Feb. 8, 1966 M. C. GLITSCH 3,233,708

VAPOR-LIQUID CONTACT TRAYS

Filed Oct. 15, 1962

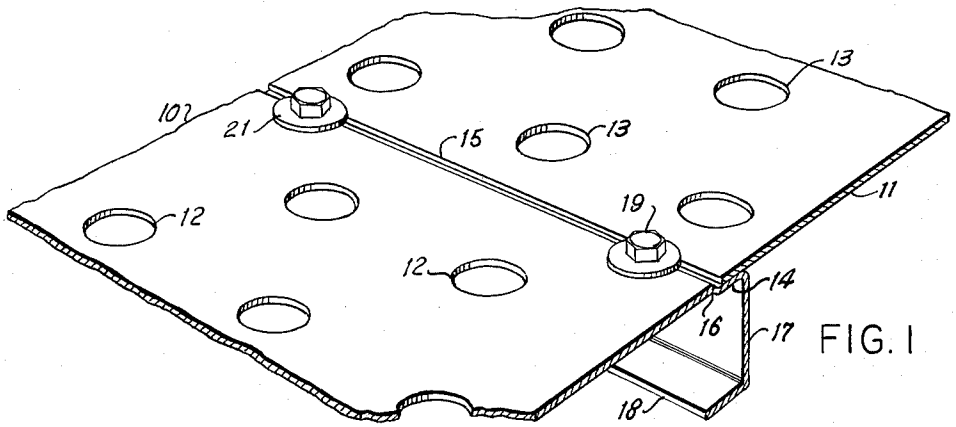


FIG. 1

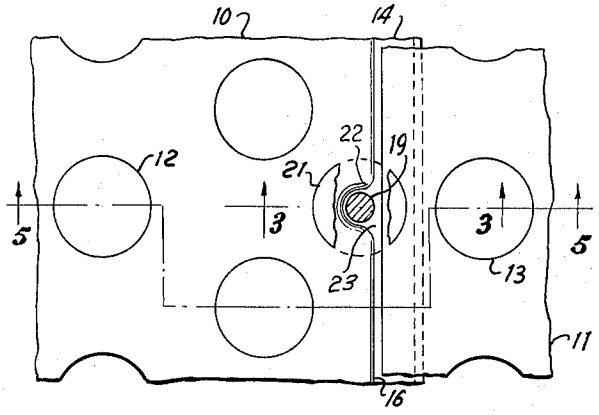


FIG. 2

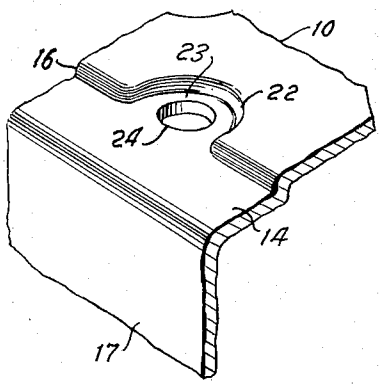


FIG. 4

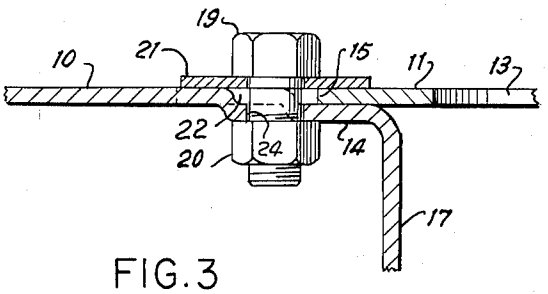


FIG. 3

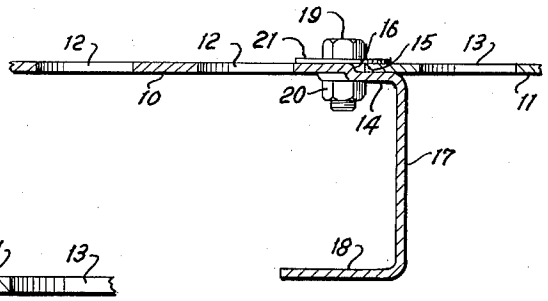


FIG. 5

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VAPOR-LIQUID CONTACT TRAYS

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This invention relates to new and useful improvements in vapor-liquid contact trays and more particularly to tray sections having offset, overlapping edge portions.

