Nov. 27, 1934. D. A. MONRO 1,982,226

BUBBLE CAP

Filed Nov. 11, 1932

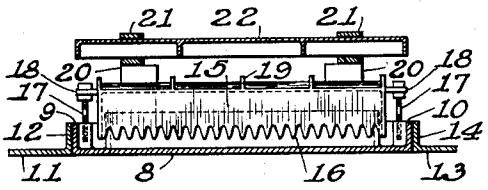


Fig.2

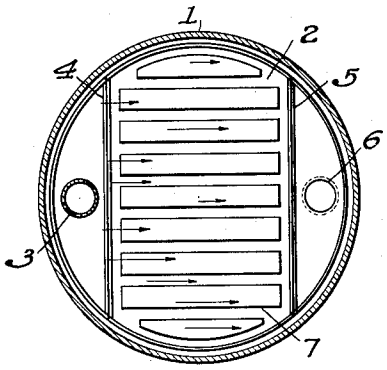


Fig.1

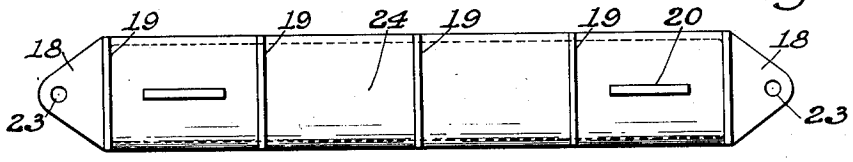


Fig.3

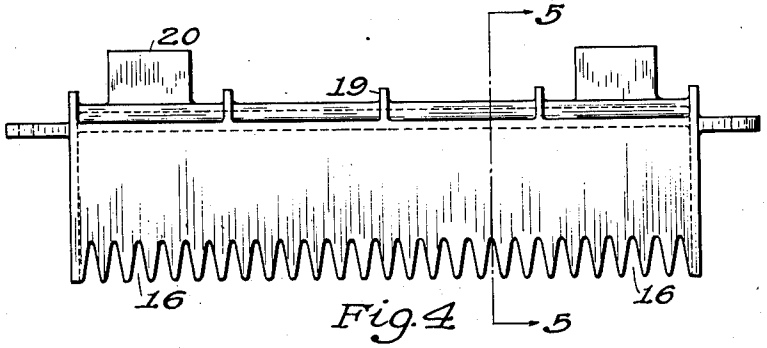


Fig.4

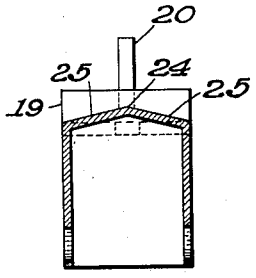


Fig.5

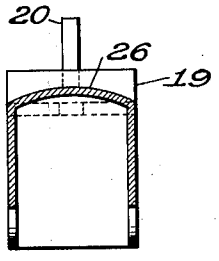


Fig.6

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BUBBLE CAP

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Application November 11, 1932, Serial No. 642,199

12 Claims. (Cl. 261—114)

This application relates to bubble caps and more particularly to bubble caps having greater length than breadth, such as rectangular or oblong bubble caps.

The use of bubble plates so constructed as to employ a plurality of oblong bubble caps disposed in a parallel series has become increasingly more popular of recent years. Elongated and rectangular bubble caps placed in a parallel series permit good contact between the rising vapors and the liquid maintained on the bubble tray in the channels between adjacent bubble caps. Moreover, there has, in recent years, been a trend toward using in bubble towers vapor velocities sufficiently high to maintain a foam in the channels between adjacent bubble caps. One of the disadvantages of this foam is that the bursting of the bubbles, coupled with the turbulence of the liquid caused by the high vapor velocities, tends to cause entrainment of particles of liquid which are carried upwards with the rising vapors. To avoid this entrainment, various types of splash arresters have been installed above the bubble caps with the idea of causing de-entrainment and knocking back onto the tray, drops of the entrained liquid.

Since most bubble caps are cast, simplicity of casting has resulted in caps having flat roofs. It has been found that where splash arresters have been used and even where they have not been used, the de-entrained liquid, as well as certain amounts of liquid thrown upwards because of the turbulence at the point of contact of the vapors and liquids tends to form pools and streams of liquid which are maintained upon the flat roofs of the bubble caps. Since there is always a liquid flow from the downcomer from the tray above to the tray below and since this liquid flow is generally designed to be in directions parallel to the longer dimensions of the bubble caps, an attendant flow is set up in the liquid maintained on top of the bubble caps. This flow of liquid on top of the bubble caps is maintained even when the liquid level of the tray is not such as to submerge the bubble caps. The liquid which thus flows along the top of the caps does not contact with the rising vapors and the purpose of the bubble caps, namely, to make effective contact between vapors and liquid, is thus defeated.

My invention has for an object a construction of bubble cap which will not permit liquid to be maintained upon or to flow along the top of the cap. A further object of my invention is a construction of bubble cap which requires that all of the liquid on the tray be urged toward the edges of the bubble caps and into the space between the caps to effect more perfect contact of liquid and vapors. Further objects of my invention will be apparent as my description proceeds.

