Feb. 27, 1934. R. W. BIELFELDT 1,948,500

FRACTIONATING APPARATUS

Filed Sept. 28, 1931

Fig. 1

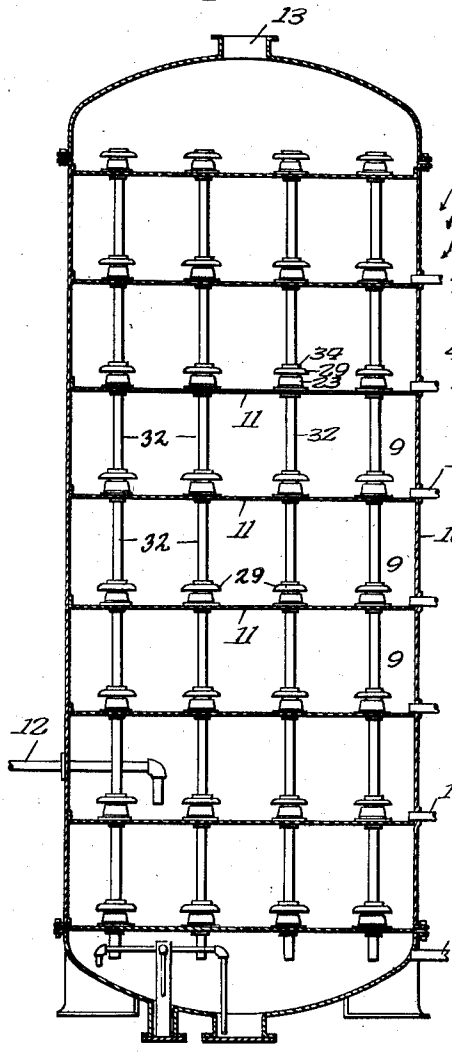


Fig. 2

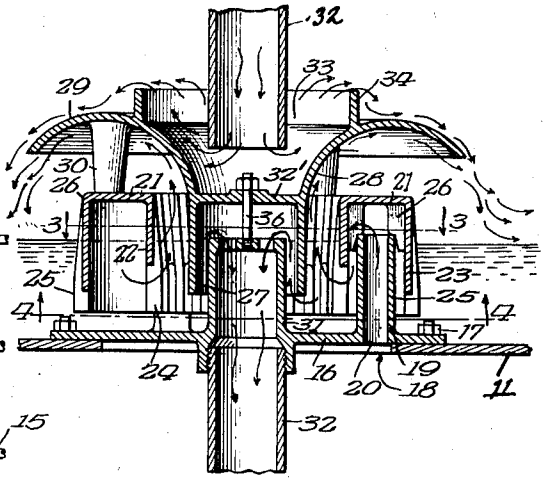


Fig. 3

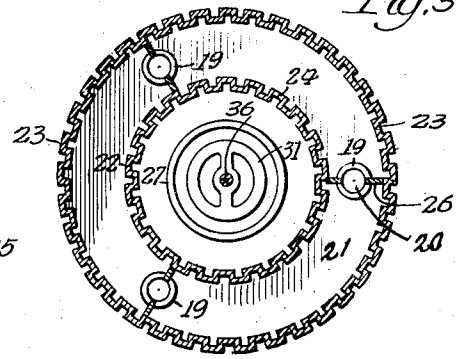
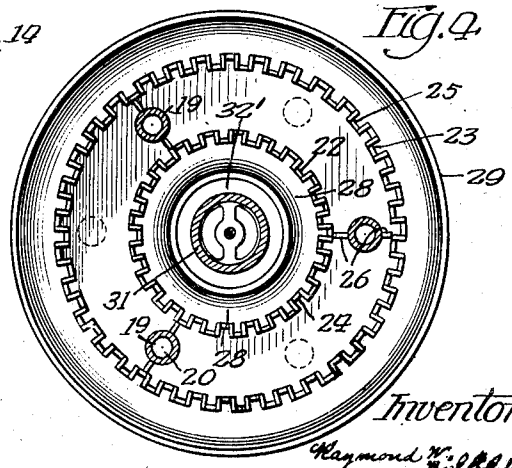


Fig. 4



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UNITED STATES PATENT OFFICE

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FRACTIONATING APPARATUS

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Application September 28, 1931
Serial No. 565,480

9 Claims. (Cl. 261—114)

The invention relates to apparatus for fractionating oil.

One object of the invention is to provide improved means for efficient contacting of liquid and vapor in fractionating oil which eliminates liquid entrainment, for producing a high grade of oil or gasoline, and which is of high volumetric capacity.

Another object is to provide a construction of bubble-cap for fractionating towers, which causes the vapor from one cap to contact with the liquid from the down-flow from a tray above. Heretofore it has been the practice to discharge the down-flow out of operative relation to the caps, which necessitated transverse travel of the liquor and resulted in different temperatures and concentration of liquids in different portions of the chamber. By contacting the vapor from one cap with the down-flow of oil from another cap, a portion of the down-flow will be vaporized, and this increases the efficiency of the caps. Another object is to provide a cap which will cause reflux mixing.

