Dec. 15, 1959 M. MENDELSOHN ET AL 2,917,293

BUBBLE TOWER AND TUNNEL TRAY CONSTRUCTION

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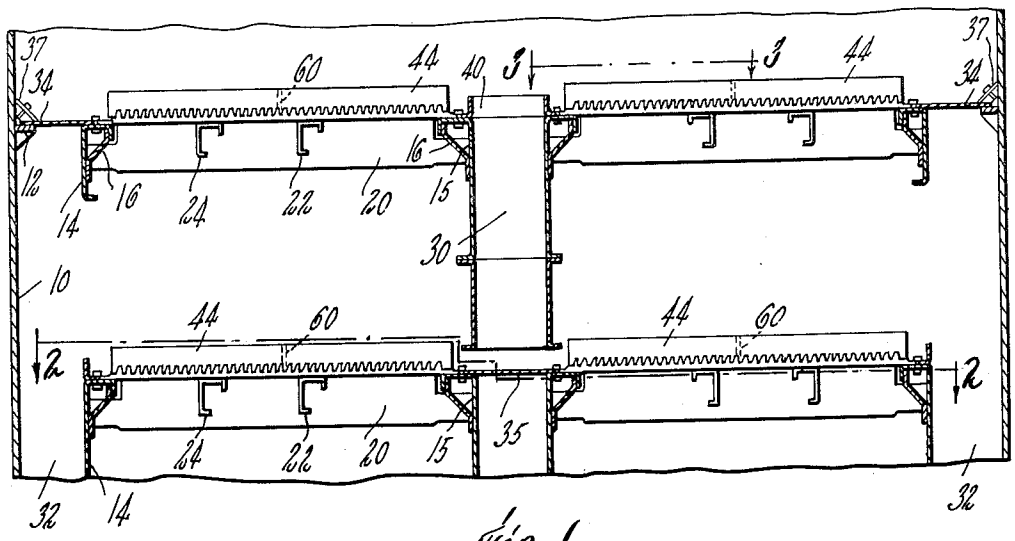


Fig. 1.

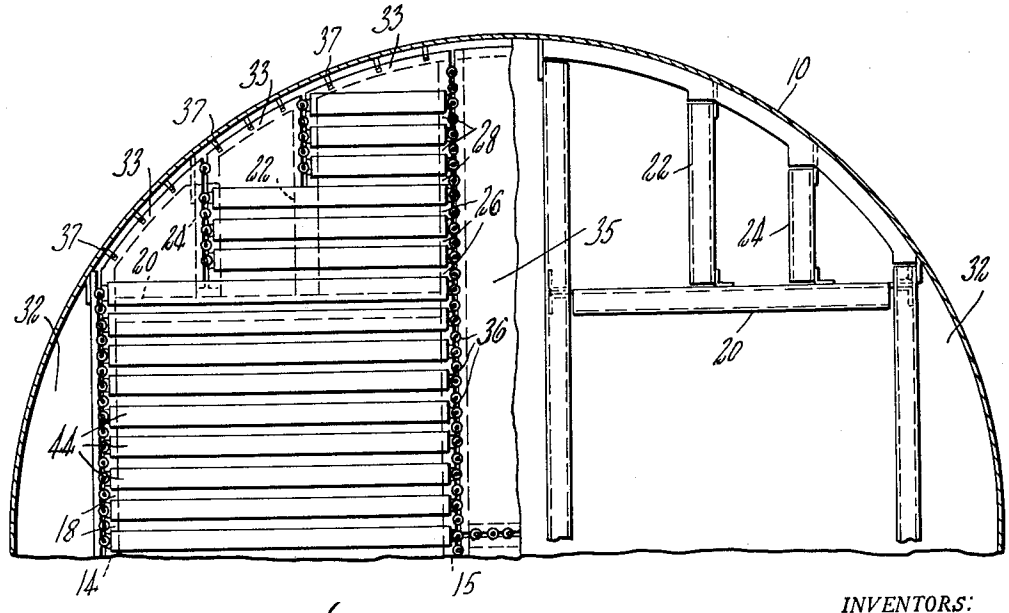


Fig. 2.