My improved bubble cap will be described with relation to the drawing in which Fig. 1 is a plan view somewhat diagrammatic in character showing a conventional bubble tray with an assembly of parallel rectangular bubble caps showing the direction of liquid flow both on the tray and on the caps; Fig. 2 shows somewhat in detail a side view in section of my improved bubble cap, together with the splash arrester assembly supported thereon; Fig. 3 shows a plan view in detail of my improved cap; Fig. 4 shows a side view; Fig. 5 shows an end view in section of one form of my improved cap; and Fig. 6 shows an end view in cross section of a modification of my improved type of cap.

With reference to Fig. 1 of the drawing, reference number 1 represents the wall of the bubble tower; 2 represents a bubble tray which may be formed of a single casting or a plurality of sections bolted or otherwise fastened together; 3 represents a liquid downcomer which may be of any desired form or construction, the purpose of which is to transmit liquid from the tray above into the segmental space maintained by the dam 4 which is a vertical flange of sufficient height to maintain a body of liquid at any desired level between the dam and the inner wall of the tower or the rim of the tray. The liquid flowing over the dam 4 flows in the direction of the arrows toward the dam 5 which is of sufficient height to maintain the liquid on the main portion of the tray at any desired level but naturally lower than the dam 4; the liquid flowing over the dam 5 is collected in a pool and transmitted to the tray below through the downcomer 6.

Assembled on the main part of the tray is a plurality of elongated bubble caps 7 disposed in parallel in such fashion as to maintain a channel of liquid between the caps for contact with vapors which rise upwardly through risers (not shown) from the space below and thence downwardly and under the edges of the caps in the conventional manner. It will be observed that the upper surface or roofs of the caps collectively constitute an appreciable proportion of the total area of the tray. Since the ratio of the combined area of the top of the bubble caps to the total area of the contact section of the tray is relatively large, it will be observed that there is ample opportunity

for a very appreciable amount of liquid to be maintained upon and to flow across the tops of the bubble caps in the direction shown by the arrows in Fig. 1. I have found that a considerable quantity of liquid is thus permitted to bypass the zone of contact and to pass from tray to tray without contacting the rising vapors.

My invention in its broad aspect consists of so forming the upper surface or roof of the cap as to form a shed to divert the liquid back into the channels maintained between the adjacent caps. To accomplish this I may form the roof of the cap of opposed inclined surfaces which tend to form a ridge along the center of and along the major axis of the cap. Other modifications, of course, may be made, such as that shown in Fig. 6 in which the roof is made dome-shaped.

One type of my invention may be illustrated by the type of cap shown in Fig. 2 in which 8 represents the lower surface of the bubble tray, the ends of which are formed into upwardly extending flanges 9 and 10. Adjacent the section 8 of the tray is another section of the tray 11 provided with an upwardly extending flange 12 adapted to be bolted or otherwise joined to the corresponding flange 9 of section 8. Similarly, flange 10 of section 8 is bolted or otherwise fastened together with flange 14 of a corresponding section 13 of the tray. The upwardly extending flanges 9 and 12 tend to form a dam or retaining wall which corresponds to the dam 4 shown in Fig. 1 while the flanges 10 and 14 tend to form a dam or retaining wall corresponding to that shown as 5 on Fig. 1. Suspended above the tray 8 is bubble cap 15, the lower edges of which are serrated or notched as shown at 16, but which may be constructed in any desired equivalent manner. The cap may be supported upon the tray in any desired fashion, thus it may be bolted to the tray by means of bolts 17 which pass through suitable holes in the end flanges 18. Upon the roof of the cap are a plurality of vertical dams 19 which extend across the roof of the cap in a direction at right angles to the major axis of the cap and in such a fashion as to form miniature dams or baffles. If desired, the cap may be equipped with vertical flanges 20 disposed in a line coinciding with the major axis of the cap and of sufficient height to form supports for blocks 21 which in turn function as supports for splash arresters 22 which may be of any desired shape.

In addition to being equipped with the dams 19 the roof of the cap is pitched or sloped as shown more particularly in Fig. 5 of the drawing to give the opposite inclined surface and to form a peak or ridge 24, the purpose of which is to shed liquid from the top of the cap towards the sides thereof and into the contact space between adjacent trays. The end flanges 18 of the cap may be provided with suitable bolt holes 23 or any other desired means for securing the caps in place on the tray may be employed.

The modification shown in Fig. 6 is similar to that shown in Fig. 5 but differs in that the roof is curved in cross section to resemble a dome 26, the highest point of which is along the major axis of the cap.

It will be apparent that my improved cap may be installed in bubble trays in parallel construction without danger of loss of contact between vapor and liquid resulting from liquid flow along the roof of the cap. Any liquid which is splashed upon the roof of the cap or which drops upon the roof of the cap from the superimposed splash arrestor is forthwith shed from the cap into the contact space between adjacent caps. The dams 19 tend to supplement this shedding action and to further eliminate any tendency toward flow along the top of the cap. Thus my improved cap serves to accomplish more perfect contact between gas and liquid.

