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FRACTIONATION SYSTEM

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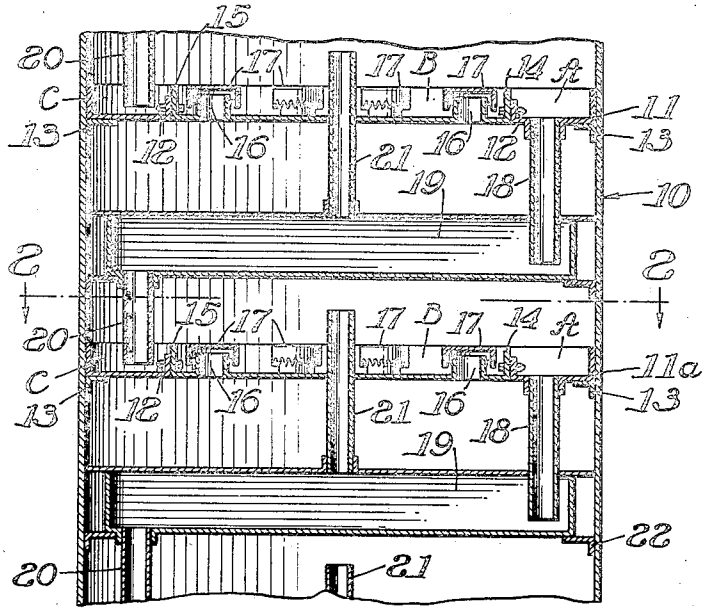


Fig. 1

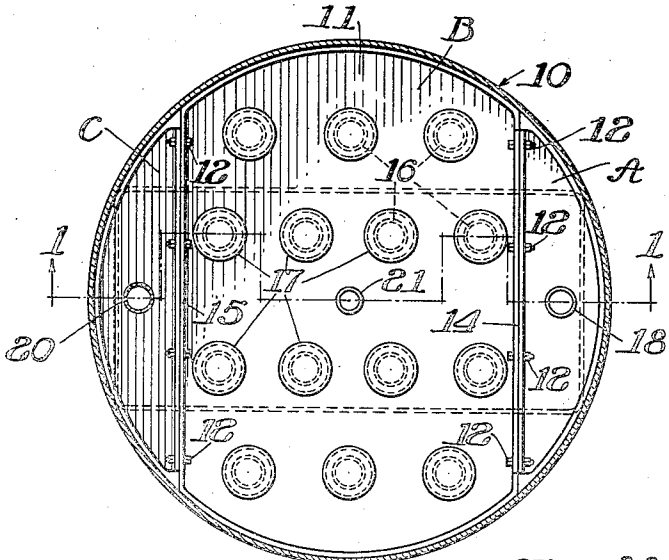


Fig. 2

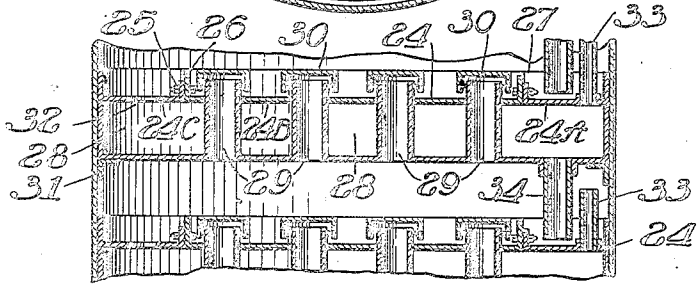


Fig. 3

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FRACTIONATION SYSTEM

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4 Claims. (Cl. 261—114)

This invention pertains to improvements in columns for the fractionation of volatile liquids, and, more particularly, means for breaking up froth or foam formed in fractionating columns operating under pressure as in pressure distillation of hydrocarbon oils.

