May 29, 1945. R. H. RIEMENSCHNEIDER 2,376,940

FRACTIONATION COLUMN

Filed June 28, 1943

Fig. 1.

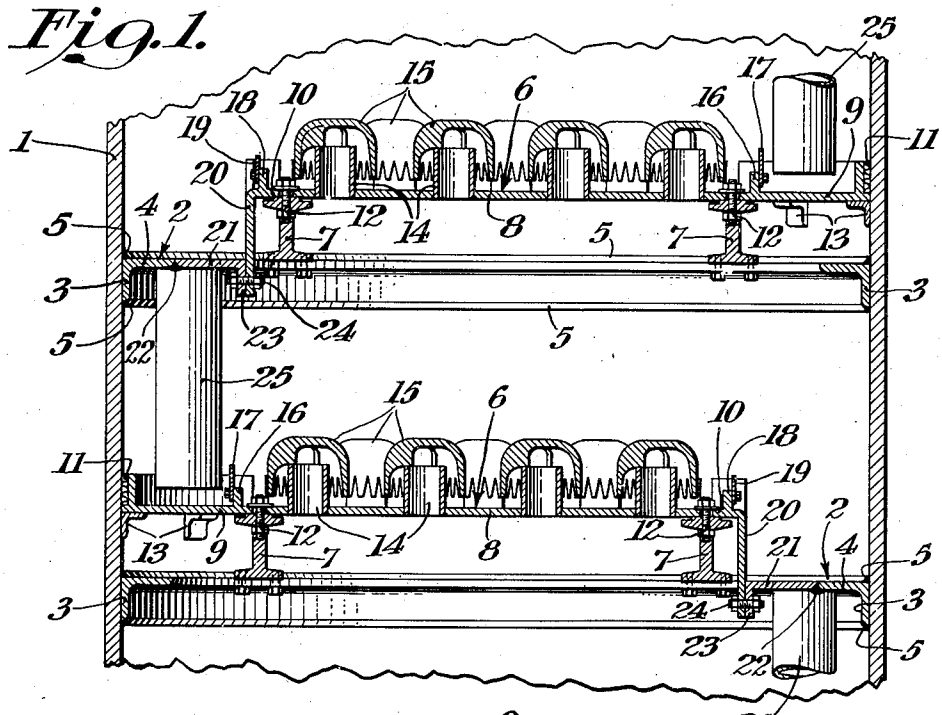


Fig. 2.

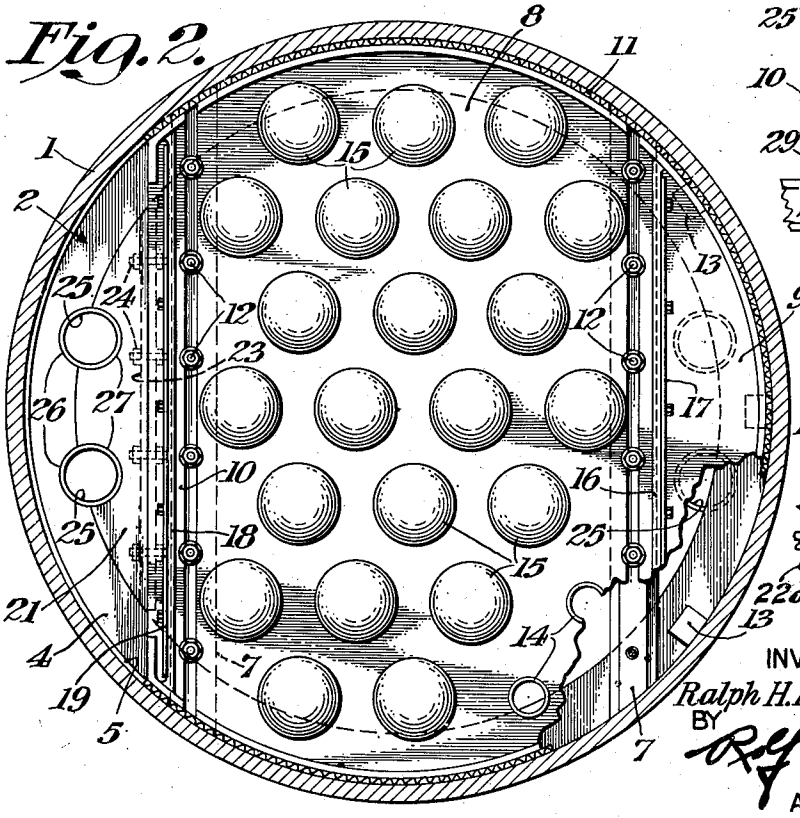


Fig. 3.

