

Jan. 10, 1933.

J. PRIMROSE ET AL

1,893,906

FRACTIONATING TOWER

Filed May 5, 1926

4 Sheets-Sheet 1

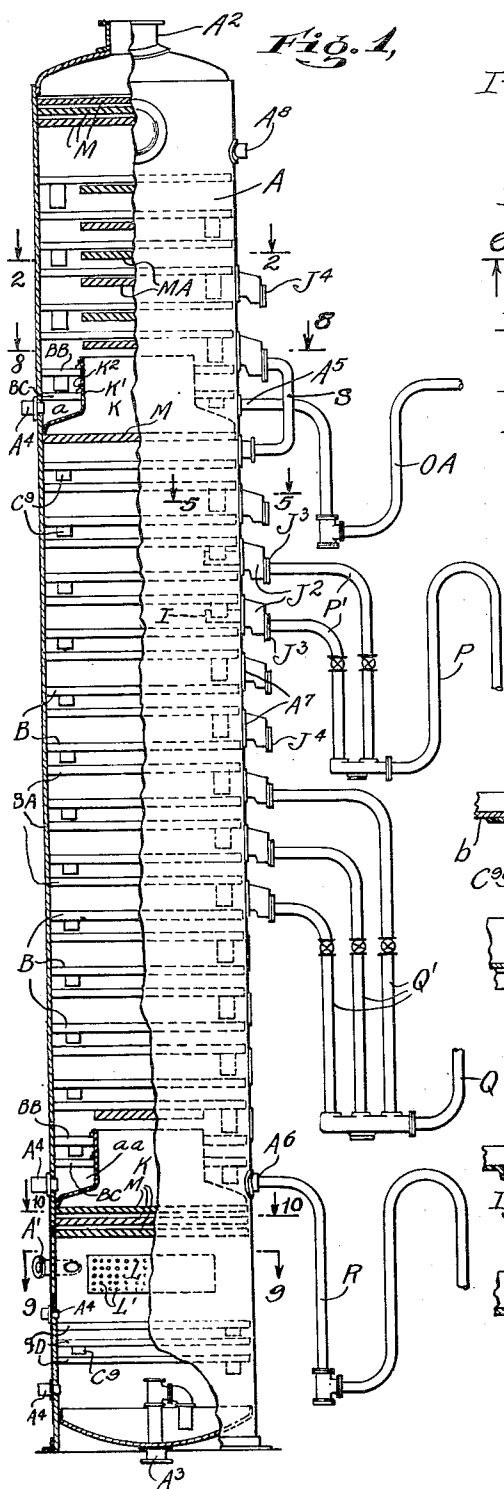


Fig. 1,

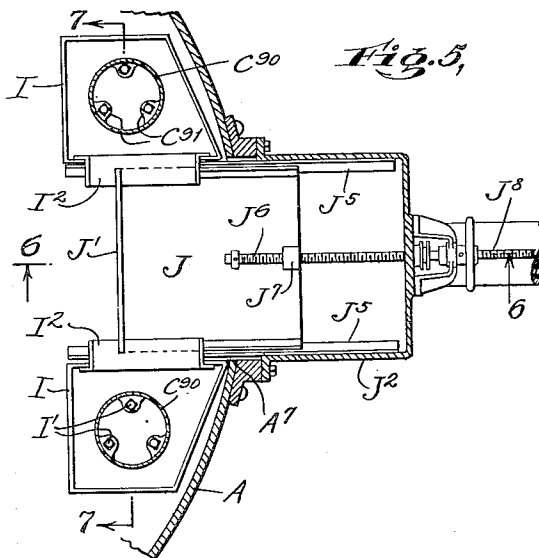


Fig. 5,

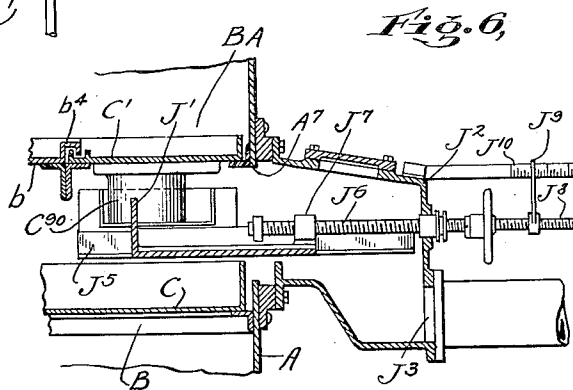


Fig. 6,

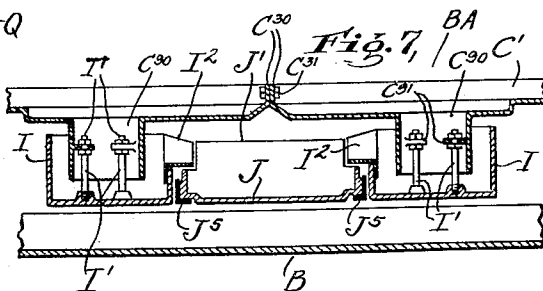


Fig. 7,

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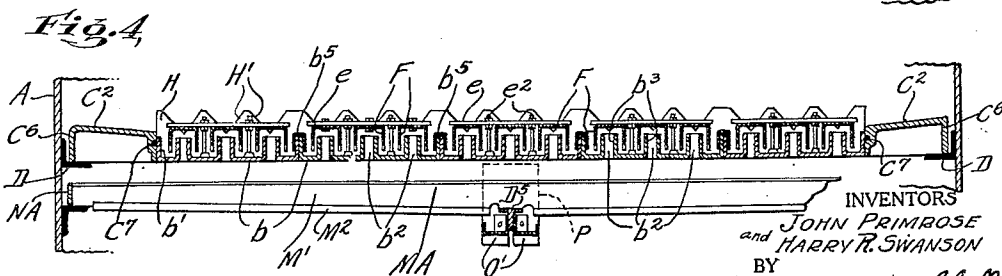
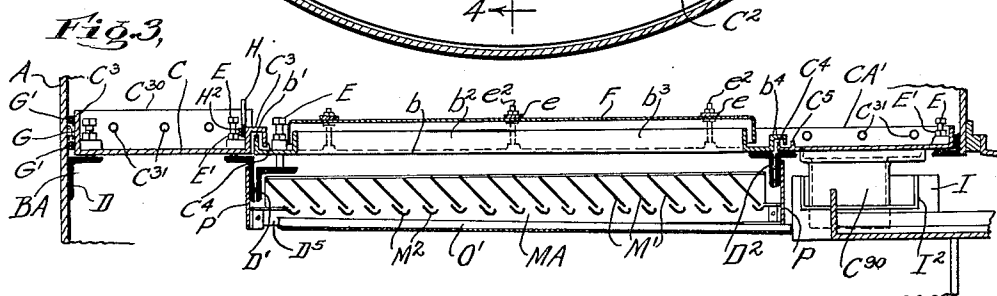