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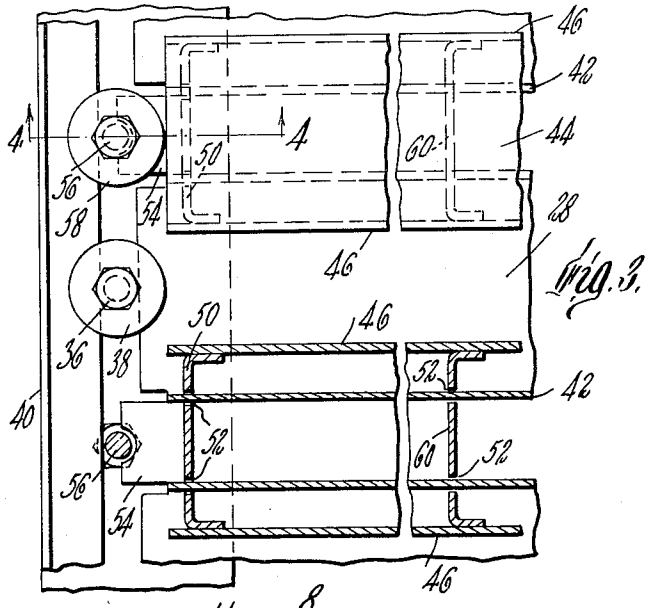


Fig. 3.

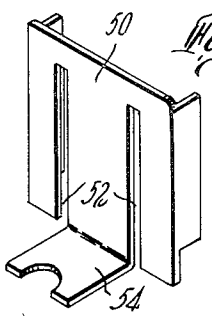


Fig. 6.

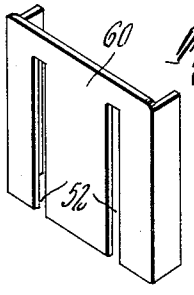


Fig. 7.

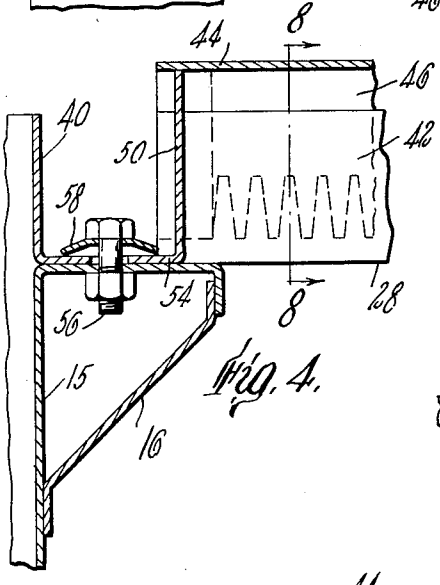


Fig. 4.

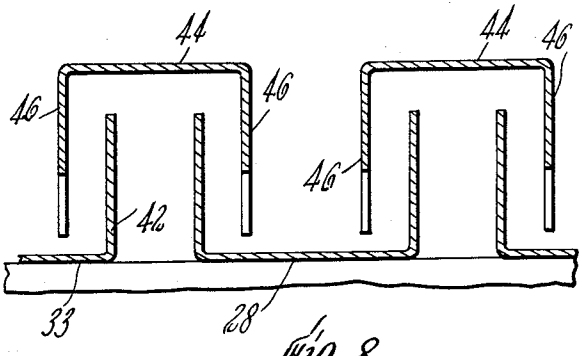


Fig. 8.

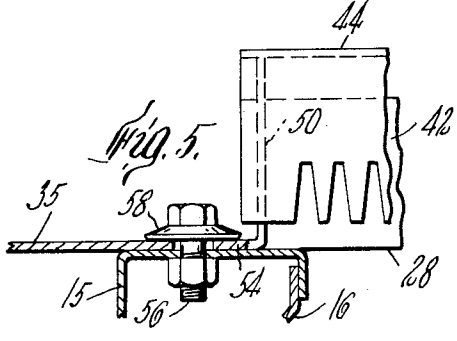


Fig. 5.