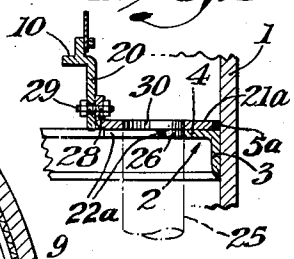
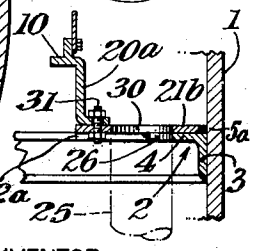


Fig. 4.



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FRACTIONATION COLUMN

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Application June 28, 1943, Serial No. 492,569

3 Claims. (Cl. 261—114)

The present invention relates to fractionation columns and particularly to improvements in the construction of the liquid downflow means and the internal reinforcing means of a fractionation column.

It is common to provide for internal reinforcement of a fractionation column by securing to the inner wall thereof a series of vertically spaced reinforcing rings. For adequate strength, such rings are generally made quite wide radially so that they project a considerable distance into the interior of the column. In the case of a column which is to be operated under vacuum conditions, the rings are usually made particularly wide in order to enable the column to withstand the external atmospheric pressure. Such wide rings occupy much of the cross-sectional area of the space within the column and, heretofore, have placed objectionable limitations upon the positioning of the liquid downpipes and upon the design of the bubble cap decks therein.

According to one standard design, a bubble cap deck extends from one side of the column across the interior thereof and terminates short of the opposite side of the column to provide the deck with an overflow edge. A weir is provided at this edge, and one or more downpipes are arranged to receive the liquid flowing over the weir and to conduct it downwardly within the column generally to the next lower deck. It is desirable that the deck extend as far as possible across the interior of the column in order to provide a relatively large deck area for the accommodation of bubble caps.

Heretofore, the wide reinforcing rings projecting inwardly from the wall of a column such as one used in vacuum fractionation have formed obstructions to advantageous placing of the downpipes and have necessitated placing of the latter entirely inwardly of the rings. Such placing of the downpipes necessitates narrowing of the deck in order to bring the overflow edge thereof in proper relation to the downpipes and thereby entails the sacrifice of much precious deck area. The deck area thus sacrificed may reduce the area available for bubble caps to such a degree as to require the elimination of an entire row or more of bubble caps. Thereby, the fractionation capacity of a column of a given diameter is objectionably limited.

An important object of the present invention is to provide for a fractionation column an improved construction and arrangement of the liquid downflow means and the internal reinforcing means so devised as to avoid the sacrifice of bubble cap deck area. This improved liquid downflow means may be used with particular advantage in a vacuum fractionation column.

Another important object of the invention is to provide for a fractionation column an improved construction and arrangement of the liquid downflow means and the internal reinforcing means which enables the downpipes to be placed in such a position as to intersect the reinforcing rings without weakening thereof whereby the downpipes may be located closer to the inner wall of the column and the decks may consequently be extended farther across the column to afford greater area for the accommodation of bubble caps.

Another object of the invention is to provide an improved construction and arrangement of the liquid downflow means and the internal reinforcing rings so devised as to define for each bubble deck a suitable space for disengagement of vapor from the liquid before passage of the latter into the downpipes.

Other objects and advantages of the invention will appear hereinafter.

In the drawing,

Fig. 1 is a vertical central sectional view of a portion of a fractionation column embodying the invention;

Fig. 2 is a horizontal section through said column, one of the bubble cap decks and associated parts appearing in plan and a portion of the deck being broken away to disclose the underlying structure; and

Figs. 3 and 4 are detail vertical sectional views of modified features of construction.