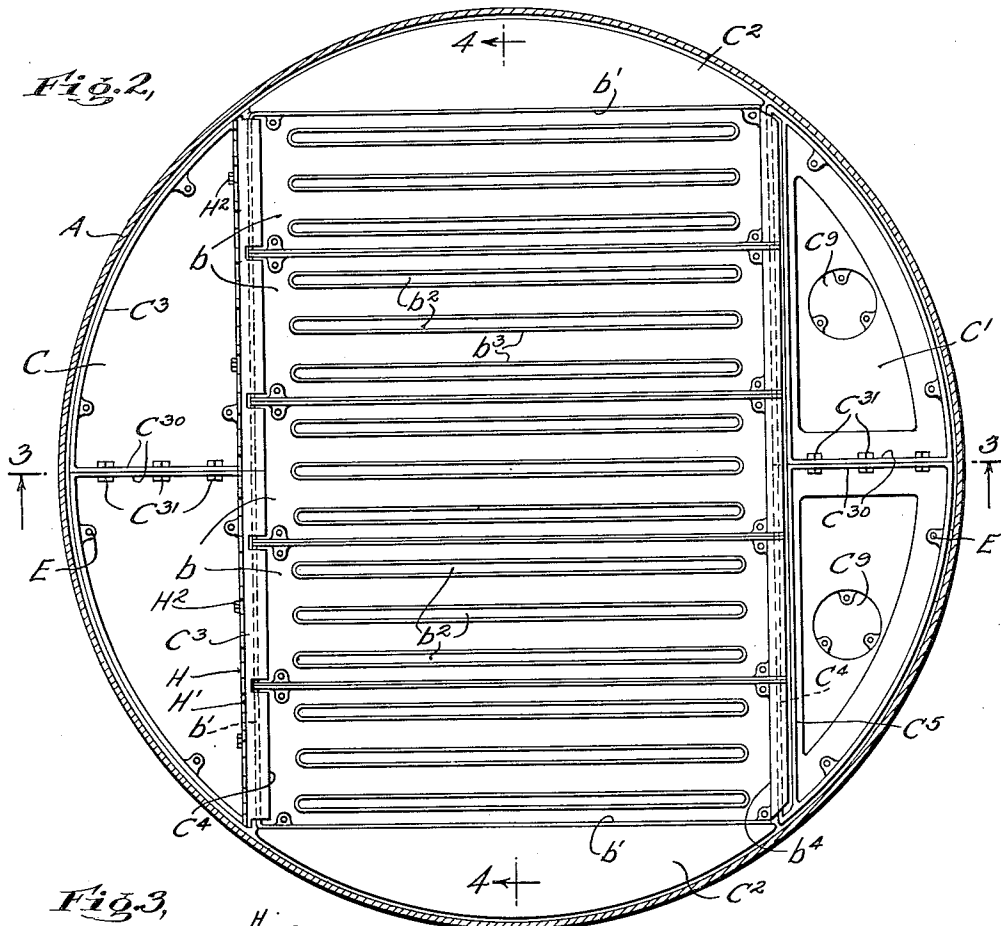
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4 Sheets-Sheet 2



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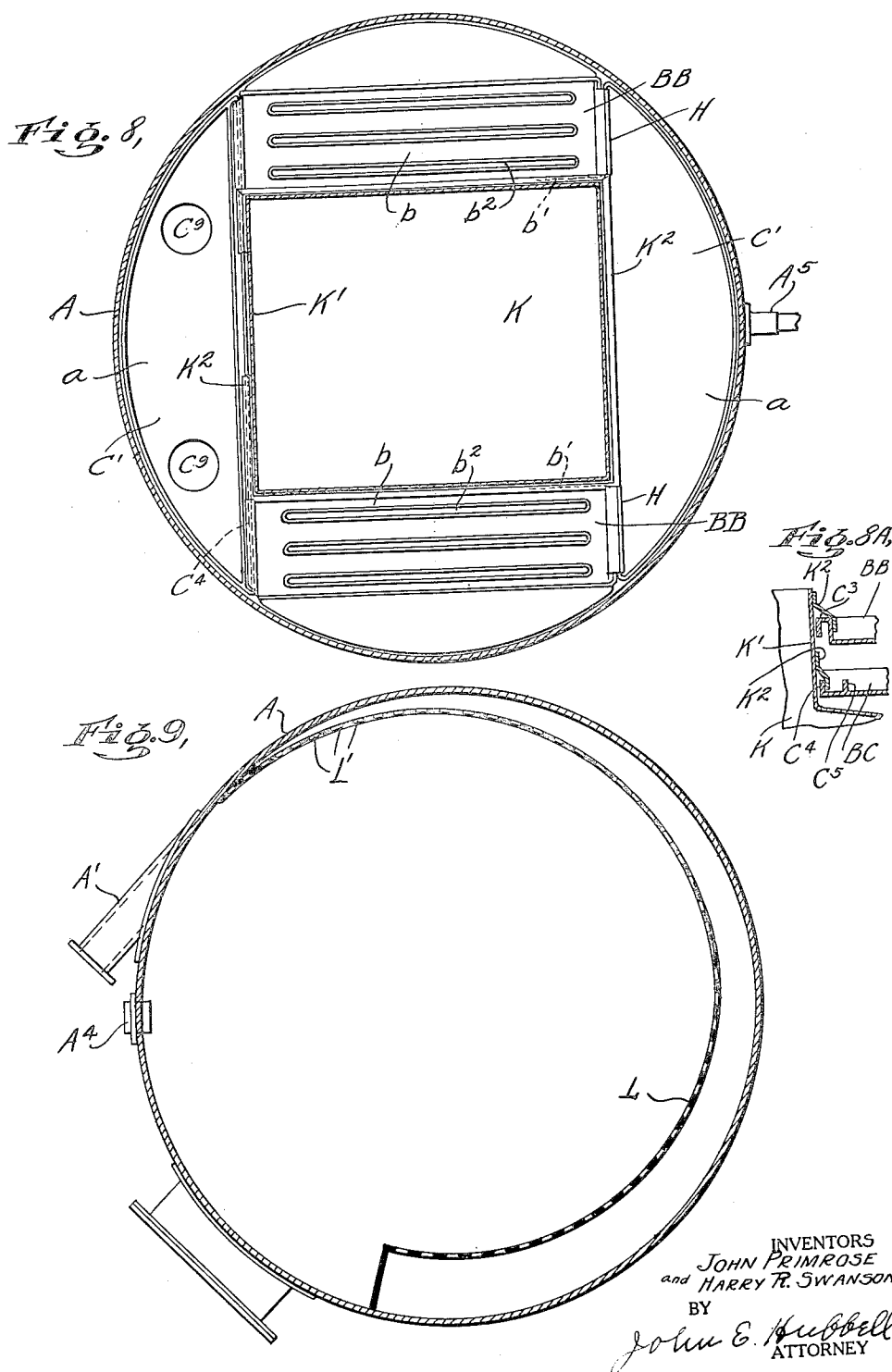
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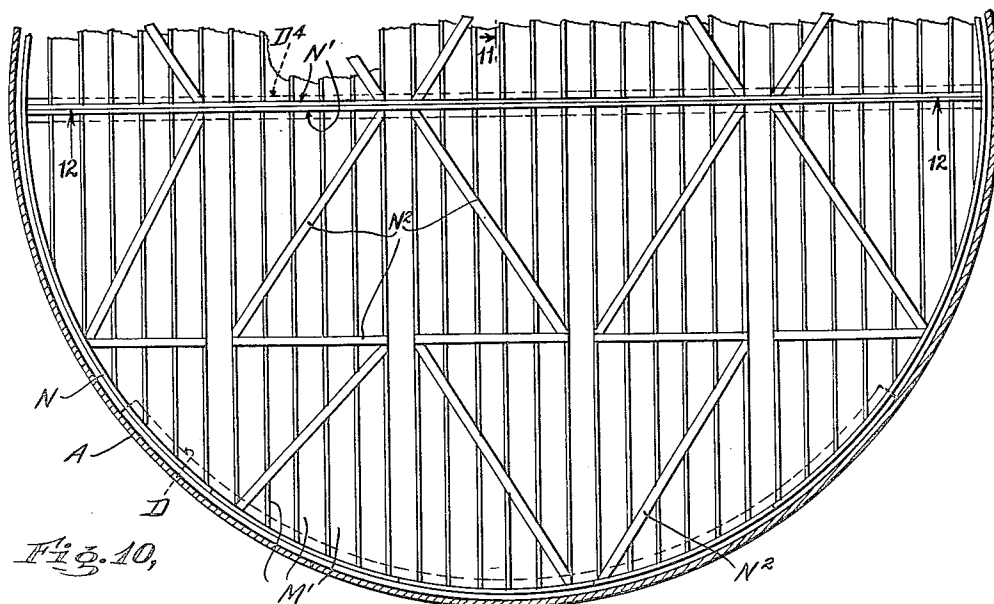
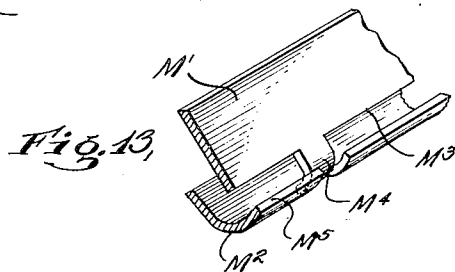
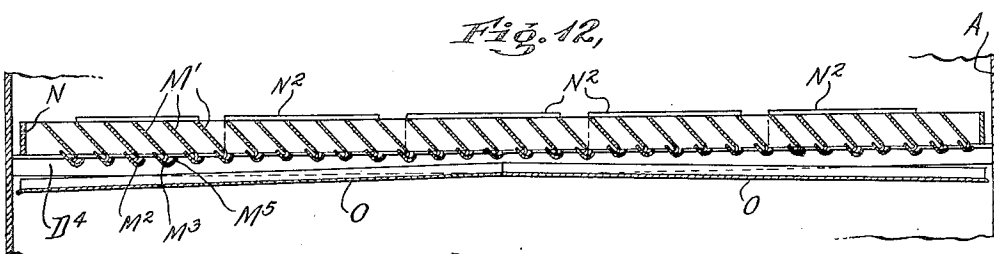
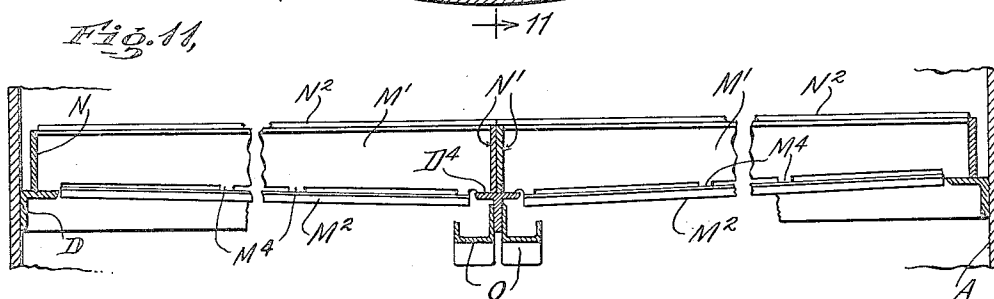


