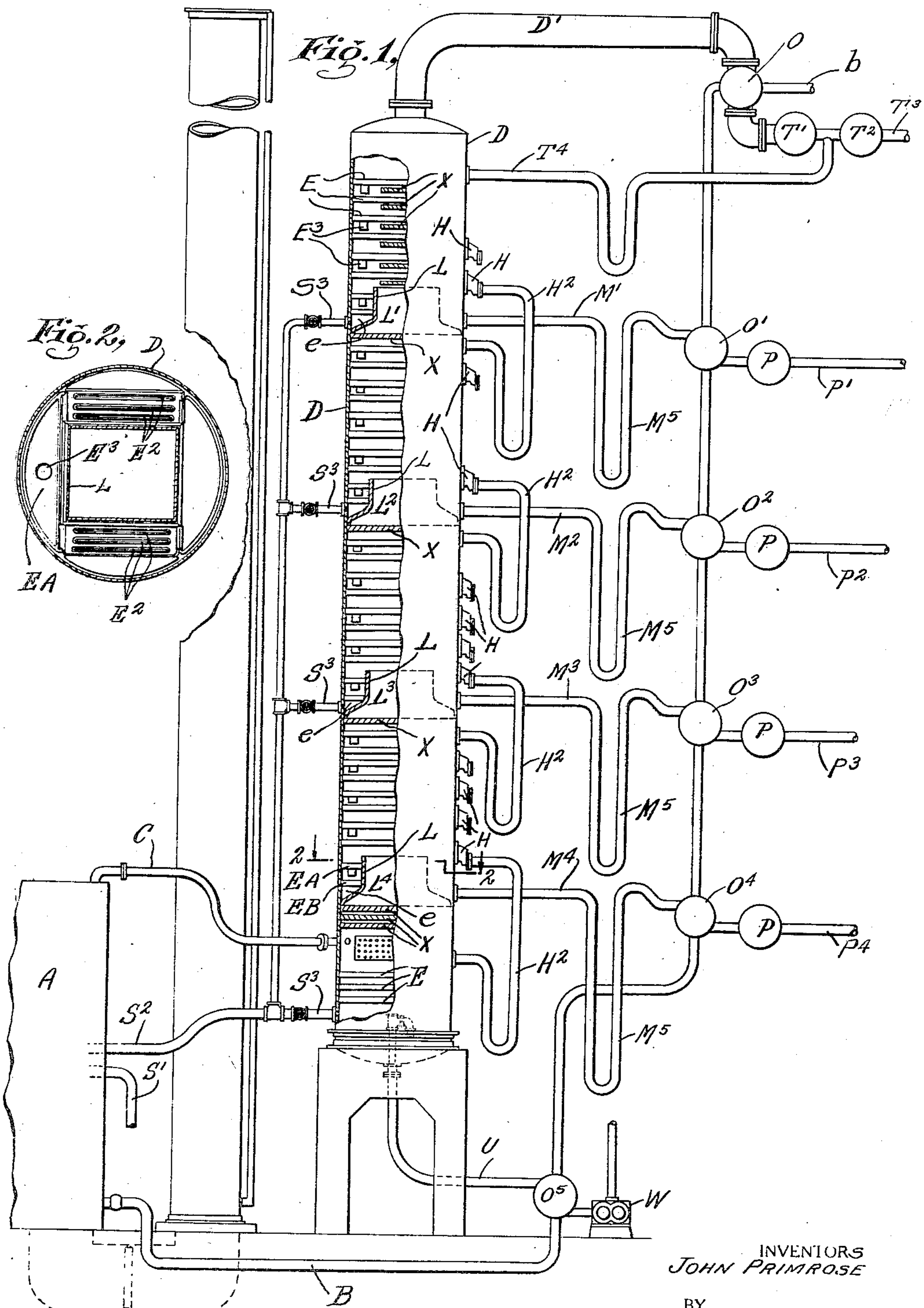
Jan. 10, 1933. J. PRIMROSE 1,893,907

FRACTIONATING METHOD

Filed April 8, 1927 2 Sheets-Sheet 1



INVENTORS
JOHN PRIMROSE

BY
John E. Hubbell
ATTORNEY

Jan. 10, 1933.

