Dec. 25, 1945. J. M. LARSEN 2,391,464

VAPOR AND LIQUID CONTACT DEVICE

Filed Nov. 21, 1941

Fig. 1.

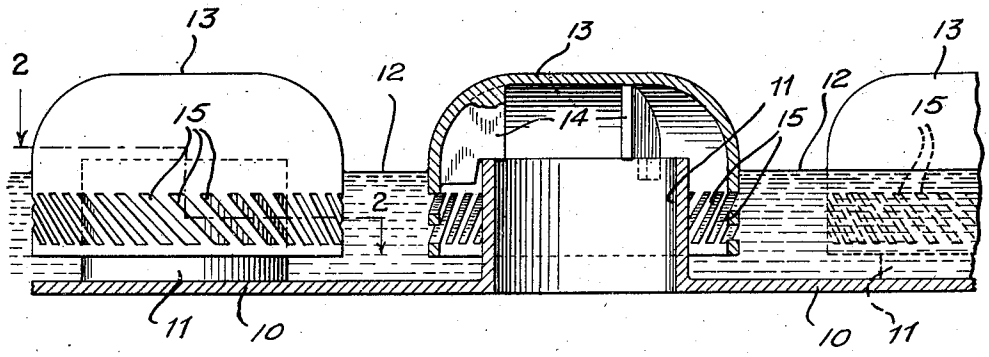


Fig. 2.

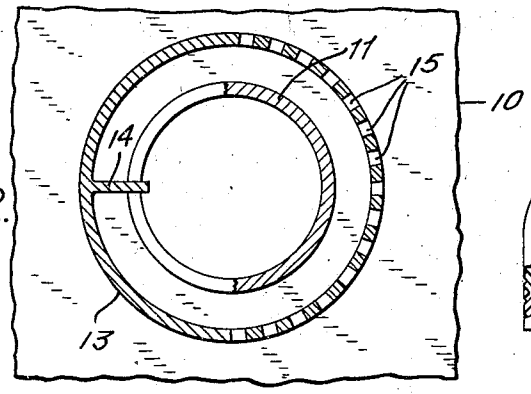


Fig. 3.

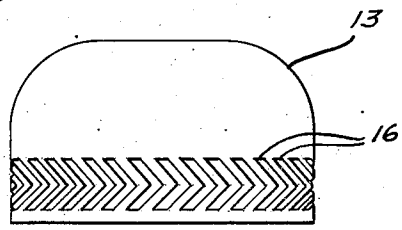


Fig. 5.

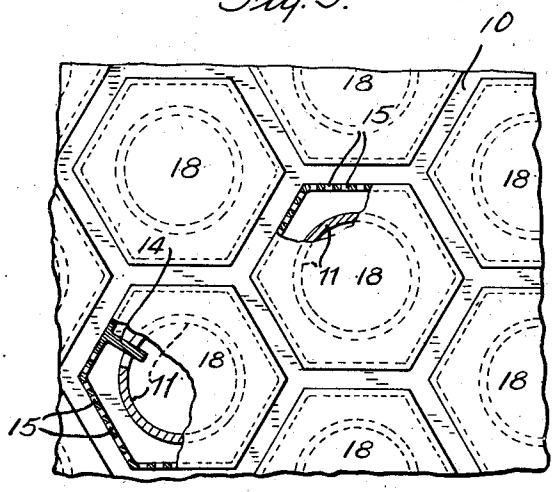
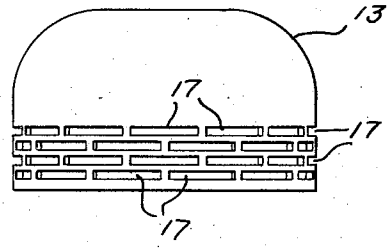


Fig. 4.



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VAPOR AND LIQUID CONTACT DEVICE

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Application November 21, 1941, Serial No. 419,957

8 Claims. (Cl. 261—114)

This invention relates to vapor and liquid contact devices, and more particularly pertains to bubble trays and to caps for the vapor risers thereof.

The invention provides a bubble cap for bubble tray vapor risers which insures a more intimate contact of the vapor with the liquid on the tray than has been obtained heretofore.

The invention is particularly well adapted to the fractional distillation and rectification of composite liquids such as petroleum and animal and vegetable oils, although it is useful generally to provide intimate contact of vapors and gases with liquids.