Fig. 10,



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FRACTIONATING TOWER

Application filed May 5, 1926. Serial No. 106,866.

The general object of the present invention is to provide apparatus of improved form for separating liquid and vapor, and for the separate recovery of fractional condensates of different boiling points, and the invention was primarily devised, and is especially adapted for use in treating oil and oil vapors coming to the fractionating apparatus from a heater in which oil is heated to a cracking temperature.

An important specific object of the invention is to provide an improved form of bubble tray especially devised and adapted for use in an oil fractionating tower which is substantially larger in diameter than ordinary so-called bubble stills. What may be called the bubble tray portion of our invention is characterized by the relatively simple and effective mechanical provisions made for the construction and support of a bubble still tray which is characterized by the novel and effective manner in which the liquid collecting on and running over the tray is properly distributed over the latter, notwithstanding the relatively large horizontal area of the tray.

A further object of our invention is to effect a novel and useful combination with the bubble trays of simple and effective means for eliminating entrained liquid from the vapors. A further object of the invention is to provide improved means for withdrawing condensate fractions at any one of a multiplicity of different levels, and still another object of the invention is to provide improved means for rectifying or purifying within the fractionating apparatus some of the more important, at least, of the fractional condensates withdrawn.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it,

reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is an elevation partly broken away and in section;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 2;

Fig. 5 is a partial section on the line 5—5 of Fig. 1;

Fig. 6 is a partial section on the line 6—6 of Fig. 5;

Fig. 7 is a partial section on the line 7—7 of Fig. 5;

Fig. 8 is a section on the line 8—8 of Fig. 1;

Fig. 8A is a partial section illustrating a detail feature of the construction shown in Fig. 8;

Fig. 9 is a section on the line 9—9 of Fig. 1;

Fig. 10 is a section on the line 10—10 of Fig. 1;

Fig. 11 is a section on the line 11—11 of Fig. 10;

Fig. 12 is a section on the line 12—12 of Fig. 10;

Fig. 13 is a perspective view of a portion of the apparatus shown in Figs. 10, 11, and 12.

In the drawings, A represents a fractionating tower embodying a preferred form of construction of the invention. The tower A, as shown, comprises a vertically disposed cylindrical shell having an oil and vapor inlet A' adjacent, but somewhat above the bottom of the shell, and provided with a vapor outlet A² at the top of the shell, a residuum outlet A³ at the bottom of the shell, suitably disposed steam inlets A⁴, fractional condensate outlets A⁵ and A⁶, and other wall openings A⁷ at different levels through which liquid condensates can be withdrawn as herein-after described. A⁸ represents an inlet for reflux liquid. Within the tower shell a multiplicity of bubble trays B, and alternating

bubble trays BA are superposed between a level slightly above the inlet A' and a level somewhat below the vapor outlet A².