J. PRIMROSE

1,893,907

FRACTIONATING METHOD

Filed April 8, 1927

2 Sheets-Sheet 2

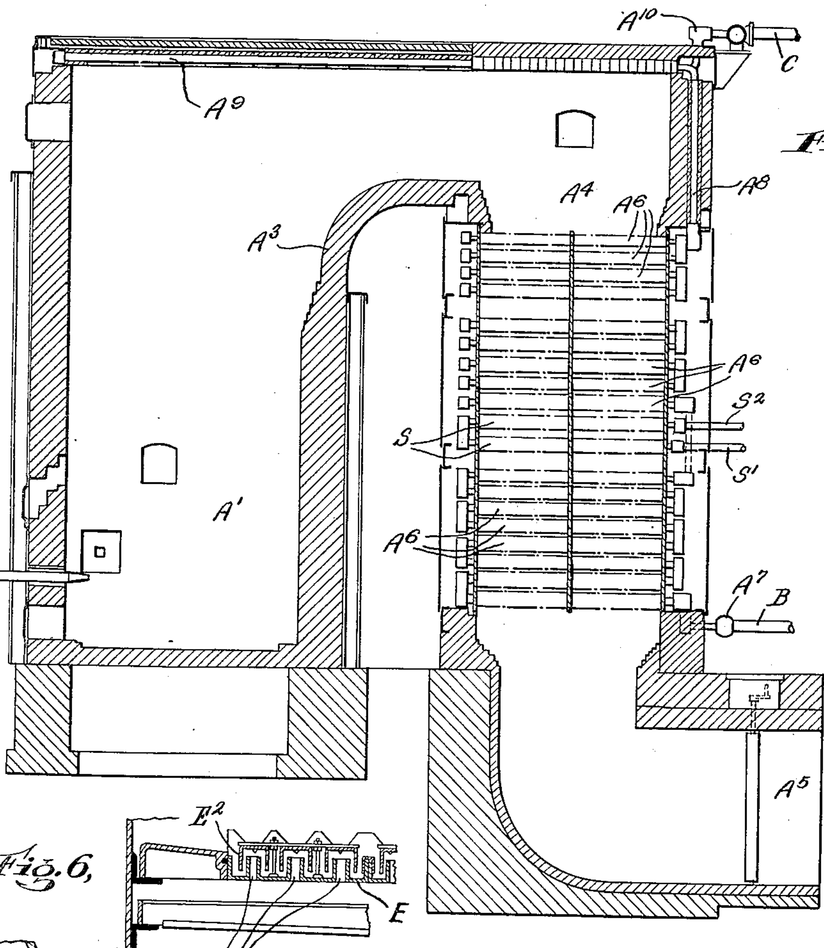


Fig. 3,

Fig. 6,

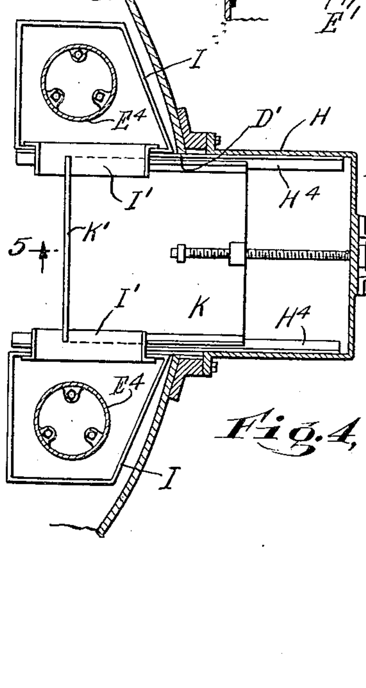


Fig. 4,

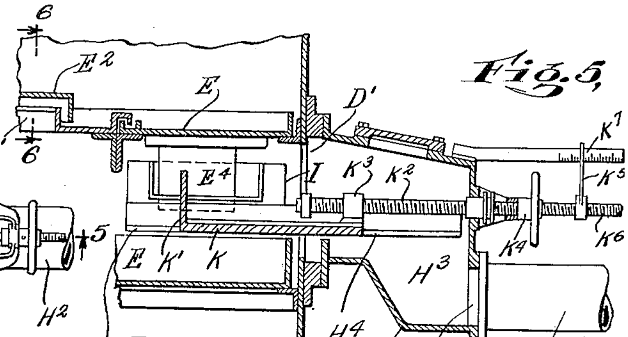


Fig. 5,

INVENTORS
JOHN PRIMROSE

BY

John E. Hubbell
ATTORNEY

Patented Jan. 10, 1933

1,893,907

UNITED STATES PATENT OFFICE

JOHN PRIMROSE, OF RICHMOND, NEW YORK, ASSIGNOR TO FOSTER WHEELER CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

FRACTIONATING METHOD

Application filed April 8, 1927. Serial No. 181,973.

The general object of the present invention is to provide an improved method of fractionally distilling stock oil such as crude petroleum or the relatively heavy residues of other mineral oil distillation processes, to produce fractions with small differences in boiling point differentials between the fractions but having certain clearly defined differences in physical characteristics. The invention was primarily devised and is especially adapted for the production from stock oil of the character specified of lubricating oil fractions with small overlapping from the viscosity standpoint of the fractions.

The invention is characterized primarily by the fact that the stock oil is heated to the maximum temperature required in the process with such uniformity and rapidity as to substantially avoid the cracking which would occur if the oil were heated to the same temperature at the slower rate of which oil is normally heated to such temperatures in ordinary oil refining operations. In practice I thus heat the oil in a tubular oil heater which may be the same as, or similar in type to ordinary tubular oil heaters, but for the purposes of the present invention the number of, or the manner of connecting the tubes, or the rate at which the oil is passed through the tubes is such that the required time for each particle of the oil to pass through the heater tubes is substantially smaller than has heretofore been the practice in heating oil in a tubular oil heater for oil refining purposes.