Another object is to provide an improved construction of bubble-cap.

Other objects will appear from the description.

The invention consists in the several novel features hereinafter set forth and more particularly pointed out in the claims.

In the drawing: Fig. 1 is a diagrammatic section of a fractionating tower. Fig. 2 is a section of one of the bubble-caps. Fig. 3 is a section on line 3—3 of Fig. 2. Fig. 4 is a section on line 4—4 of Fig. 2.

The invention is exemplified in a tower comprising a shell 10 which is provided with a vertical series of cross-walls 11 which form trays for retaining columns of oil and divide the tower into chambers 9. A pipe 12 delivers crude oil to one of the chambers 9. An outlet pipe 13 for the vapor is connected to the top of the tower. Pipe 14 delivers high pressure steam into the tower. Pipes 15 are provided to drain different grades of oil from the tower. The heavy oil or residuum is drained from the bottom of the tower as well understood in the art. Bubble-caps in the desired number are provided over each of the trays 11. These are alike in construction so that a description of one will be applicable to all.

Each cap comprises a lower member consisting of a base or plate 16 secured by bolts 17 to one of the cross-walls 11 over an opening 18, and a series of three circumferentially spaced upstanding nipples 19 integral with the said base. These nipples each have a port 20 through which the vapor from one chamber 9 will pass upwardly to the next chamber in the series. A primary deflector for directing the vapor downwardly against or through the liquid over the nipples 19 comprises an annular top wall 21 which acts as a baffle, and integral depending inner and outer annular side-walls 22 and 23 which are spaced from the nipples and deflect the vapor downwardly into the liquid. The lower ends of walls 22 and 23 are spaced from the base 16 so the vapor can pass laterally thereunder and through the liquid. These side walls are fluted or grooved vertically. Slots 24 are formed in the lower portion of the inner annular side-wall 22 of the deflector to divide the vapor into streams and wall 23 has slots 25 for the same purpose. The slots 24 extend higher than the slots 25 so the primary flow of vapor from the deflector will be through the liquid and toward the center of the deflector and the discharge through slots 25 will be secondary. This deflector is provided with lugs 26 which seat on the upper ends of the nipples 19 to support the deflector so it can be easily replaced or removed, when desired. This exemplifies a bubble-cap with a series of upwardly discharging ducts and a deflector which will cause the vapor to flow primarily toward the center of the cap.

A reflux deflector for the vapor comprises a central tubular wall 27, and an upwardly extending and outwardly flared wall 28 with its marginal portion 29 curved upwardly and outwardly and then downwardly as at 29' over the primary deflector to deflect the vapor from the central portion of the primary deflector downwardly toward the liquid. Lugs or feet 30 depend from the underside of the wall 28 and engage the top wall of the primary deflector, to properly space the reflux deflector from the primary. This exemplifies a reflux deflector for directing the vapor from the boiling mixture around the inner wall of the primary deflector, back to the liquid for further mixing.

An overflow nipple 31 which causes a column of liquid of the desired height to be maintained in each chamber 9, extends upwardly from the base 16, is centrally disposed in and spaced from the tubular deflector wall 27, and its upper end terminates below a cross-wall 32 joined to said tubular wall, to permit the liquid in the tray or chamber 9 as it rises above the level of the upper end of the nipple, to flow under the lower end of tubular wall 27, upwardly between said wall and nipple 31 and over the top of the nipple into the downwardly extending duct therein. The annu-

lar wall 28 and the cross-wall 32 of the reflux deflector form a hood to prevent vapor from passing into the overflow. A pipe 32 is connected to the base 16 and leads downwardly to discharge the overflow into a weir 33 in the top of the bubble cap in the subjacent chamber 9. This weir is formed by the walls 32 and 28 of the reflux deflector and an annular vertical wall 34. The liquid overflows wall 34, spreads over the top wall of the reflux deflector, and is contacted with the blast of vapor which is deflected downwardly and outwardly by the under side of wall 29. A bolt 36 holds the reflux deflector on the top of the primary deflector, so both deflectors will be held against upward displacement. This exemplifies a bubble-cap onto which the downflow of liquid from a superjacent cap or chamber is discharged, so it will be contacted by and subjected to the action of the refluxed vapor from the cap in the subjacent chamber; and also a cap with a central overflow for that purpose.

In operation, the chambers 9 will retain liquid oil supplied by pipe 12 approximately at the level of the tops of the overflow nipples 31. Superheated steam is admitted to the tower to flash the oil into vapor, as well understood in the art. This vapor passes successively from one chamber 9 to the superjacent chamber, through the ducts 20 in nipples 19 of the caps. These ducts act as injectors to draw the vapor from the top of one chamber 9 into caps in the next chamber. The vapor is discharged from nipples 19 against the top wall 21 which acts as a baffle. Next the vapor passes downwardly in the deflector and through slots 24 to the space within the annular wall 22. This causes the vapor to contact and mix with the liquid oil. The vapor next passes upwardly through the annular space between side wall 22 and tubular wall 27, and under flared wall 28 which deflects the vapor outwardly to the downwardly curved wall 29. The latter directs the vapor downwardly to the liquid on the bottom of the chamber 9 around the cap. This results in the reflux mixing. A secondary volume of the vapor passes under the outer side wall 23 of the cap, contacts with and bubbles through the liquid around the cap. The overflow liquid passes into the top of nipple 31 and flows downward to the weir 33 in the cap of the subjacent chamber. The liquid in each weir overflows its wall 34, spreads over the top of deflector wall 29 and as it passes off said wall it is mixed with the vapor from the cap. This causes mixing of the vapor from the cap with the downflow at a point above the liquid level.