The invention will be understood from the following description considered in connection with the accompanying drawing forming a part thereof and in which:

Fig. 1 is an elevational view, partly in section, of one form of bubble cap embodying the invention;

Fig. 2 is a horizontal sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is an elevational view of another form of the invention;

Fig. 4 is a view similar to Fig. 3, showing another form of the invention, and

Fig. 5 is a plan view of a bubble tray having hexagonal bubble caps embodying the invention.

Like characters of reference refer to the same or to similar parts throughout the several views.

Referring to the drawing, reference character 10 designates a bubble tray, which is arranged to hold liquid and to be disposed, for example, in a fractionating column in which vapor and liquid contact is effected. The tray 10 has a plurality of spaced circular vapor risers 11 which extend upwardly from the tray. It will be understood that during operation, the liquid level 12 on the tray will not rise above the upper ends of the vapor risers.

Disposed over each vapor riser and maintained in the desired spaced relationship therewith, is an inverted cup-shaped bubble cap 13. Each bubble cap is provided with three, equally spaced supporting members 14 which support the bubble cap on the riser in spaced relationship thereto. Any suitable means may be employed for holding the bubble caps on their respective risers. The lower portion of each cap is provided with a plurality of relatively closely spaced, parallel, narrow, elongated slots 15, the elongated edges of which are vertically inclined in the same direction around the skirt of the cap, the lower ends of the slots being in spaced relation to the lower edge of the cap.

In operation, vapor will flow from the zone below the tray 10, upwardly through the risers 11 and will be deflected downwardly by the bubble caps to the annular spaces between the bubble caps and the risers. The pressure of the vapor will prevent the liquid in these annular spaces from rising substantially above the lower edges of the slots 15. The vapor will flow from these annular spaces through the slots into the liquid on the tray between the bubble caps, and then will flow upwardly through the liquid and be released above the surface thereof. In passing through any particular slot, the vapor will flow over the upper elongated edge thereof in a thin, elongated stream which will flow upwardly through the liquid adjacent the cap on the tray. The vapor passing through the next adjacent slot will also be formed into a thin, elongated stream, and part at least of this stream will flow through the same liquid traversed by the stream from the first slot, either previously thereto, or subsequently thereto, due to the overlapping relationship of the slots with respect to the vertical. With this arrangement, the same portions of the liquid are traversed by a plurality of thin, elongated streams, thereby providing a relatively large area of contact between the vapor and liquid. Moreover, as will be seen in Fig. 1, the slots are oppositely inclined on adjacent portions of adjacent caps, with the result that the vapor issuing from one cap into the liquid between the caps will be in thin streams inclined in one direction while the vapor passing from the other cap into the same portion of the liquid will be in thin streams inclined in the opposite direction. These streams will intermingle and will provide intimate contact of the vapor with the liquid.

The form of the invention shown in Fig. 3 is like the form shown in Figs. 1 and 2, excepting for the shape of the vapor slots 16. In Fig. 3, the slots have communicating portions which are vertically inclined in opposite directions to provide V-shaped openings which are relatively closely spaced in "nested" relationship around the lower portion of the skirt of the cap. The operation is substantially the same as the operation previously described.

In the form shown in Fig. 4, the skirt of the bubble cap 13 is provided with a plurality of superposed horizontal rows of spaced, horizontally elongated, and narrow slots 17, with the slots in adjacent rows arranged in staggered re-

lationship as shown, so that the areas between slots in each row below the uppermost row, are in vertical alignment with the slots in the row immediately above. With this arrangement, the vapor will come into contact with the liquid in a plurality of thin, elongated streams, which will traverse the same portions of the liquid, generally as in the forms previously described, so that intimate contact of the liquid with the vapor is obtained.

With the hexagonal caps 18 shown in Fig. 5, the skirts are provided wth slots of the type shown in Figs. 1 and 2, although they may be provided with other types of slots. These caps 18 provide liquid spaces between them which are substantially of uniform width and length, thus insuring that all of the liquid in these inter-cap spaces will come in intimate contact with vapor. It will be understood that the vapor slots in adjacent portions of adjacent caps will be inclined vertically in opposite directions as disclosed in Figs. 1 and 2, thereby providing additional intermingling of the liquid and vapor.