After being thus heated the oil is treated in a fractionating tower in which the oil, and the condensates formed in the upper portion of the tower from vapors liberated in the lower portion of the tower are subjected to an intimate contact with the steam and vapors passing up through the tower from which the desired fractions are withdrawn at substantially different levels.

By proceeding in the manner described I am able to produce lubricating oil fractions with small overlapping of the fractions from the viscosity standpoint, although the fractions differ but little from one another in boiling point and viscosity. Furthermore I may produce such fractions not only from asphaltic base petroleums, but also from paraffin base petroleums which are easier to crack than asphaltic base petroleums, and also from the heavier distillates obtained in various mineral oil distillation processes. As a result of the speed with which the oil is heated and treated, a relatively large capacity may be had with apparatus of given bulk. Furthermore, the apparatus required is comparatively simple and inexpensive in construction, and is characterized by relatively low maintenance and operation costs.

The various features of novelty which characterize my 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 I have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is a diagrammatic representation of apparatus for use in carrying out the method;

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

Fig. 3 is a sectional elevation of an oil heater shown in Fig. 1;

Fig. 4 is a partial sectional plan;

Fig. 5 is a section on the line 5—5 of Fig. 4; and

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

The particular form of apparatus illustrated in the drawings for use in carrying out the method comprises a tubular oil heater A receiving oil from a supply pipe B and delivering oil and oil vapors to a fractionating tower D through an outlet pipe C.