As shown best in Figs. 2, 3, and 4, each tray B comprises an active portion formed by a multiplicity, five as shown, of similar side by side sections *b*. Each section *b*, as shown, is a rectangular metal plate with an uprising marginal flange *b'*, and formed with a series of elongated through ports *b*² each extending almost the full length of the tray section and each surrounded by an integral uprising lip *b*³. At the opposite ends of the sections *b* of each tray, are segmental plates C and C' which extend from the ends of the sections to the peripheral wall of the shell, and other segmental plates C² extend from the sides of the outer sections *b* of each tray to the peripheral wall of the shell. The sections *b* and segmental plates C, C' and C² of each tray B, unite to form a perforated diaphragm extending across the periphery of the shell from which the tray is supported by means shown as including a rib D riveted, welded, or otherwise secured to the shell, and transverse bars or beams D' and D² extending as chords across the interior of the shell at the ends of the sections *b*. As shown, the sections *b*, and the segmental plates C and C' are each tapped to receive leveling screws E which engage the supports D, D', and D² and make it readily possible to accurately level the various parts of each tray B in the initial assembly of the apparatus. Advantageously, the leveling screws are provided with lock nuts E' by which the screws may be secured in any desired adjustment.

Each segmental plate C, as shown, comprises a plate-like body portion with an uprising marginal flange C³. To facilitate manufacture for use in towers of relatively large diameter each plate C, as well as each plate C', is conveniently formed in two sections with uprising flange portions C³⁰ at the abutting edges of the two sections of each plate. The abutting flanges C³⁰ of the two sections of each plate member C or C' are secured together as by clamping bolts C³¹, the joints between the sections being sealed in any suitable manner. In practice the abutting faces of the flanges C³⁰ of each connected pair of plate sections may well be machined so that no special packing is required between the sections to avoid liquid or gas leakage through the joint.

To seal the joint between the ends of the sections *b* and the segment C, the latter is provided with a depending lip portion C⁴ on the corresponding portion of the flange C³ which extends over the top and then down alongside the adjacent marginal flanges *b'* of the sections *b*. The upper edges of the flange portions *b'* of the section *b* extend to a level slightly below that of the horizontal portion of the lip C⁴ so that clearance is provided to

accommodate relative adjustments of the parts in the initial setting of the leveling screws E. A similar liquid seal for the joints between the opposite ends of the sections *b* and segmental plate C' is secured by means of lip portions *b*⁴ on the sections *b* which overlap the adjacent portion of the uprising marginal flange C⁴ of the plate C'. A second flange C⁵ on the plate C' provides a seal trough into which the depending portions of the lips *b*⁴ dip.

Each side plate C² has a depending marginal flange C⁶ which engages the support D and which is so proportioned that the body of the plate is located above the sections *b* and slopes upward from its side adjacent the sections *b* to the tower shell, so that stagnant liquid will not collect on the plates C². A packing groove C⁷ is formed in the surface of the flange C⁶ of each member C² abutting against the marginal flange *b'* of the adjacent sections *b*. Rope or analogous packing is placed in the groove C⁷ to prevent gas and liquid leakage through the corresponding joints. Advantageously, as shown, the plates C, C', and C² are spaced away from the wall of the tank to provide a groove in which a suitable packing may be placed. As shown, this packing is formed of asbestos G, or the like, held in place between bands G' of wire cable, or the like. To avoid gas leakage through the joints between adjacent sections *b*, the abutting marginal flanges *b'* of adjacent sections are covered, as shown, by inverted trough shape joint sealing members *b*⁵ of sheet steel or other suitable material.

Over each of the tray ports *b*² is placed a corresponding bell F which serves to compel gas passing upward through the port to bubble through the liquid on the top of the corresponding tray B before passing above the tray. The bells F for each tray section are bolted to transverse supporting bars *e*, and the latter are secured to the corresponding tray section *b* at the proper level by means of bolts *e*² tapped at their lower ends into the tray section and passing through perforations in the bars *e* which are clamped in place between clamping nuts screwed onto the upper threaded ends of the bolts *e*² so that the bars *e* may be vertically adjusted to thereby adjust the bells F to the proper level. The lower edges of the bells F are serrated and the space between the uprising marginal lip *b*³ surrounding each port *b*² and the adjacent depending portion of the bell is sealed by the liquid on the tray. The liquid level on each tray section *b* is normally determined by the height of the discharge weir formed by the lip *b*⁴ over which the liquid flows from the section *b* onto the plate C' which is at the liquid discharge side of each tray.

Each plate C' is formed with a pair of drain outlets which comprises an integral depending pipe portion C⁸ dipping below

the level of sealing liquid beneath the tray. Advantageously the discharge pipes or outlets C^0 lead from depressions in the body portion of the corresponding part of the plate C' which depressions are clearly indicated in Figs. 2, 3, 6 and 7 of the drawings. These depressions materially restrict any tendency of the liquid accumulating on the plates C' in amount sufficient to interfere with the flow of liquid over the corresponding discharge weir formed by the lip b^4 . The drain outlets C^0 of each upper tray B supplies liquid to a weir chamber formed above the segmental plate C of the tray B beneath. The weir of this weir chamber is formed as shown by a weir plate H bolted or otherwise suitably secured to the portion of the marginal flange C^3 of each tray plate C which is adjacent the sections b . Each weir plate H may be welded, or, as shown, connected by bolts H^2 to the plate C to which it pertains, and each weir plate H is formed with a plurality of V-notches H' for distributing the liquid over the various tray sections b . The drain pipes C^0 of the trays B are of such length as to extend into the subjacent weir chamber to a level below the lowermost level of flow through the weir notches H' .

The trays BA, one of which is located immediately above each shell outlet opening A^7 , and which alternate with the trays B, are identical in construction with the latter except, that the tray plate members CA' of the trays BA corresponding to the plate portions C' of the trays B, have drain pipe outlets C^{00} which are shorter than the drain pipes C^0 of the trays B. The drain pipes C^{00} of each tray BA do not dip into the liquid in the weir chamber of the subjacent tray B, but into separate seal chambers I. The latter, as shown, are adjustably suspended (see Figs. 5, 6, and 7) by bolts I' connected at their upper ends to lugs C^{01} on the inner walls of the corresponding drain outlets C^{00} . The two seal boxes I associated with each tray BA are formed in their adjacent sides each with a weir overflow outlet I^2 having an elongated horizontal overflow edge. The liquid discharged through each weir outlet I^2 passes into the weir chamber of the subjacent tray B, or into an outlet trough J, or partly into the latter or partly in the weir chamber of the subjacent tray according to the position of the trough J. The trough J is movable radially of the tower through the corresponding tower shell aperture A^7 , from an intermediate position in which its rear end J' is at the inner side of the corresponding overflow outlets I^2 into an outer position in which the rear edge J' of the trough J is at the outer side of the corresponding weir outlets I^2 . In the last mentioned position the trough J is wholly or largely received within a casing J^2 secured to the tower shell at its outer side at the margin of the corresponding opening

A^7 . The casing J^2 is provided with a flanged outlet J^3 which may be closed by a cover J^4 or outlet J^3 may have a pipe attached for the withdrawal of so much of the condensate as is received within the corresponding trough J. As shown, each trough J is supported on guides J^5 carried by the corresponding casing J^2 and is adjusted radially of the tank shell by means of a spindle J^6 which is journaled in the outer wall of the casing J^2 , and has an internal threaded portion passing through a threaded boss J^7 formed on the trough J. As shown, an external threaded extension J^8 of the spindle J^6 passes through a threaded opening in an indicator pointer J^9 working along a scale J^{10} secured to the casing J^2 and indicating the position of the rear edge of the trough J relative to the overflow outlets I^2 , and thereby indicating what portion of the liquid coming from the tray BA above is being passed onto the subjacent tray and what portion is being passed out of the tower through the trough J and corresponding outlet casing J^2 . As shown, the rear edge J' of each trough J is extended upwardly to form a division plate sharply dividing the streams of liquid coming over the weirs J^2 into portions falling onto the subjacent tray and into other portions received by the trough J.