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BUBBLE TOWER AND TUNNEL TRAY CONSTRUCTION

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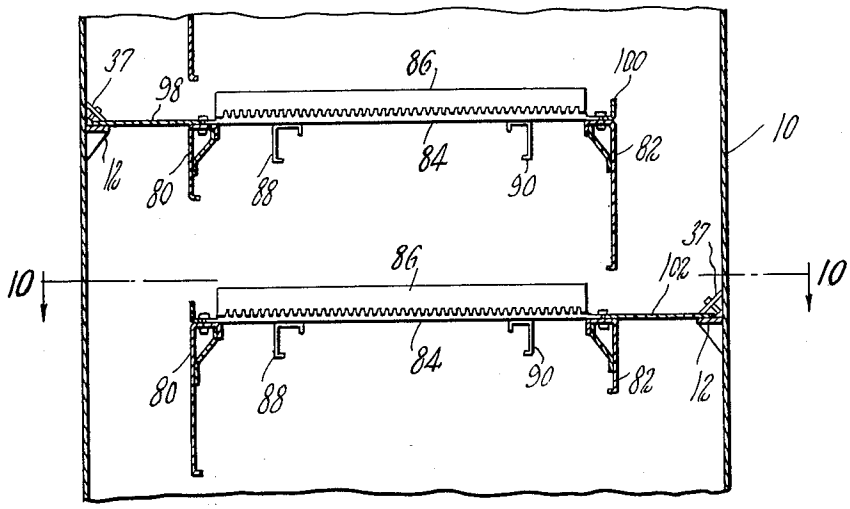


Fig. 9.

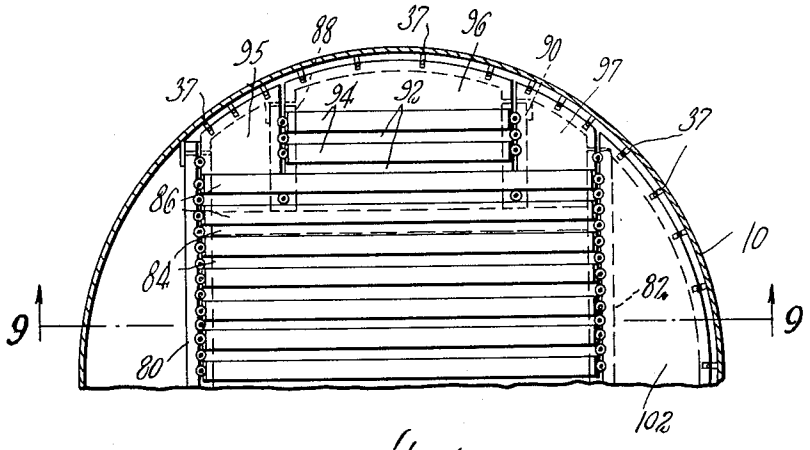


Fig. 10.

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BUBBLE TOWER AND TUNNEL TRAY CONSTRUCTION

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Application October 28, 1955, Serial No. 543,478

2 Claims. (Cl. 261—114)

This invention relates to a bubble tower for fractional distillation of liquid materials such as hydrocarbon liquids and pertains more specifically to a bubble tray construction of the tunnel type for use in such towers.

One object of the invention is to provide a bubble tray construction having elongated tunnel-type bubble caps in which the individual bubble caps are frictionally secured to the supporting purlins or beams of the tray to permit independent expansion and contraction of each bubble cap with respect to the rest of the tray.

Another object is to provide a bubble tray construction of simplified and inexpensive construction having parallel tunnel-type bubble caps and having improved operating efficiency.

Still another object is to provide a bubble tray and tower having tunnel-type bubble caps constructed and arranged to permit differential expansion and contraction of the tray in two dimensions.