It is customery to fabricate vapor-liquid contact trays in relatively narrow sections to facilitate the installation of the trays in fractioning towers and other refining vessels. Frequently, it is necessary to pass the tray sections through the manways of the refining vessels, particularly, when the trays thereof are being replaced. These trays have a plurality of openings for accommodating the upward flow of ascending vapor through said trays for contact with the liquid which flows across said trays and downwardly from tray to tray. The openings may be merely perforations, which permit the downward flow of liquid as well as the upward flow of vapor, or may have bubble caps, valve elements or other flow control means associated therewith. In most instances, the openings are equally spaced and arranged in parallel rows so as to uniformly distribute the ascending vapor and its contact with the liquid on the trays.

Due to the use of sectional trays, it is necessary to provide expansion joints in order to permit thermal expansion and contraction of the tray sections without buckling and separation thereof. Also, it is highly desirable, if not essential, to maintain the upper surface of each tray in a common plane and this may be accomplished by offsetting one of the edge portions of the tray sections to support the adjacent edge portions of other tray sections in parallel, coplanar relationship. In any event, it is necessary to space the coplanar portions of adjacent tray sections and to utilize frictional fasteners in order to permit relative movement of the sections upon thermal expansion and contraction and, at the same time, maintain uniform spacing of the vapor openings and to also minimize loss of available area for vapor openings. Heretofore, the expansion joints have utilized valuable area and restricted the minimum spacing of the openings since non-uniform spacing permits channeling of the liquid and lack of contact of a portion thereof with the vapor.

It is, therefore, one object of the invention to provide an improved vapor-liquid contact tray formed in sections having offset, overlapping edge portions so as to be disposed in coplanar relationship wherein the coplanar portions of adjacent tray sections are closely spaced to permit minimum spacing between the vapor openings contiguous the overlapping edge portions of the tray sections.

Another object of the invention is to provide an improved vapor-liquid contact tray, of the character described, wherein one of adjacent tray sections has its edge portion offset downwardly to support the other tray section in parallel, coplanar relation to the major portion of the first tray section, the downward offsetting of the edge portion extending into said major portion of said first tray section at spaced intervals to accommodate frictional fasteners for clampingly connecting the tray sections with the adjacent edge portion of said other tray section in close proximity to said major portion of said first tray section so that loss of available area for vapor openings is kept to a minimum.

A further object of the invention is to provide an improved vapor-liquid contact tray, of the character described, wherein recesses are formed in the margin of the major portion of the tray section contiguous its downwardly offset edge portion to accommodate the frictional fasteners and permit close spacing of the edge portion of the adjacent tray section relative to said margin whereby the vapor openings of the tray sections may be spaced more uniformly without excessive distance between adjacent vapor openings or rows of vapor openings across the overlapped edge portions of the contiguous tray sections.

A further object of the invention is to provide an improved vapor-liquid contact tray, of the character described, wherein recesses are formed in the margin of the major portion of the tray section contiguous its downwardly offset edge portion to accommodate the frictional fasteners and permit close spacing of the edge portion of the adjacent tray section relative to said margin whereby said frictional fasteners are not subject to excessive bending or distortion by their clamping means and said fasteners can more properly perform their frictional fastening function.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawing, wherein an example of the invention is shown, and wherein:

FIG. 1 is a perspective view of a portion of a vapor-liquid contact tray constructed in accordance with the invention,

FIG. 2 is a plan view of the tray,

FIG. 3 is an enlarged, transverse, vertical sectional view, taken on the line 3—3 of FIG. 2,

FIG. 4 is an enlarged, perspective view showing one of the recesses for the frictional fasteners, and

FIG. 5 is an enlarged, transverse, vertical, sectional view, taken on the line 5—5 of FIG. 2.