A portion of a fractionation column embodying the invention is indicated at 1. This column is reinforced internally by vertically spaced rings 2 each of which is of angle-iron construction and comprises an annular vertical outer flange 3 and a horizontal circular flange 4 extending inwardly from the upper edge of the vertical flange. The ring is rigidly secured to the inner wall of the column as by welding therearound as indicated at 5. The dimensions of the ring will vary according to the diameter of the column and the nature of the fractionation process in which the column is employed. For a process performed under vacuum conditions, for instance, a column having an internal diameter of ten feet may require reinforcing rings of approximately six to eight inches radial width, measured from the outer periphery of the ring to the inner edge of the horizontal flange 4. Such a wide ring will

reinforce the column to the extent necessary to withstand the external atmospheric pressure.

With reference to Figs. 1 and 2, a bubble cap deck 6 is associated with each reinforcing ring. In the present instance, each deck is supported by its associated ring through a pair of I-beams 7. These beams extend across the ring and are borne by the flange 4 of the ring and are detachably secured thereto. They support the deck at a suitable elevation above the ring for a purpose which will be explained hereinafter.

In the present instance, the deck comprises three sections or plates including a large central plate 8, a margin plate 9 of segmental form at one edge of the central plate, and a margin plate 10 at the opposite edge of the central plate. The edges of these plates opposed to the inner wall of the column are shaped to conform to the curvature of such wall and are desirably formed with upstanding arcuate flanges. Suitable packing 11 is interposed between these flanges and the column wall. The opposed edges of plates 8 and 9 extend along the upper side of one of the beams, and the opposed edges of the plates 8 and 10 extend along the upper side of the other beam. Rows of studs 12 detachably secure the plates along the opposed edges thereof to the cross-beams, the shanks of the studs extending between the opposed edges and having nuts screwed upon their upper ends to engage both of the adjacent plates. One or more brackets 13 are secured to the inner wall of the column in position to afford under-support for the outer edge of the margin plate 9.

The central deck plate 8 bears a plurality of rows of bubble cap risers 14, over which are mounted caps 15. Margin plate 9 has an upstanding rib 16 upon which a weir 17 is mounted for vertical adjustment thereof, and margin plate 10 has an upstanding rib 18 upon which a weir 19 is also adjustably mounted. These ribs and weirs are arranged parallel to the opposed edges of the deck plates. Margin plate 10 is formed with a vertical depending portion 20 reaching to a level below that of the flange 4 of the reinforcing ring and forming a downflow apron.

The total width of the three deck plates is such that the apron is located in a suitably spaced relation to the opposed portion of the column wall to afford therebetween a liquid downflow space of a desired capacity. Between the lower edge portion of the downflow apron 20 and the adjacent reinforcing ring 2, there is a bottom plate 21 of segmental form. This plate is horizontally disposed in the same plane as the flange 4 of the ring, and its outer edge is shaped to conform to the curvature of the inner edge of the flange and is welded continuously thereto as at 22 to form a sealed, rigid connection. Along its inner edge, plate 21 is formed with a depending flange 23 bolted, as at 24, to the lower margin of the downflow apron.

In the present instance, two downpipes 25 are shown as provided for each bubble cap deck. However, the number of downpipes per deck may be varied. In order to locate the downpipes close to the inner wall of the column, the flange 4 of each reinforcing ring associated with a respective deck and the bottom plate 21 welded to this flange are formed respectively at their opposed edges with two pairs of registering recesses 26 and 27. The registering recesses define circular apertures of a size to snugly receive the downpipes, and the upper ends of the downpipes are fitted respectively in these apertures and welded therearound to the flange and the plate. The downpipes extend downwardly into a sealing well on the next lower deck as defined by the margin plate 9, the weir 17, and the adjacent portion of the column wall, the decks being in staggered relation to each other so that this well underlies the downpipes.

Liquid delivered by the downpipes fills the well, overflows the weir 17, and is collected upon the deck area surrounded by the column wall and the weirs 17 and 19. Weir 19 is lower than weir 17, and the liquid flows over weir 19 into the preliminary downflow space defined by the inner wall of the column, the apron 20, and the bottom structure formed by the reinforcing ring and the plate. Thence, the liquid flows through the downpipes to the sealing well of the next lower deck.