Other and further objects will be apparent from the drawings and the description which follows.

Although bubble tray constructions having tunnel-type bubble caps have previously been known, the constructions of the prior art have permitted the bubble caps to cover only a limited fraction of the total area of the tray, resulting in undesirably low operating efficiency of the tray. Furthermore, such constructions have failed to provide for differential expansion and contraction of the several parts of each tray with respect to each other as the temperature within the tower fluctuates. Inasmuch as such bubble towers are normally operated at relatively high internal temperatures, considerable expansion and contraction of the tower and of the trays themselves occurs when the tower is placed in operation and when operation is interrupted for repairs or for any other reason. Unless suitable provision is made for such expansion and contraction, warpage and distortion of the trays may occur, resulting in leakage and decreased efficiency of operation.

The construction of the present invention overcomes these deficiencies and provides a bubble tray construction which permits extensive thermal expansion and contraction without distortion or warpage of the tray and which, in addition, permits relief of pressure surges which may occur in the tower during normal operation with a minimum of disturbance to the tray construction.

In the drawings:

Fig. 1 is a view in vertical section of a portion of a bubble tower constructed in accordance with the present invention showing two of the bubble trays;

Fig. 2 is a plan view of a portion of the lower bubble tray of Fig. 1, partly broken away;

Fig. 3 is a plan view on an enlarged scale, partly broken away, along the line 3—3 of Fig. 1;

Fig. 4 is a view in vertical section along the line 4—4 of Fig. 3;

Fig. 5 is a view similar to Fig. 4 showing a tunnel tray in side elevation and showing the manner in which the flat deck members are secured to the supporting purlins;

Fig. 6 is an isometric view of an end closure for a bubble cap;

Fig. 7 is an isometric view of an intermediate stiffener for a bubble cap;

Fig. 8 is a view in vertical section along the line 8—8 of Fig. 4;

Fig. 9 is a view in vertical section of a portion of a bubble tower of the present invention showing the trays arranged for single cross-flow; and

Fig. 10 is a plan view of the lower tray of Fig. 9.

Referring to the drawings, a complete tower, it will be understood, will include a large number of vertically spaced trays, only two of which are shown in the embodiment of Fig. 1. The tower comprises a generally cylindrical wall **10**, on the inner face of which are secured at vertically spaced intervals tray support members **12, 12** which may be secured in place by riveting, bolting, welding, or any other suitable means. At the level of each supporting member **12** a suitable number of supporting beams or purlins **14, 15** extend across the tower in spaced generally parallel relationship, the beams being supported at their ends from brackets secured to wall **10** or supported by supporting member **12**. Beams or purlins **14, 15** preferably are constructed of relatively thin sheet metal channel members which may be provided with strap reinforcements **16, 16** at intervals along their length. Resting upon purlins **14, 15** and extending transversely thereof is an array of generally parallel laterally spaced open-ended trough members **18, 18** having imperforate bottoms and upwardly extending marginal flanges along their length. In order to facilitate construction, these trough members are of uniform length throughout the central portion of the tray, spanning the space between purlins **14, 15**. In order to permit maximum utilization of the tray area, the marginal portions of the tray are preferably provided with auxiliary purlins **20, 22, 24** (see Fig. 2) to support progressively shorter sets of trough members **26, 26, 28, 28**. A central downcomer **30** may be provided in alternate trays, as shown in the upper tray of Fig. 1, while intervening trays are provided with side downcomers **32, 32** to provide a split flow tower. The remaining areas of each tray comprise flat deck members **33, 34, 35** which rest upon and are supported by the purlins and supporting members **12**, the outer margins being frictionally clamped to supporting members **12** by means of angle rim clamps **37, 37**. The margins of flat deck members **33, 34, 35** adjacent the ends of trough members **18, 26, 28** are spaced therefrom by a small gap extending along the top of each purlin.

