. 5.

Line 63 may be arranged according to the location of flow exit opening 4.

It is clear that other improvements, such as the insulation of side walls 5 of the container may additionally be applied.

The containers 1 are constructed, besides the above mentioned particularities, according to conventional techniques usual for these types of products, with longitudinal and transversel profiles 13 and 14 in order to provide the container with a rigid bottom, as well as with angle pieces 16 and side walls 5.

As example, one may indicate the following dimensions :

length of the container :	6,0 m
height :	2,0 m
width :	2,4 m
height of the meander :	10 to 12 cm
width of the meander conduits :	29 cm
thickness of insulation 10 :	4 cm
diameter of opening 6 :	12 cm
diameter of opening 4 :	8 cm

The substance to be transported in such containers has been indicated as bitumen. Naturally, other substances which are solid or pasty at ambient temperature and liquid at higher temperatures may also be transported in such containers. Exemples for such materials are tar, paraffin, wax or polyethylen-glycol.



CLAIMS

1. Container for the transport of a substance (52) in solide condition having a melting point above ambient temperature such as bitumen, comprising an essentially parallelepipedical enclosure (50) which receives said substance in liquid condition, permitting said substance to cool down before or during transport, said container further comprising a means (62) for reheating the substance comprised in said enclosure, characterized in that the heating means for the substance comprises a meandering tube for the passage of a heating fluid, which is arranged such that straight portions (9) of the tube are abutting each onto an adjacent one, having a common and continuous upper surface or wall (2) which constitutes a bottom wall of the parallelepipedical enclosure (50), which surface is essentially flat and extends over the entire bottom of the enclosure.

2. Container according to claim 1, characterized in that the upper, essentially flat wall (2) is slightly inclined with regard to a horizontal plane, and the enclosure (50) comprises an exit opening (4) immediately adjacent to the lowest point of the inclined surface.

3. Container according to claim 2, characterized in that the upper, essentially flat wall (2) of the meander comprises at least two flat portions (2', 2'') of different inclination, presenting an inclined line of intersection between the two portions of the flat surface which line has its lowest point near the exit opening (4).

4. Container according to any one of claims 1-3, characterized in that the meander of conduits (9) for the heating fluid has at least one entry opening (6) and at least one exit opening for the heating fluid.



5. Container according to claim 4, characterized in that the conduits (9) for the heating fluid are conduits for a combustion gas.

6. Container according to claim 1, characterized in that the entry opening of the meander is provided with a means for establishing communication with the exit of a gas or oil combustion device.

7. Container according to claim 5 or 6, characterized in that the meander comprises, near its entry opening (6, 20) a combustion chamber (21) having walls which are different from the walls forming the tubes (9) of the heating fluid.

8. Container according to claim 7, characterized in that the combustion chamber (21) comprises a cylindrical wall (21'), the length of which is at least as long as the flame of the gas or oil burner.

9. Container according to any one of claims 3-8, characterized in that the continuous upper surface (2) of the meander comprises a rectangular shape, whereby the exit opening (4) of said enclosure (50) is located at the center, in a corner or at any desired point of the short side (5') of the rectangle.

10. Container according to claim 9, characterized in that the exit of said enclosure (50) may be located at a corner of said rectangle and the line of intersection (63) between the two inclined portions (2', 2'') of the continuous upper wall (2) of the meander is leading to this same point and has its lowest point also in this corner.

11. Container according to claim 10, characterized in that the entry (20) of the meander is located at the center of the short side (5') of said rectangle and the meander is constituted of a central conduit (64) which traverses essentially the length of the container, and of at least one return conduit (64') on each side of the central conduit (64).



12. Container according to any one of claims 1-11, characterized in that the exits (65) of the meander are connected to vertical conduits (8) which traverse the container in vertical manner adjacent to the corners thereof which are formed by intersections of adjacent vertical walls (5, 5') which are perpendicular to each other.

13. Container according to claim 12, characterized in that said vertical conduits (8) have rectangular or round cross section.

14. Container according to claim 11, characterized in that it comprises a symmetrical deflector plate (22) which is arranged at the communication points between the central conduit (64) and the return conduits (64') in order to avoid excessive turbulences and overheating of the walls of the meander and these communication points.