As shown, the main stack of trays B and BA, is divided into a relatively short upper section and a longer lower section, and between these two tray stack sections we provide, what we call a clean-up section comprising provisions for collecting and rectifying condensate and reflux liquid coming to the clean-up section from the bubble trays above it. The clean-up sections, shown in Figs. 1 and 8, comprise means providing a liquid pocket or stripping section a , and means for scrubbing the condensate collecting in the pocket a with steam or other stripping medium before the liquid is withdrawn from the pocket through the fractional condensate outlet A^5 . The outer wall of the liquid pocket a , is formed by the tower shell, and its inner and bottom walls are formed by a member K which may be described as of inverted funnel shape having a vertical conduit portion K' surrounded by the pocket a , and at the bottom of the latter an outwardly extending flange which extends into contact with, and is secured to the tower shell. As shown, the conduit portion K' of the member K is rectangular in cross section and so proportioned as to fill the central openings in two special trays BB and BC. The trays BB and BC differ from the trays B and BA previously described, only in that the three central sections b of the latter are omitted in each of the trays BB and BC, to provide an opening receiving the conduit portion K' of the member K. To seal the joints between the conduit section K' and

the adjacent edges of the trays BB and BC, the conduit portion K' is provided on its outer side with downwardly inclined flanges or hoods K² which overlap the upwardly rising flanges at the margins of the adjacent portions of the trays BB and BC. The steam inlet A⁴ and the fractional condensate outlet A⁵ open to the pocket *a* below the tray BC therein.

As shown, we also provide a second clean-up section at the bottom of the bottom stack section of trays B and BA, and between the latter and the inlet A'. The last mentioned clean-up section comprises a liquid pocket *aa* formed by a member K and trays BB and BC as in the clean-up section first described. The fractional condensate outlet A⁵, and the corresponding steam inlet A⁴ open to the liquid pocket *aa* below the tray BC therein.

Below the oil and vapor inlet A' and residuum outlet A³ is advantageously located a short tray stack composed as shown, of three trays BD, each of which may be like the trays B previously described, and so relatively arranged that the central tray BD has its drain outlets C⁹ at the opposite side of the tower from the drain outlets C⁹ of the other two trays BD. As shown, steam inlets A⁴ to the tower are provided immediately above and immediately below the trays BD.

To provide an initial separation of oil and vapor, we advantageously arrange the oil and vapor inlet A' so that it discharges in a tangential direction against the inner wall of the tower shell, or preferably, as shown, against a curved plate L. The latter is in the form of a spiral, the axis of which is parallel to the tower axis, and is so disposed that one end contacts with the tower shell adjacent the inlet A' while the body of the plate L is spaced away from the tower shell by a distance increasing with the distance along the length of the plate L, from the inlet A'. The plate L is formed with a multiplicity of fine apertures L' through which liquid carried by the vapor entering through the inlet A' is driven by centrifugal force, and the vapor thereby separated in large part from entrained liquid which passes down onto the subjacent tray BD adjacent the periphery of the tower shell and out of the path of the vapors rising from that tray.

At various levels above the inlet A' the tower is advantageously provided with horizontal vapor distributing and liquid and vapor separating devices or screens M and MA. Each liquid and vapor separator M comprises a multiplicity of parallel blades or plates M' which extend horizontally across the tower and lie in planes inclined to the horizontal at an angle of 45° or so. As shown, the angle is a little greater than 45°. The blades M' are spaced apart to provide a corresponding series of inclined ports. In practice the blades M' are so spaced that

the upper edge of each blade will overlap the lower edge of a blade alongside of it so that vertically upmoving drops of liquid coming to the separator necessarily impinge against one or another of the blades M' thereof.

To facilitate assemblage, the blades M' of each separator M, are formed in sections each comprising a number of blades M', and each extending from a plane extending diametrically of the tower to the periphery of the latter. The blades of each section have their ends adjacent the tower shell secured to an arc-shaped bar N, and their opposite ends connected to a straight bar N'. In addition the bars of each section are connected to stiffening devices N² in the form of flat bars secured to the top edges of the blades M' and extending diagonally of the latter. The blades M' of each section are advantageously connected to the corresponding bars N, N', and N² by welding. The various bars N of the sections of each separator M, rest upon a circumferentially extending rib D secured to the tower shell, and the corresponding bars N' rest on a beam D⁴ extending diametrically across the tower.

The liquid collecting on the various blades M' and tending to drip from the lower edges of the latter is advantageously diverted out of the path of the uprising vapor stream. The means shown for this purpose comprises a trough M² formed at the lower edge of each blade M'. As shown, this trough is formed by slitting each blade along lines parallel to its length and adjacent its lower edge as indicated at M³, except for connecting neck portions M⁴. After the slits M³ are formed, the lower portion of the blade is bent up underneath the body of the blade to form the trough M², the bending being so carried out that the upper edge of the part cut away from the body of the blade by each slit M³ will project upward away from the upper side of the body of the blade M', and serve to guide liquid running down the upper side of the blade into the trough M² which extends beneath the under side of the blade.

While the blades M may properly be described as horizontally disposed, the individual blades may be slightly inclined to the horizontal for drainage purposes or the lower edges of the blades may be so inclined as shown in Figs. 4 and 11, each support D⁴ being located at a lower level than the corresponding support D. Each trough M² is therefore inclined downward toward the diametral plane including the supports D⁴. Each support D⁴ carries troughs O receiving the liquid discharged by the corresponding troughs M². There are two end to end troughs O at each side of each bar D⁴, the two end to end troughs O being inclined to the horizontal downwardly from the center of

the tower to the periphery of the latter. As shown, there are three separators M immediately beneath the pocket *aa*, and three liquid screens M immediately beneath the vapor outlet A².

Beneath the tray sections *b* of each of the trays B and BA above the liquid pocket *a*, and of the tray BA immediately above the liquid pocket *aa*, is located a corresponding liquid and vapor separator MA which is carried by the tray above it. Each separator MA is formed of blades M' which may be shaped and relatively arranged as are the blades M' of the separating screens M. As shown, the blades M' of the separator MA extend transversely to the elongated ports *b*² of the tray B or BA above the separator, and each separator MA is divided into three sections, the blades M' of which are mechanically connected together by bars NA, N', and N². As shown, each separator MA differs from the separator M essentially only in that the former does not include the two side sections of the separator M which, if present, would extend under the inlet and outlet tray portions C and C' of the bubble tray above the separator MA. The sections of each separator MA are carried in part by corresponding beams D⁵, which are supported at their ends, as shown, by hangers P secured to the corresponding tray supporting beams D' and D². The central beams D⁵ which are at a lower level than the side beams D, support troughs O' which discharge liquid received thereon from the troughs M² of the separators MA, onto the drain plate segment C' of the subjacent tray B or BA.