Each end of each trough member **18, 26, 28** is frictionally secured against the upper face of its respective supporting purlin by means of a bolt **36** extending through the top of the purlin in the gap between the end of the trough members and the adjacent margin of the flat deck member, bolt **36** carrying a cupped washer **38** which bridges the gap and frictionally bears against the upper face of the trough member and the deck member. The trough members and deck members thus are free to slide beneath washers **38** as they expand or contract with changing temperatures. In those areas where a downcomer is provided, angle member **40** replaces the flat deck member and serves as a weir for maintaining the desired liquid level in the trough members.

The margins of flat deck members **33, 33** which are adjacent the sides of the last or end trough members in the array are provided with upwardly extending marginal flanges **42, 42** which are spaced from the end trough member as shown in Fig. 8.

It will be understood that in alternate trays of the tower, the space occupied by central downcomer **30** will be filled by imperforate flat deck member **35**. Similarly, the spaces occupied by side downcomers **32, 32** will be

filled by imperforate flat deck members 34, 34. The marginal portions of these flat deck members are secured to tray support members 12 by means of frictional angle clamps 37, 37. This arrangement, as shown in Figs. 1 and 2, provides that liquid descending through the tower from tray to tray will pass downwardly through central downcomer 30 then flow laterally across the tray through trough members 18 to side downcomers 32, 32 of the tray next beneath. From that tray the liquid descends to the next lower tray through the side downcomers, then flows through the trough members 18, 18 across the tray to central downcomer 30.

Mounted above and extending substantially the full length of the trough members are elongated tunnel-type bubble caps 44, 44 which consist of inverted troughs spanning the space between adjacent trough members 18, 26, 28 and having marginal flanges 46, 46 extending downwardly into trough members 18, 26, 28 toward the bottom thereof. Marginal flanges 46, 46 may be provided with serrated or notched edges or may be perforated to facilitate mixing of the vapor issuing therefrom with the liquid contained in the trough members 18, 26, 28, or they may be left plain. Bubble caps 44, 44 are provided with end closures 50, 50 secured by welding or any other suitable means adjacent each end of the bubble cap. Each end closure 50 is provided with a pair of spaced vertical slots 52, 52 adapted to receive upwardly extending marginal flanges of two adjacent trough members 18, 26, 28, the slots 52, 52 being oversize to permit limited lateral movement of adjacent trough members with respect to each other and with respect to bubble cap closures 50. Each end closure 50 in addition is provided with a flange 54 extending outwardly from its lower margin between slots 52, 52 over purlins 14, 15 to terminate in spaced relation from the margin of flat deck members 33, 34, 35 or weir 40 as the case may be. Flanges 54, 54 are frictionally secured to the top of purlins 14, 15 in the same manner as trough members 18, 26, 28 by means of bolts 56 and cupped washers 58 as shown in Fig. 4. Accordingly bubble caps 44 are free to expand and contract longitudinally with respect to purlins 14, 15 independently of each other and of the trough members. Bubble caps 44 are also free to move slightly laterally with respect to each other and with respect to the trough members by reason of the clearance in slots 52, 52. This arrangement accordingly permits expansion and contraction of the tray in two dimensions.

It should be noted that the number of bubble caps in the array is one more than the number of trough members, and that the end bubble caps of the array span the space between the last or end trough members and the adjacent flat deck member 33 with its upwardly extending marginal flange 42.

In the case of relatively long bubble caps such as those spanning trough members 18 near the center of the tray, it is desirable to provide intermediate stiffeners 60, 60 which consist simply of webs similar to end closure 50 provided with upwardly extending slots 52, 52 for receiving the margins of adjacent trough members. In the case of the intermediate stiffeners, of course, flanges 54 are omitted.