The efficiency of fractionating columns in cracking systems is frequently greatly reduced because of frothing or foaming of the liquid on the fractionating trays. This trouble is probably attributable to the fact that under the pressure conditions existing within the column the specific gravities of the liquid and of the vapors are of the same order of magnitude, and in bubbling through the liquid, the vapors, instead of passing therethrough as they normally do, exert a buoyant force on the liquid producing a froth or foam. For efficient fractionation it is necessary to break up this froth or foam, and separate the vapors from the liquids. Our invention effectively accomplishes this, and will be fully understood from the following description illustrated by the accompanying drawing in which—

Figure 1 is a section through 1—1 of Figure 2 of an increment of a fractionating column equipped with our foam breaking device.

Figure 2 is a section through 2—2 of Figure 1, in which like parts are indicated by similar reference characters.

Figure 3 is a section of a fractionating column showing a modified form of our invention.

Referring to Figures 1 and 2 of the drawing, a fractionating column 10 of the conventional type contains a plurality of fractionating trays 11 and 11*a* constructed in sections A, B, C, secured together by bolts 12 and supported in the column by rings 13 welded or otherwise secured to the shell of column 10. The upwardly turned flanges between sections A and B, and B and C form dams or weirs 14 and 15, the height of which determines the height of the liquid level on each tray. Each of the fractionating trays 11, 11*a*, etc. is provided with vapor passages 16 covered by bubble caps 17 which are perforated or serrated at the bottom thereof to allow the vapors to bubble out through the liquid on the tray, and a liquid downflow pipe 18 which communicated with an enclosed chamber or reservoir 19 within the column and spaced between adjacent trays. Each reservoir is provided with a drain pipe 20 leading to the subjacent tray and extending below the liquid level of said tray, and a vapor line or vent 21 extending into the vapor space above the tray above said reservoir 19. The reservoirs may be supported in the column by means of lugs or brackets 22 welded or otherwise secured to the shell of the column.

Although our invention is applicable to any type of column within which there is formed a froth or foam which must be separated into its constituent vapors and liquid to obtain the most efficient fractionation, for the purpose of illustration we will describe the operation of our invention in a fractionating column in a hydrocarbon oil cracking system.

In practice, our invention operates as follows: Hot hydrocarbon oil vapors from a pipe still or reaction chamber (not shown) at 850–900° F. and under 300–325 lbs. gage pressure enter fractionating column 10 through a vapor line in the lower part of the column (not shown). The vapors ascend within the column through vapor passages 16 and bubble caps 17 and are fractionated therein, the heavier constituents condensing in the lower sections of the column and part of the lighter condensible constituents condensing in the upper sections of the column to form a reflux which flows to the fractionating trays 11 and 11*a* through which the ascending vapors are bubbled. The constituents not condensible at the temperatures within the column are taken off overhead through a vapor line (not shown)

We have found that fractionating columns operating under pressure as described may become clogged with foam, even at vapor velocities, which would permit perfectly satisfactory operation at other conditions. Thus, at vapor velocities of as low as one-half foot per second, foaming may occur and, of course, the difficulty is increased at higher rates of operation.

The foam so produced, together with the liquid on the trays 11 and 11*a*, etc., overflows dams 14 through pipes 18 and enters chambers 19 wherein the foam, out of contact with the ascending vapors and in quiescent state, is separated into its component liquid and vapor. The separated vapors within the quiescent areas 19 are removed therefrom through vapor outlets 21 to the vapor space above tray 11, and the separated liquid freed from admixed vapors, are removed from chamber 19 through drain 20 which extends below the liquid level of the subjacent tray.

A modified form of our invention is shown in Figure 3 in which we have shown a section of a fractionating column 23 in a cracking unit. Column 23 is equipped with a plurality of fractionating trays 24 which are constructed in sections 24A, 24B and 24C, secured together by bolts 25. These sections form pools for incoming liquid and flanges 26 and 27 act as weirs to determine the

depth of the liquid on each tray. Each tray is provided with a subjacent foam chamber 28 which may be an integral part of the fractionating plate 24 and through which risers 29 lead the vapors from the plate below to the bubble caps 30. The fractionating trays 24 are sealed to the walls of the column in the conventional way, and may be supported in the column by any suitable means, for example, by brackets or lugs 31 welded or otherwise secured to the walls. Each tray 24 communicates with the reservoir 28 formed by said fractionating tray 24 and its subjacent plate 28A by means of opening 32. Each reservoir 28 is provided with a vapor outlet 33 communicating with the vapor space of the fractionating tray above, and a liquid outlet 34 extending below the liquid level of the subjacent fractionating tray.