In any particular use of a fractionating tower of the type disclosed under any particular set of operating conditions, we contemplate that many of the openings J³ in the boxes J² will be closed by cover plates J⁴, as shown in Fig. 1, or, indeed, that some of the boxes J² may be omitted, the corresponding openings A⁷ in that case being closed by suitable cover plates. It is a characteristic advantage of our invention, however, that it is possible to withdraw a fractional condensate through each outlet opening A⁷, and that the tower levels at which separate fractional condensates are withdrawn may be readily made whatever seems desirable for the best results under any particular set of operating conditions. The particular fractionating tower with the condensate outlet connections thereto illustrated in Fig. 1, was primarily designed to receive petroleum oil and vapors coming to the tower from an oil heater so heated and operated as to evaporate with little or no cracking practically all of the vaporizable constituents of crude petroleum except the tars.

Under such conditions, and with the outlet connections shown in Fig. 1, all of the gasoline constituents recovered pass out of

the tower in vapor form through the vapor outlet A², while kerosene is withdrawn from the liquid pocket *a* through the pipe OA connected to the outlet A⁶, heavy cylinder oil is withdrawn from the liquid pocket *aa* through the pipe R connected to the outlet A⁶, so-called gas oil is withdrawn from the tower at an upper level intermediate the pockets *a* and *aa* through piping P, and so-called wax distillates are withdrawn from the tower at a lower intermediate level through piping Q. As shown the piping P is connected to the outlets J³ of a pair of adjacent boxes J² by separate valved branches P', and the piping Q is similarly connected to the tower at three adjacent levels by separate valved branches Q'. With separate pipe connections to the tower at closely adjacent levels, it is obviously easy to instantly vary the level from which a corresponding fractional distillate is withdrawn as conditions may require to insure the proper quality or boiling point of the fraction withdrawn, without opening the tower and without interfering with its operation in any manner. This obviously facilitates the initial starting of the tower into operation under any given set of operating conditions, and permits of a quick and easy variation in the levels at which the intermediate condensates are withdrawn as conditions of operation may vary. With the particular character of use referred to above, the purity and character of the kerosene and heavy cylinder oil constituents withdrawn from the liquid pockets *a* and *aa* may be controlled by regulating the temperature and amount of steam (ordinarily superheated) which is passed into each pocket through the corresponding steam inlet A⁴. The purity of the kerosene fraction is enhanced, moreover, with the construction shown by diverting some of the condensate directly received on the tray B immediately above the upper clean-up section away from the liquid pocket *a* thereof, through a pipe S, which returns the liquid to the tower above the tray B immediately beneath that clean-up section.

The construction disclosed possesses important practical advantages. Especially to be noted is the flexibility of the tower in respect to the variations permitted in the quantity and the character of the different fractional condensates withdrawn. The tray construction is simple and relatively inexpensive and permits of the effective distribution of the liquid flowing over trays substantially larger in horizontal cross section than have heretofore been employed in bubble tray stills or towers in regular use. The leveling provisions for the trays and for the bells for sealing the vapor ports in the trays insure the proper depth of liquid in all portions of the liquid seal through which the gas and vapor bubble in passing from the space below each

tray to the space above it. It will be observed, moreover, that even though the different tray sections b of each tray are not brought to exactly the same level, each individual section, if properly leveled, will receive its proper share of the liquid from the corresponding notches H' of the weir H , and that the liquid received will be properly distributed over the tray section. The manner in which the ports b^2 are elongated and the direction in which they extend relative to the direction of liquid flow avoid the formation of stagnant pools of liquid on the trays through which the gas and vapors might bubble without achieving the effect which such vapor and liquid contact is intended to produce. The means for sealing the joints between the sections of each tray are simple and effective. The initial separation of liquid from the gases and vapors by the device L , and the subsequent repeated separating effects of the various separators M and MA , contribute to the efficiency and capacity of the apparatus. Quite aside from their liquid and vapor separating action the devices M and MA serve as vapor mixing and distributing trays or screens tending to produce a uniform composition and a uniform distribution of flow of the gases and vapors passing through each such distributing action tray or screen. The vapor distributing of the screen trays MA is enhanced when, as shown, the elongated gas passages between the tray blades are transverse to the elongated tray ports b^2 . The introduction of the oil, vapor and gas mixture from the heater into the tower between the main upper tray stack section and the lower tray stack section formed by the trays BD is advantageous in that it insures the elimination of the final small quantity of light material from the heavy residue with the use of a relatively small amount of superheated steam. The stack section formed by the trays BD provides a liquid seal preventing the downflow of vapors from the space above those trays into contact with the liquid collecting at the bottom of the tower. Bottoms with a high flash point are thus readily obtained which is not practically possible even with the use of a much larger amount of superheated steam when the oil, gas and vapor mixture is admitted to the tower below all the trays as is usual. The construction as a whole, is well adapted for its use in a fractionating tower of relatively very large capacity adapted for use under widely different conditions. The sectional tray and separator screen constructions facilitate the construction of the parts and their insertion and removal through suitable manholes in the tower shell.

While in accordance with the provisions of the statutes, we have illustrated and described the best form of embodiment of our invention now known to us, it will be apparent to those

skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of our invention as set forth in the appended claims and that in some cases certain features of our invention may be used to advantage without a corresponding use of other features.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:

1. A bubble still tray comprising a central rectangular ported portion and two opposing pairs of segmental plates uniting with the said central portion to form a tray of curved outline.

2. In a bubble still tray, a rectangular portion formed with parallel elongated gas ports each extending nearly the full distance between opposite edges of said portion, and a weir extending along each of said edges, one of said weirs being notched to distribute liquid flowing over the weir onto said portion along the corresponding edge of said portion while the other weir is adapted to regulate the liquid level on said portion.

3. In a bubble still tray, a rectangular portion formed with parallel elongated gas ports each extending nearly the full distance between opposed end edges of said portion, and a notched weir extending along one of said edges and adapted to distribute liquid flowing over the weir onto said portion along the length of the corresponding end of the portion.

4. In a bubble still, the combination of tray supports, trays each comprising a plurality of separable sections, and level adjusting devices carried by the different sections and engaging the corresponding tray supports.

5. In a fractionating tower, the combination with a bubble tray comprising a rectangular ported portion and segmental plates uniting with said ported portion to form a tray of circular outline, supports for said tray comprising beams beneath the latter adjacent and parallel to opposite side edges of said portion, a liquid and vapor separating screen beneath said tray, and supporting means therefor including beams transverse to and supported by the first mentioned beams.

6. In a fractionating tower having a multiplicity of fractional condensate outlets distributed at short intervals along the length of the major portion of the tower, a multiplicity of bubble trays located one above each outlet, and means whereby liquid collecting on the bubble tray immediately above each outlet opening may be discharged from the tower through said outlet opening or passed to the tray below, said means including a trough-like member extending through said opening and adjustable toward and away from the center of the tower.

7. In a fractionating tower having an outlet opening in its wall, a bubble tray within said tower above said opening and having a depending liquid drain pipe, a seal chamber into which said pipe dips and having a weir discharge, and means including a liquid receiver adjustable through said opening for receiving and discharging through said opening a greater or smaller portion of the liquid passing over said weir depending on the adjustment of said liquid receiver.