The construction of Figs. 9 and 10 shows a single cross-flow arrangement of the trays. In this construction a pair of spaced parallel main purlins 80, 82 supports an array of spaced parallel trough members 84, 84 and bubble caps 86, 86 identical in construction with those shown in Figs. 1 to 8. A pair of short auxiliary purlins 88, 90 is provided to supoprt an array of shorter trough members 92, 92 and bubble caps 94, 94, thus providing maximum coverage of the tray area with bubble caps. The remaining small areas at each end of the array of bubble caps are covered with flat deck members 95, 96, 97 similar to flat deck members 33, 33 of

Figs. 1 to 8 secured with frictional clamps 37, 37. The upper tray of Fig. 9 is provided with flat deck member 98 spanning the space between purlin 80 and the adjacent wall of the tower, while the space between purlin 82 and the adjacent wall forms a downcomer, weir 100 being provided to maintain the liquid at the desired level on the tray. The next lower tray in Fig. 9 is provided with flat deck member 102 between purlin 82 and wall 10, immediately beneath the downcomer of the tray above, while the downcomer of the lower tray is arranged at the opposite side of the tray, between purlin 80 and wall 10. This arrangement of successive trays is repeated throughout the tower. Accordingly, the liquid flow is from left to right across the upper tray and from right to left across the lower tray of Fig. 9. It should be noted that in the case of the construction shown in Figs. 9 and 10 as well as in the case of the construction shown in Figs. 1 to 8 the flow of liquid is parallel to the trough members and bubble caps.

It will be apparent from the foregoing description that in the event of a sudden surge of pressure in the tower during operation, flat deck members 33, 34, 35 which are frictionally held along their margins by means of washers 38, 58 and clamps 37 may pull free, thus relieving the pressure with a minimum of distortion and damage to the tray and tower as a whole.

Although specific embodiments of the invention have been described herein, it is not intended to limit the invention solely thereto, but to include all of the obvious variations and modifications within the spirit and scope of the appended claims.

We claim:

1. A lightweight bubble tray construction capable of differential expansion and contraction both lengthwise and widthwise comprising a plurality of supporting purlins, a plurality of generally parallel open-ended sheet metal trough members extending transversely of said purlins and having flat bottom end portions frictionally clamped to the top of said purlins to permit independent expansion and contraction of each trough member with respect to the purlins, each trough member being laterally spaced from the adjacent trough members throughout its length, a plurality of sheet metal bubble caps, each bubble cap comprising an inverted trough extending substantially the full length of and spanning the space between a pair of adjacent trough members and being mounted in spaced relation thereabove throughout its length with its lateral margins extending downwardly into said trough members toward the bottom thereof, means for closing both ends of said bubble caps and of the spaces between the trough members comprising a sheet metal closure member secured to said bubble cap adjacent each end thereof having a pair of spaced slots extending upwardly from its lower edge adapted to receive loosely the spaced marginal portions of a pair of adjacent trough members and having a flange extending outwardly from its lower margin to rest on said purlin, and means for frictionally clamping each flange to the top of a purlin to permit independent expansion and contraction of each bubble cap with respect to the purlins.

2. A lightweight bubble tray construction capable of differential expansion and contraction both lengthwise and widthwise comprising a plurality of supporting purlins, a plurality of generally parallel open-ended sheet metal trough members extending transversely of said purlins and having flat bottom end portions frictionally clamped to the top of said purlins to permit independent expansion and contraction of each trough member with respect to the purlins, each trough member being laterally spaced from the adjacent trough members throughout its length, a plurality of sheet metal bubble caps, each bubble cap comprising an inverted closed-end trough extending substantially the full length of and spanning the space between a pair of adjacent trough

members and being mounted in spaced relation thereabove throughout its length with its lateral margins extending downwardly into said trough members toward the bottom thereof, each said bubble cap including means for closing the spaces between the trough members adjacent each end thereof comprising a closure member secured to said bubble cap adjacent each end thereof extending loosely between the spaced marginal portions of a pair of adjacent trough members and having a flange extending outwardly from its lower margin to rest on said purlin, and means for frictionally clamping each flange to the top of a purlin to permit independent expansion and contraction of each bubble cap with respect to the purlins.

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