In the drawing, the numerals 10 and 11 designate the deck plates or floor sections of a vapor-liquid contact tray of the type used in fractionating towers and other refining vessels and mounted therein by a substantially annular support (not shown). The tray sections are of uniform thickness, being formed of relatively thin or light gauge metal, and are relatively narrow in comparison to their lengths to permit passage thereof through the conventional manways (not shown) of the refining vessel. As shown, a plurality of circular openings or orifices 12 and 13 are formed in the tray sections 10 and 11 to accommodate the upward flow of vapor which ascends through the vessel for contact with the liquid which flows across the tray and downwardly from tray to tray. The openings 12 and 13 may have flow control means (not shown) associated therewith to direct the vapor laterally through the liquid on the tray or may be in the nature of perforations which permit said liquid to descend or "rain" therethrough. In order to uniformly distribute the ascending fluid and prevent channeling of the liquid, it is essential to space the openings as equally as possible. Usually, the openings are disposed in parallel rows with the openings of adjacent rows being staggered or offset relative to one another.

The tray sections 10 and 11 are of the general type shown in Patent No. 2,611,596 and have their adjacent marginal or longitudinal edge portions in overlapping, substantially parallel relationship. An offset, horizontal flange or shoulder 14 is formed by downwardly offsetting the adjacent longitudinal edge portion of one of the tray sections, such as the section 10, a distance substantially equal to the thickness of said sections for underlying and

supporting the adjacent longitudinal edge portion 15 of the other tray section 11 in coplanar relationship whereby the major portions of said sections are disposed in a common plane. The downwardly offset shoulder 14 provides an upright, contiguous margin 16 on the major portion of the section 10 (FIG. 4) in parallel, close proximity to the edge portion 15. For reinforcing and adding rigidity to the tray sections so as to eliminate the necesssity for auxiliary supports, an upright leg or flange 17 may depend from the outer longitudinal margin of the shoulder 14 and have a horizontal leg or flange 18 extending therefrom in underlying relation to said shoulder. A conventional gasket or sealing strip (not shown) may be interposed between the shoulder and the overlying edge portion. It is pointed out that the major portions of the tray sections are substantially flat.

Suitable fasteners 19 are provided for frictionally clamping the adjacent edge portions of the tray sections and may be in the form of bolts, having nuts 20 screw-threaded on their lower ends, with enlarged washers 21 confined beneath the heads of the bolts for overlying said edge portions. These frictional fasteners permit relative movement of adjacent tray sections upon thermal expansion and contraction thereof and may vary in structure as shown in Patent No. 2,611,596. Heretofore, it has been customary for the bolts or other fasteners 19 to extend through openings in the downwardly offset shoulder 14, thereby necessitating the spacing of the edge portion 15 from the margin 16 a distance sufficient to accommodate said fasteners and provide a temperature expansion joint between the adjacent edge portions of the tray sections. As a result, this space has had to be of appreciable width and has materially restricted the minimum spacing of the vapor openings 12 and 13, since said spacing should be uniform to prevent channeling of the liquid and ensure maximum contact thereof with the vapor ascending through said openings. In view of the fact that the vapor openings must necessarily be spaced from the expansion joint, it is essential to uniform spacing of the openings that the space between the edge portion 15 and margin 16 of adjacent tray sections be of minimum width.

A plurality of semi-circular recesses 22 is provided for accommodating the fasteners 19 by offsetting the marginal portion 16 of the tray section 10 downwardly a distance substantially equal to the downward offset of the shoulder 14. As shown most clearly in FIG. 4, each recess 22 has a substantially flat bottom 23 which is coplanar with the shoulder and, in effect, forms a lateral continuation or extension of said shoulder. A circular aperture or opening 24 extends through each recess bottom 23 for receiving one of the bolts 19 and the underside of the recess bottom provides a flat surface coplanar with the underside of the shoulder 14 for engagement by the nut 20 (FIG. 3). This flat surface is necessary in order to prevent canting of the fasteners and binding of the edge portion 15 of the tray section 11, whereby said edge portion may slide between the shoulder and the washer 21 upon relative movement of the tray sections. Due to the provision of the recesses, the edge portion 15 may be clamped by the fasteners in close proximity to the margin 16 of the tray section 10 as well as to the bolts of said fasteners. Also, the recesses 22 permit this close spacing without the necessity of recessing the edge portion 15, which recessing is undesirable because it reduces the surficial area of said edge portion engageable by the washer and requires alinement with the apertures 24.