It will be seen that the construction disclosed provides for advantageous arrangement of the downpipes close to the inner wall of a fractionation column regardless of the radial width of the reinforcing rings so that the decks can be made wide enough to afford deck area sufficient for a required bubble cap capacity. This advantage is obtained without weakening of the reinforcing rings since each ring is reinforced by the welded-on plate, which compensates for the recessing of the rings to accommodate the downpipes. In addition, the construction provides the desirable preliminary downflow space of greater capacity than the downpipes to permit retained vapors to disengage from the liquid before the latter enters the downpipes.

Fig. 3 shows a modified construction wherein a larger bottom plate 21*a* for the downflow space is substituted for the plate 21. Plate 21*a* is of segmental form and overlies the associated reinforcing ring. The outer edge of the plate conforms to the column wall, and the plate is welded around this edge to the wall as at 5*a*. Welding 22*a* also secures the plate to the inner edge of the ring flange 4; and, if desired, the plate and the flange may be welded together face-to-face for maximum reinforcement of the ring. At its inner edge the plate is formed with an upturned flange 28 bolted to the apron 20 as at 29. As in the first-described form of the bottom structure, the ring flange 4 is recessed as at 26 to partially receive the downpipes. The plate 21*a*, however, has complete apertures 30 for fully receiving the upper ends of the downpipes, and the latter are welded to the plates around these apertures. The downpipes may also be welded to the flange 4 around the recesses 26.

Fig. 4 shows a modification of the bottom plate and the downflow apron. Here, the apron, designated at 20*a*, has an out-turned flange along its lower edge, and the plate, designated at 21*b*, has a flat inner margin underlying this flange and bolted thereto as at 31.

It will be appreciated that my invention is also applicable to a bubble deck construction wherein no provision is made for disengagement of retained vapor from the downflowing liquid. In such case the plate 10 is not provided with the downwardly extending portion 20.

Although my invention has been more particularly described in connection with a vacuum fractionation column wherein the reduction of the cross-sectional area is most desirable because of the accompanying decrease in construction cost, it is not necessarily limited thereto and may also be used in connection with a column operat-

ing at atmospheric or superatmospheric pressure.

While I have disclosed several satisfactory forms of embodiment of my invention, the invention is not limited to these specific embodiments and to the details disclosed but includes such changes as come within the scope of the appended claims.

I claim:

1. In a fractionation column, an internal reinforcing ring for the column secured to the inner wall of the latter, a bubble cap deck within the column and having an edge thereof spaced from said column wall and provided with a downflow weir, crossbeams borne by said ring and supporting said deck in a position spaced above the ring, a downflow apron extending downwardly from said deck edge and disposed with relation to the opposed portion of said column wall to afford therebetween a downflow space substantially segmental in horizontal section for disengagement of vapor from liquid flowing over said weir, a plate extending from the lower portion of said apron outwardly to said ring to form a bottom for said space, and a downpipe leading downwardly from the bottom of said space and of small downflow capacity in comparison with the flow capacity of said space, said ring and said plate being both recessed to receive the upper end of said pipe therethrough and said plate being secured to the ring to reinforce the latter and compensate for such recessing of the ring.

2. In a fractionation column having a bubble cap deck, a plurality of downpipes eccentrically located within the column and arranged to receive liquid from said deck and conduct the liquid downwardly within the column, an internal reinforcing ring for the column and secured to the inner wall thereof and having an inwardly extending annular flange, and a segmental plate disposed inwardly of said flange and with its outer edge in opposition to the inner edge of the flange and welded thereto, said opposed flange and plate edges being recessed to accommodate said downpipes therebetween and being welded at the recesses to the downpipes around the peripheries of the latter, and the plate reinforcing the flange to compensate for such recessing of the flange.

3. In a fractionation column having a bubble cap deck with an edge thereof spaced from the inner wall of the column and provided at said edge with a downflow weir, an internal reinforcing ring for the column secured to said inner wall and disposed at a level spaced below that of the deck, a downflow apron extending downwardly from said deck edge and disposed in relation to the opposed portion of the column wall to afford therebetween a downflow space segmental in cross section for disengagement of vapors from liquid flowing over said weir, a plate extending outwardly from the lower portion of said apron to said ring to form a bottom for said space, and a downpipe leading downwardly from said bottom and of small downflow capacity in comparison with the flow capacity of said space.

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