The use of a plurality of inlets or jets for the vapor in each cap, the reflux mixing produced by the second deflector, and the mixing of the downflow liquid with the vapor, above the liquid level, result in efficiently separating the lighter oils from the crude and produce a high grade of oil. These also cause circulation of the liquid which prevents the settlement of the sediment in the chambers. The plurality of overflow ducts in each cap greatly increase the capacity of the tower. The overflow for the liquid is in the center of the annular zone where the vapor mixes with the liquid without substantial transverse travel of the liquid to reach the downflow. When there is such travel, different temperatures are produced in different portions of the chamber, and this retards fractionation. The improved cap is simple in construction and a single bolt serves to hold both deflectors on the base. These caps give the tower a high volumetric capacity. The reflux mixing prevents entrainment when the tower is forced beyond its intended capacity, and this avoids producing an inferior grade of oil. The provision of a down-take for each cap produces uniform distribution and flow of the liquid in each chamber.

I claim:

1. In fractionating apparatus, the combination of a bubble-cap comprising an upwardly discharging duct for vapor, a primary deflector for directing the vapor downwardly to mix with the liquid in the chamber, comprising an annular depending wall, a tubular deflector inside of and separated from the depending wall and an overflow conduit inside of the tubular wall.

2. In a bubble-cap, the combination of a member having a plurality of upwardly discharging nipples therein, a separately formed deflector for the vapor from and supported on the nipples, comprising annular inner and outer depending walls, a separately formed reflux deflector mounted on the primary deflector, and a bolt for securing both deflectors on said member.

3. In a bubble-cap, the combination of a member having a plurality of upwardly discharging nipples therein, a separately formed deflector for the vapor from and supported on the nipples, comprising annular inner and outer depending walls, a reflux deflector for the vapor from the inner wall, and an overflow nipple under the reflux deflector.

4. In vapor and liquid contacting devices for use in fractionating towers, a cap comprising a member having an upwardly discharging nipple, a primary deflector over and around the nipple and provided with inner and outer annular depending walls under which vapor may pass, and a reflux deflector having means for directing vapor upwardly from the space inside of the inner wall, over the top and to the space around the outside of the outer annular wall of the primary deflector.

5. In vapor and liquid contacting devices for use in fractionating towers, a cap comprising a member having a plurality of upwardly discharging nipples, a primary deflector extending over and around the nipples and provided with inner and outer annular depending walls under both of which vapor may pass, and a reflux deflector having means for directing vapor upwardly from the space inside of the inner wall to the outside of the outer annular wall of the primary deflector.

6. In vapor and liquid contacting devices for use in fractionating towers, a cap comprising a plate having an upwardly extending overflow nipple and an upwardly extending discharge nipple, a primary deflector over and around the discharge nipple comprising inner and outer annular depending walls, and a reflux deflector having an annular wall for directing the vapor upward from the space between the inner deflector wall and the overflow nipple and over the primary deflector to the outside of the outer wall.

7. In vapor and liquid contacting devices for use in fractionating towers, a cap comprising a plate having an upwardly extending overflow nipple and a plurality of upwardly extending discharge nipples, a primary deflector over and around the discharge nipples comprising inner and outer annular depending walls under which vapor may pass, and a reflux deflector comprising an annular wall between the overflow nipple and the inner annular wall of the primary deflector and an extension for directing the vapor

from the inner wall over the primary deflector and to the outside thereof.

8. In vapor and liquid contacting devices for use in fractionating towers, a cap comprising a plate having an upwardly extending overflow nipple and a plurality of upwardly extending and discharging discharge nipples, a primary deflector over and around the discharge nipples comprising inner and outer annular depending walls, a reflux deflector over the overflow nipple and comprising an annular wall between the overflow nipple and the inner annular wall of the primary deflector to form a liquid seal around the overflow nipple, the reflux deflector having a wall extending upwardly and outwardly to direct the vapor from the space around the inner annular wall, over and to the outside of the outer wall of the primary deflector.

9. In vapor and liquid contacting devices for use in fractionating towers, a cap comprising a plate having an upwardly extending overflow nipple and a plurality of upwardly extending and discharging discharge nipples, a primary deflector over and around the discharge nipples comprising inner and outer annular depending walls, a reflux deflector comprising an annular wall between the overflow nipple and the inner annular wall of the primary deflector and an extension to direct the vapor over to the outside of the primary deflector, and means for delivering overflow from a superjacent cap onto the top of the reflux deflector so the overflow will be discharged over the vapor under the reflux deflector.

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