8. In a fractionating tower having a superposed series of outlet openings in its wall, external chambered casings secured to said tower, and each open to the interior of the tower through a corresponding opening and each having an outlet in its bottom wall and a liquid receiver associated with each casing and movable through the corresponding tower opening into position to pass more or less liquid from said tower to said casing outlet, and means for adjusting each of said receivers comprising an operating member extending through the wall of the corresponding casing.

9. In a fractionating tower, the combination with the tower shell, of a stack of bubble trays each comprising a series of side by side sections, each of the latter being formed with one or more gas ports, means providing a liquid seal for each such port, trays at the bottom of said stack and each differing from the first mentioned trays in that some of said sections are omitted, an open ended hollow member passing through the portion of the last mentioned trays from which said sections are omitted, said member having its lower end enlarged and attached to said shell to form an annular liquid space in which the last mentioned trays are mounted, and means for injecting steam into said space.

10. In a fractionating tower, having a tangential liquid and vapor inlet, the combination therewith of a perforated baffle within the tower having its receiving end approximately parallel to and adjacent the discharge end of said inlet and curving away from the shell wall to provide space through which liquid passing through the perforations in the baffle may be diverted away from the path of vapor flow through the tower.

11. A bubble still tray comprising a plurality of similar side by side sections each formed with an uprising marginal flange and with a plurality of side by side elongated gas ports and with an uprising lip surrounding each of said ports, a bell receiving the lip of each port, and bell supporting means adjustable to raise and lower the bells associated with each section, said means comprising bolts tapped into said section and adjustable clamping nuts carried by said bolts.

12. In a bubble still tray, a rectangular portion formed with parallel elongated gas

ports each extending nearly the full distance between opposed end edges of said portion, and a weir extending along one of said edges and adapted to distribute liquid flowing over the weir onto said portion along the length of the corresponding end of the portion.

13. In a fractionating tower having an outlet in its wall, a bubble tray within said tower above said opening and having a depending liquid drain pipe, a seal chamber into which said pipe dips and having a discharge weir, and means including a liquid receiver adjustable through said opening away from and toward the center of the tower for receiving and discharging through said opening a greater or smaller portion of the liquid passing over said weir depending on the adjustment of said liquid receiver, said weir extending parallel to the direction of adjustment of said receiver.

14. In a fractionating tower having an outlet in its wall, a bubble tray within said tower above said opening and having a depending liquid drain pipe, a seal chamber into which said pipe dips and having a discharge weir, means including a liquid receiver adjustable through said opening away from and toward the center of the tower for receiving and discharging through said opening a greater or smaller portion of the liquid passing over said weir depending on the adjustment of said liquid receiver, said weir extending parallel to the direction of adjustment of said receiver, and said receiver having a plate-like projection adjacent and transverse to said weir sharply dividing the liquid flowing over said weir into two streams, one only of which is received in said receiver.

15. In a fractionating tower having a tangential liquid and vapor inlet, the combination therewith of a perforated baffle located within said tower adjacent said inlet and against which entering liquid and vapor impinge, said baffle being spaced away from the tower wall to provide space for the flow of liquid passing through the baffle perforations.

16. Fractionating apparatus comprising a shell, members within said shell for contact of down-flowing liquid oil with up-flowing vapors, means forming a pocket within said shell, means for dividing down-flowing liquid and causing some down-flowing liquid to pass into said pocket and some down-flowing liquid to by-pass said pocket to an earlier stage of the fractionating system, means for by-passing up-flowing vapor around said pocket, means to introduce steam into said pocket into direct contact with oil therein, and means to withdraw liquid from said pocket.

17. Fractionating apparatus comprising a shell, members within said shell for contact of down-flowing liquid oil with up-flowing

- vapors, means forming a pocket within said shell, means comprising a weir and a member movable across said weir for dividing down-flowing liquid and for causing some down-flowing liquid to pass into said pocket and some down-flowing liquid to by-pass said pocket to an earlier stage of the fractionating system, means for by-passing up-flowing vapor around said pocket, means to introduce steam into said pocket into direct contact with oil therein and means to withdraw liquid from said pocket.
18. Fractionating apparatus comprising a shell, members within said shell for contact of down-flowing liquid oil with up-flowing vapors, means forming a tubular passage within said shell and a pocket around said tubular passage within said shell, means for dividing down-flowing liquid and causing some down-flowing liquid to pass into said pocket and some down-flowing liquid to by-pass said pocket to an earlier stage of the fractionating system, said tubular passage serving for by-passing up-flowing vapor around said pocket, means to introduce steam into said pocket into direct contact with oil therein, and means to withdraw liquid from said pocket.
19. Fractionating apparatus comprising a shell, members within said shell for contact of down-flowing liquid oil with up-flowing vapors, means forming a vertical tubular passage within said shell and a pocket around said tubular passage within said shell, means comprising a weir and a member movable across said weir for dividing down-flowing liquid and for causing some down-flowing liquid to pass into said pocket and some down-flowing liquid to by-pass said pocket to an earlier stage of the fractionating system, said tubular passage being adapted to by-pass up-flowing vapor around said pocket, means to introduce steam into said pocket into direct contact with oil therein and means to withdraw liquid from said pocket.
20. Fractionating apparatus comprising a shell, members within said shell for contact of down-flowing liquid oil with up-flowing vapors, means forming a pocket within said shell, a plurality of bubble trays in said pocket, means for dividing down-flowing liquid in the apparatus and causing some down-flowing liquid to pass into said pocket and some down-flowing liquid to by-pass said pocket to an earlier stage of the fractionating system, means for by-passing up-flowing vapor around said pocket, means to introduce steam into said pocket into direct contact with oil therein, and means to withdraw liquid from said pocket.
21. A tower for fractionating oil and the like comprising a shell, a plurality of trays in said shell having gas ports, means for flowing liquid downwardly from tray to tray alternately on opposite sides of the shell providing a direction of flow of liquid across each tray and means on each tray for distributing liquid on such tray across the trays transversely to said direction of flow.
22. A tower for fractionating oil and the like comprising a shell, a plurality of trays in said shell having gas ports, means for flowing liquid downwardly from tray to tray and means on each tray for distributing liquid on such tray into a plurality of paths of flow.
23. A tower for fractionating oil and the like comprising a shell, a plurality of trays in said shell having elongated gas ports, means for flowing liquid downwardly from tray to tray and means on each tray for distributing liquid on such tray transversely of the direction of extent of said ports and dividing the liquid into a plurality of paths of flow directed in the direction of extent of said ports.
24. A tower for fractionating oil and the like comprising a shell, a plurality of trays in said shell having gas ports, means for supporting the trays, means for flowing liquid downwardly from tray to tray, means on the tray for distributing liquid received thereon from the superposed tray across the tray and threaded means engaging the tray supporting means for leveling the tray.
25. A tower for fractionating oil and the like comprising trays having elongated gas ports and baffling members below the trays extending transversely to the gas ports and means for conducting the liquid collecting on said baffles to the side of the tower.
26. In a fractionating tower, a bubble tray having elongated gas ports, means whereby liquid flows over said tray in a given direction of flow, said ports extending in said direction of flow and means arranged below said tray and transverse to said direction of flow comprising a plurality of members inclined to the horizontal for separating liquid and vapor and means for conducting liquid collecting on said members to the side of the tower.
27. In a fractionating tower, adjacent bubble trays having parallel elongated gas ports, means whereby liquid flows over each tray in a given direction of flow, the direction of flow on one tray being parallel to and opposite in direction to the flow on the adjacent tray, the gas ports of the trays extending in the same direction and in the direction of flow and means between the trays for separating liquid from vapor comprising a plurality of baffling members extending transversely to the direction of extent of the gas ports and means for conducting liquid collecting on said baffling members to the side of the tower.
28. In a fractionating tower, adjacent bubble trays having parallel elongated gas ports, means whereby liquid flows over each tray in a given direction of flow, the direction of flow on one tray being parallel to and opposite in

direction to the flow on the adjacent tray, the gas ports of the trays extending in the same direction and in the direction of flow, means between the trays for separating liquid from vapor comprising a plurality of flat members inclined to the horizontal and extending transversely of the direction of extent of the gas ports and means for conducting liquid from the last mentioned means to the side of the tower.