The invention is applicable to bubble caps of shapes other than those illustrated, such as rectangular, oval, or any multi-sided shape.

The term "vapor" as used herein and in the claims includes "gas."

It will be understood that changes may be made in the forms of the invention disclosed without departing from the principles of the invention, which is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. A bubble tray comprising a liquid holding portion, a vapor riser and a cap for the riser, the cap having a substantially vertically extending portion normally submerged in the liquid on the tray, said portion being provided with a plurality of spaced, elongated vapor passages having spaced substantially parallel longer walls extending at an angle to the vertical, the walls of the passages being arranged and disposed in the normally submerged portion of the cap so that part at least of the longer walls of one passage are in substantial vertical alignment with a portion of one of the longer walls of an adjacent passage so that vapor flowing from a plurality of passages will pass through substantially the same portion of the liquid on the tray.

2. A bubble tray comprising a liquid holding portion, a vapor riser and a cap for the riser, the cap having a substantially vertically extending portion normally submerged in the liquid on the tray, said portion being provided with a plurality of elongated vapor passages having spaced substantially parallel, vertically inclined longer walls, the walls of the passages being arranged and disposed in the normally submerged portion of the cap so that part at least of the longer walls of one passage are in substantial vertical alignment with a portion of one of the longer walls of an adjacent passage so that vapor flowing from a plurality of passages will pass through substantially the same portion of the liquid on the tray.

3. A bubble tray comprising a liquid holding portion, a vapor riser and a cap for the riser, the cap having a portion normally submerged in the liquid on the tray and provided with a plurality of vertically spaced, horizontal rows of spaced, relatively elongated vapor passages, the passages in adjacent rows being arranged in staggered relationship so that part at least of the longer walls of one passage are in substantial vertical alignment with a portion of the longer walls of the adjacent passage.

4. A bubble tray comprising a liquid holding portion, a vapor riser and a cap for the riser, the cap having a substantially vertically extending skirt normally submerged in the liquid on the tray said skirt being provided with a row of spaced elongated vapor passages of substantially the same length extending around the skirt, the passages having spaced, substantially parallel, vertically inclined longer walls, the longer walls of one passage being substantially parallel with each other and the longer walls of adjacent passages, said longer walls of one passage having a part at least thereof in substantial vertical alignment with a portion of one of the longer walls of an adjacent passage so that vapor flowing from a plurality of passages will pass through substantially the same portion of the liquid on the tray.

5. A bubble tray comprising a liquid holding portion, a plurality of substantially equidistantly spaced vapor risers, and a cap for each riser, each cap having a substantially hexagonal configuration and having a skirt portion normally submerged in the liquid on the tray and provided with a row of spaced, elongated vapor passages of substantially the same length extending around the skirt, the passages having spaced, substantially parallel, vertically inclined longer walls, the longer walls of one passage being substantially parallel with each other and the longer walls of adjacent passages, said longer walls of one passage having a part at least thereof in substantial vertical alignment with a portion of one of the longer walls of an adjacent passage, the longer walls of the vapor passages of adjacent portions of adjacent caps being vertically inclined in opposite directions.

6. A bubble tray comprising a liquid holding portion, a vapor riser and a cap for the riser, the cap having a skirt normally submerged in the liquid on the tray said skirt being provided with a row of spaced V-shaped vapor passages extending around the skirt, the apex of each of said passages being disposed substantially intermediate the opposite sides of the row, and within the area of the skirt bounded by one of the next adjacent passages in the row.

7. A bubble tray comprising a liquid holding portion, a vapor riser and a cap for the riser, the cap having a skirt portion extending around the cap and normally submerged in the liquid on the tray and provided with a plurality of spaced rows of vapor passages extending around the skirt, each row comprising a plurality of spaced rectangular-shaped passages having spaced substantially horizontally extending, parallel longer walls, the passages in adjacent rows being arranged in staggered relationship so that part at least of the longer walls of one passage are in substantial vertical alignment with a portion of the longer walls of the adjacent passage.

8. A bubble tray comprising a liquid holding portion, a vapor riser and a cap for the riser, the cap having a portion normally submerged in the liquid on the tray and provided with a plurality of vapor passages, each passage having parts vertically inclined in opposite directions, the parts being joined at one end, said one end of each of the passages being disposed within the area of the submerged portion of the cap bounded by the parts of one of the next adjacent passages in the row.

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