Since the bottoms 23 of the recesses 22 function as coplanar extensions of the downwardly-offset shoulder 14, the close spacing of the bolts 19 with respect to the edge portion 15 does not interfere with relative sliding movement of said edge portion toward the upright margin 16 upon expansion of the tray sections and contraction of the joint therebetween nor subject the washers 21 to excessive bending or distortion which would prevent said relative sliding movement. In addition, this coplanar relationship permits the underside of the shoulder to be engaged by the lower portions of the frictional fasteners.

From the foregoing, it is readily apparent that the temperature expansion joints between adjacent tray sections are of minimum width and permit minimum spacing between the vapor openings 12 and 13 on opposite sides of said expansion joints. As shown in FIG. 5, this spacing is not much greater than the spacing of the vapor openings of each tray section and permit substantially uniform spacing of all of the tray openings. As a result, the ascending vapor is more evenly distributed for contact with a greater portion of the liquid and channeling of said liquid, due to uneven spacing of the vapor openings, is minimized. Due to the relatively close spacing of the vapor openings on opposite sides of the temperature expansion joints, the vapor openings of each tray section may be more closely spaced so as to permit the provision of a greater number of vapor openings of a given area and more uniform distribution of the ascending fluid.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A vapor-liquid contact tray including at least a pair of sections having adjacent edge portions in overlapping substantially parallel relationship, the sections having substantially flat major portions, a substantially horizontal shoulder on the adjacent edge portion of the first of said sections offset downwardly a distance substantially equal to the thickness of said sections, the major portion of said first section having an upright margin contiguous the horizontal downwardly offset shoulder, the adjacent edge portion of the second of said sections resting on said shoulder in close proximity to the upright margin and supporting the major portion of said second section in coplanar relation to said major portion of said first section, said major portion of said first section adjacent its upright margin being offset downwardly at spaced intervals to provide a plurality of recesses having bottoms substantially coplanar with said shoulder, and frictional fasteners mounted in the recesses in transversely spaced relation to said adjacent edge portion of said second section and overlying said adjacent edge portion of said second section to clamp the same against upward displacement relative to said shoulder.

2. A vapor-liquid contact tray as set forth in claim 1 wherein the frictional fasteners extend through the bottoms of the recesses and have clamp means underlying said recess bottoms.

3. A vapor-liquid contact tray as set forth in claim 1 wherein the frictional fasteners are removably mounted in the recesses and have clamp means overlying the major portion of the first section as well as the adjacent edge portion of the second section.

4. A vapor-contact tray as set forth in claim 3 wherein the bottoms of the recesses have openings spaced transversely from the adjacent edge portion of the second section, the frictional fasteners extending through the openings and having clamp means underlying said recess bottoms.

5. A vapor-liquid contact tray as set forth in claim 1 wherein the bottoms of the recesses have substantially flat undersides, the frictional fasteners extending through said recess bottoms and having clamp means bearing against the undersides of said bottoms.

6. A vapor-liquid contact tray as set forth in claim 1 including an upright flange depending from the outer margin of the horizontal shoulder for reinforcing the adjacent edge portions of the sections.

7. A vapor-liquid contact tray as set forth in claim 1 wherein the sections are in the form of substantially flat plates of substantially uniform thickness.

8. A vapor-liquid contact tray as set forth in claim 7

wherein the bottoms of the recesses have openings spaced transversely from the adjacent edge portion of the second section, the frictional fasteners extending through the openings and having clamp means underlying said recess bottoms and overlying the major portion of the first section as well as said adjacent edge portion of said second section.

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