29. In a fractionating tower, a bubble tray, a stationary member receiving liquid from said bubble tray, said stationary member having an overflow edge, means for leveling the stationary member and adjustable means cooperating with the overflow edge for receiving a portion of the liquid over-flowing the edge and withdrawing such portion from the tower and a bubble tray below said overflow edge receiving the liquid not withdrawn.

30. In a fractionating tower, a bubble tray, a stationary member suspended from said bubble tray and arranged to receive liquid therefrom, said stationary member having an overflow edge, means for leveling the tray and thereby the overflow edge and adjustable means cooperating with the overflow edge for receiving a portion of the liquid over-flowing the edge and withdrawing such portion from the tower and a bubble tray below said overflow edge receiving the liquid not withdrawn from the tower.

31. Apparatus for the fractional distillation of hydrocarbon oils and the like comprising a shell, means in the shell for passing oil vapors counter-current to and in contact with reflux oil and means in the shell for passing a portion of the reflux oil counter-current to and in contact with a stripping medium and out of contact with the oil vapors for removing low boiling constituents from said portion.

32. Apparatus for the fractional distillation of hydrocarbon oils and the like comprising a shell having an oil inlet and a vapor outlet, means in the shell for passing oil vapors counter-current to and in contact with reflux oil and means in the shell intermediate the oil inlet and vapor outlet for passing a portion of the reflux oil intermediate the lightest and heaviest fractions thereof counter-current to and in contact with a stripping medium and out of contact with the oil vapors for removing low boiling constituents therefrom.

33. Fractionating apparatus comprising a shell, bubble trays in the shell, means between the trays for separating entrained liquid from oil vapor comprising a plurality of baffles and means comprising a trough for each of said baffles adapted to conduct liquid from the baffles to the side of the tower.

34. Fractionating apparatus comprising a shell, bubble trays in the shell, means between the trays for separating entrained liquid

from oil vapor comprising a plurality of baffles, a trough for each baffle adapted to conduct liquid from the baffles and a trough adapted to receive liquid from the first mentioned troughs and conduct it to the side of the tower.

35. Fractionating apparatus comprising a shell, bubble trays in the shell, means between the trays for separating entrained liquid from oil vapor comprising a plurality of baffles and a trough disposed substantially at right angles to said baffles for conducting liquid from said baffles to the side of the tower.

36. A bubble tray comprising a central rectangular ported portion and an opposing pair of segmental plates at opposite ends of said central portion, each of said plates and said central tray portion having co-acting flange portions providing a liquid seal for the joint between the plates and said portion.

37. A bubble tray comprising a rectangular portion having a plurality of elongated ports extending approximately from end to end thereof, bubble caps for said ports, segmental portions adjoining the sides and an end of the rectangular portion, a weir extending along said end of the rectangular portion and having notches for distributing the liquid flowing from the end segmental portion onto the rectangular portion for flow thereon from end to end of the rectangular portion and along the sides of the elongated ports, and a weir extending along the other end of the rectangular portion for determining the height of the liquid on the rectangular portion and over which the liquid from the rectangular portion is adapted to flow.

38. A bubble tray comprising a rectangular portion having a plurality of elongated ports extending approximately from end to end thereof, bubble caps for said ports, segmental portions adjoining the sides and an end of the rectangular portion forming a tray of generally curved perimeter, said side segmental portions being raised above the bottom of the rectangular portion, a weir extending along said end of the rectangular portion and having means for distributing the liquid flowing from the end segmental portion onto the rectangular portion for flow thereon from end to end of the rectangular portion and along the sides of the elongated ports, and a weir extending along the other end of the rectangular portion for determining the height of the liquid on the rectangular portion and over which the liquid from the rectangular portion is adapted to flow.

39. Apparatus for the fractional distillation of hydrocarbon oils comprising a shell having an oil inlet in its lower portion and a vapor outlet in its upper portion, a plurality of spaced bubble trays in the shell for contacting vapors of the oil with reflux oil, said bubble trays extending substantially from

- the oil inlet to the vapor outlet, means for withdrawing vapors of the oil from the top of the shell, means for withdrawing one or more fractions from the shell intermediate the oil inlet and vapor outlet, a stripping section in the shell above the oil inlet, means causing reflux to flow into the stripping section, means for introducing steam into the stripping section, means for withdrawing steamed reflux from the stripping section, bubble trays in the shell below the oil inlet, means for introducing steam in the shell below the last-mentioned bubble trays to thereby contact with steam the unvaporized portion of the oil introduced into the shell through the oil inlet and means for withdrawing from the shell said unvaporized oil, after contact with steam.
40. A fractionating tower having a liquid and vapor inlet and a curved baffle located within the tower and spaced from the tower wall and against which entering liquid and vapor impinge to aid in the initial separation of oil and vapor.
41. A fractionating tower having a tangential liquid and vapor inlet and a curved baffle located within the tower with one end thereof adjacent the inlet spaced from the tower wall and against which the entering liquid and vapor impinge to aid in the initial separation of oil and vapor.
42. Apparatus for the fractional distillation of hydrocarbon oils comprising a shell having an oil inlet in its lower portion and a vapor outlet in its upper portion, a plurality of spaced bubble trays in the shell for contacting vapors of the oil with reflux oil, said bubble trays extending substantially from the oil inlet to the vapor outlet, means for withdrawing vapors of the oil from the top of the shell, means for withdrawing one or more fractions from the shell intermediate the oil inlet and vapor outlet, a stripping section in the shell above the oil inlet, means causing reflux to flow into the stripping section, said stripping section being arranged so that the reflux flowing thereinto is out of contact with the oil vapors flowing upwardly through the shell, means for introducing steam into the stripping section, and means for withdrawing steamed reflux from the stripping section.
43. A bubble tray having a plurality of relatively elongated gas ports spaced to provide therebetween uninterrupted paths of liquid flow in one direction across the greater part of the tray, and a notched weir on the tray adjacent one end of the gas ports for distributing liquid on the tray to the several paths of flow.

Signed at New York city, in the county of New York, and State of New York, this 3rd day of May A. D. 1926.

JOHN PRIMROSE.

HARRY R. SWANSON.