A further advantage afforded by my cap lies in its use in towers wherein the fractionation takes place in the presence of solids and solid catalysts such as fine clay, CuO, and the like. Such solids, which tend to remain on the top of the usual bubble caps, are shed into the contact space between adjacent caps and the full measure of desired contact between the solids and rising vapors is attained.

Since many modifications of my invention differing widely from the specific disclosure but which nevertheless fall within the spirit of my invention may be made, I desire it to be understood that my disclosure herein is illustrative only and not limitative and that I am to be limited only to the scope of the following claims.

I claim:

1. A bubble cap for the vapor risers of a bubble tray, said cap having substantially greater length than width, the roof of which deviates horizontally to form a surface which will shed liquids to the sides thereof, and a plurality of dams disposed upon the roof of said cap, the upper edge of said dams extending above and parallel with the normal level of said liquid.

2. A bubble cap for the vapor risers of a bubble tray, said cap having substantially greater length than width, the roof of which deviates from the horizontal to form a surface which will shed liquid to the sides thereof, and a plurality of vertical dams on the roof of said cap disposed at right angles to the major axis of the cap, the upper edge of said dams extending above and parallel with the normal level of said liquid.

3. A bubble cap having substantially greater length than width, the top surface of said cap being formed of two oppositely inclined surfaces which meet in the vicinity of the central major axis of the roof to form a ridge, a splash arrestor located above the roof of said cap, and a plurality of upstanding dams disposed upon said roof at right angles to the major axis thereof.

4. A bubble cap having substantially greater length than width, the top surface of said cap being formed of two oppositely inclined surfaces which meet in the vicinity of the central major axis of the roof to form a ridge, a splash arrestor located above the roof of said cap, and a plurality of upstanding dams disposed upon said roof at right angles to the major axis of the roof, said dams extending higher than the ridge thereof.

5. A bubble cap having substantially greater length than width, the top surface of said cap being formed of two oppositely inclined surfaces which meet in the vicinity of the central major axis of the roof to form a ridge, a plurality of upstanding dams disposed at right angles to the major axis of the roof, said dams extending higher than the ridge of the roof, and a plurality of vertical flanges disposed parallel to the major axis of the roof to provide supports for superimposed splash arresters.

6. A bubble cap for the vapor risers of a bubble tray, said cap having substantially greater length than width, the top surface of said cap being curved in cross section transverse to the major axis of the cap to form a dome-shaped

shed for liquid, and a plurality of upstanding dams disposed upon the top surface of said cap at right angles to said axis, the upper edge of said dams being above and parallel to the normal level of said liquid.

7. A bubble cap for the vapor risers of a bubble tray, said cap having substantially greater length than width, the top surface of said cap being curved in cross section transverse to the major axis of the cap to form a dome-shaped shed for liquid, and a plurality of upstanding dams disposed upon the top surface of said cap at right angles to said axis, said dams extending higher than the ridge of said dome-shaped liquid shed and having their upper edges disposed above and parallel to the normal level of said liquid.

8. A bubble cap having substantially greater length than width, the roof of which deviates from the horizontal to form a surface which will shed liquid to the sides thereof, a plurality of vertical dams on the roof of said cap disposed at right angles to the major axis of the cap, and means for conducting a reflux liquid parallel with the longitudinal axis of the cap and at a normal liquid level below the roof of the cap.

9. In apparatus for the condensation of vapors in a liquid reflux stream, a vapor riser extending through the stream, and a bubble cap disposed over said riser, said bubble cap being elongated and having its longitudinal axis parallel with the flow of reflux liquid and being provided with a plurality of dams on the roof thereof extending transversely to the direction of the flow of said stream.

10. In apparatus, for the condensation of vapors in a liquid reflux stream, a plurality of vapor risers extending through said stream, a plurality of bubble caps located over said risers, said bubble caps being of greater length than width and extending substantially through the entire length of the stream in parallel relationship, and a plurality of dams located upon the roof of said bubble caps and extending vertically in planes transverse to the flow of liquid in the stream.

11. In apparatus for the condensation of vapors in a liquid reflux stream, a vapor riser extending through the stream, and a bubble cap disposed over said riser, said bubble cap being elongated and having its longitudinal axis parallel with the flow of reflux liquid and being provided with a plurality of dams on the roof thereof extending transversely to the direction of the flow of said stream, the roof of said bubble cap deviating from the horizontal to provide a roof surface which will shed liquid to the sides thereof.

12. A bubble cap having substantially greater length than width, the top surface of said cap being curved in cross section to form a dome-shaped shed for liquids, a plurality of upstanding dams disposed at right angles to the major axis of the roof, said dams extending higher than the ridge of the roof and a plurality of vertical flanges disposed parallel to the major axis of the roof to provide supports for superimposed splash arresters.

DONALD A. MONRO.