In the operation of this modified form of fractionating columns, vapors from a pipe still or a reaction chamber in a cracking system for the conversion of hydrocarbon oil, enter the fractionating column 23 through a vapor inlet (not shown) at an intermediate point near the base of the column, and pass upward through the vapor passages and under the serrated or perforated bubble caps 30. Under normal operating conditions or conditions when the column is operating at low capacity, the vapors, after leaving the bubble caps, bubble through the reflux liquid on the trays, and thence pass to the trays above. However, under the conditions which exist in the column when operating under pressure of 100–400 pounds, and at normal capacity with a vapor velocity of more than say one-half foot per second, a sharp separation of the vapor and liquid does not occur and a froth or foam is produced on the trays. The frothy mixture of liquid and vapors flows from the trays through the overflow 32 to the reservoir 28 wherein the frothy mixture being out of contact of ascending vapors, is permitted to remain in a quiescent state for a sufficient time to permit it to separate into its component liquid and vapor. The released vapors pass through the vapor outlet 33 into the vapor space of the tray above. The vapor freed liquid flows to the subjacent fractionating tray through the drain line 34.

By the use of the apparatus and method herein described, the efficiency of fractionating columns, in which conditions are favorable for the formation of froth or foam on the trays, is substantially increased. It is to be noted that the vapors separated in the quiescent regions are introduced into the space above each tray substantially free of entrained liquid particles which results in a cleaner fractionation.

By the present invention, fractionation is improved by avoiding entrainment which gives a better quality of distillate, and in addition, column capacities are substantially increased.

Although we have described the present invention in connection with specific embodiments thereof, it is not intended that the details set forth shall be regarded as limitations upon the scope of the invention except insofar as set forth in the accompanying claims which should be construed as broadly as the prior art will allow.

We claim:

1. In a fractionating column containing a plurality of superimposed fractionating trays wherein ascending vapors are made to co-mingle with descending liquid and a froth is produced, a plurality of independent chambers, means for collecting said froth from each one of said trays and means for passing said froth to one of said chambers out of contact with the ascending vapors wherein said froth is allowed to separate into its component liquid and vapor, and means for separately discharging liquids and vapors from each of said chambers.

2. In a fractionating column containing a plurality of fractionating trays wherein ascending vapors are co-mingled with descending liquid and a froth is produced, an independent reservoir between each two adjacent trays, means for removing said froth from said trays to said reservoir out of contact with the ascending vapors whereby said froth may separate into its component liquid and vapor, venting means for removing said liquid from said reservoir to the tray below, and venting means for removing said vapors from said reservoir to the vapor space of the tray above.

3. In a fractionating column, means for permitting froth formed by the co-mingling of vapors and liquids to separate into its component liquid and vapors out of contact with the vapors rising in said column, which comprises a quiescent chamber within the fractionating column, an unsealed conduit for feeding said froth to said quiescent chamber, a sealed conduit for introducing said separated liquid to the fractionating tray below said quiescent chamber, and a conduit to lead said separated vapors from the chamber to the vapor space of the fractionating tray above said quiescent chamber.

4. In a fractionating apparatus, a column equipped with fractionating plates, independent chambers in said column spaced between said fractionating plates for receiving froth produced in the fractionating operation, an unsealed froth inlet entering each of said chambers from the plate above, a vapor outlet from each of said chambers entering the vapor space of the plate above, and a liquid outlet from each of said chambers extending below the liquid level of the plate below.

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