The oil heater A may be of various types provided it is capable of operation in such manner as to progressively heat the oil to the maximum temperature required with a rate of flow of oil through the tubes of the heater which is sufficiently rapid to avoid appreciable cracking of the oil. As shown, the heater A comprises a combustion chamber A′ in which fluid fuel supplied by one or more burner nozzles A^2, is burned and from which the products of combustion pass over a bridge wall A^3 into the upper end of a chamber A^4 through which the heating gases pass downward to an outlet connection A^5 shown as delivering the heated gases to a stack creating the necessary draft. Located in the chamber A^4 are superposed rows of horizontally disposed tubes A^6 advantageously provided with external corrugation ribs to increase their heat absorbing surface. The stock oil supply pipe B is connected to one or more of the tubes A^6 in the bottom row of tubes through an inlet header A^7. The oil passes successively through tubes A^6 at successively higher levels until it reaches an outlet pipe or pipes A^8 through which the oil is passed to tubes A^9 lining the roof of the heater. The tubes A^9 are heated mainly by the absorption of radiant heat. The oil passes from the tubes A^9 through the outlet connection A^{10} to the delivery pipe C.

The heater A, as shown, is of the well known Foster heater type now in extensive commercial use. As is ordinarily the case in heaters of this type, the tubes A^6 and A^9 may be so connected that the oil may pass successively through all or a substantial portion of the tubes A^6 in any lower row before passing to the tubes A^6 in the row immediately above, and may pass in series through all or a substantial portion of the tubes A^9, though instead of a single undivided oil flow path including all of the tubes A^6 and A^9 connected in series, the tubes may be connected to divide the entire path of flow, or some portions thereof into separated parts in which the flow is in parallel. In any event, the heater employed differs from tubular oil heaters heretofore used by such a decrease in the length of the path of oil flow, and/or such an increase in the velocity of the oil, that the time required for any particular particle of oil to travel from the inlet header A^7 to the outlet header A^{10} is but a relatively small fraction of the time required for the oil to pass from the inlet to the outlet of tubular oil heaters employed in ordinary oil refining operations.

For example, in treating crude asphaltic base petroleum for the production of lubricating oils in accordance with the present invention, I have obtained excellent results by heating the oil from an initial temperature of 300 degrees F. to a final temperautre of 775 degrees F. in a heater of the type shown in which the tubes connected in series between the oil inlet and the oil outlet provided a path of oil flow 1200 feet in length, and through which the time of travel of any particle of oil was about 10 to 12 seconds. It will be understood, of course, that the figures just mentioned are given by way of illustrative description and may be widely departed from while still proceeding in accordance with the invention herein disclosed and claimed.

Advantageously, though not necessarily, the steam employed in the fractioning power D is superheated by passing it through a convection superheater S located in the chamber A^4 between upper and lower banks of tubes A^6 at a suitable elevation. The steam to be superheated is passed to the superheater S through a steam supply pipe S′ and the superheated steam is passed from the superheater through a pipe S^2 to inlets S^3 opening to the tower D at suitable levels.

The fractionating tower D, comprises a suitably elongated vertically disposed shell, with provisions for effecting intimate contact therein between ascending oil vapors and steam and descending liquid, and for obtaining a desirable reflux action at the top of the tower, and for injecting steam into, and for withdrawing condensate fractions from the tower at suitably different levels.

As shown, the tower D, which constitutes a fractionating zone, is of the type disclosed and claimed in my copending application filed jointly with Harry R. Swanson under Serial No. 106,866, May 5, 1926. The means for effecting the desired liquid and vapor contact comprise a multiplicity of superposed bubble trays E, which may be of any usual and suitable construction. As shown, the trays E are formed with a plurality of elongated side by side gas ports E′ each surrounded by a marginal flange at the upper side of the tray, and extending into a corresponding bell E^2. Each tray E is provided with liquid draining provisions. As shown, every alternate tray E is provided with a simple drain pipe extension E^3 located at one side of the shell and extending downward into proximity with the subjacent tray E so that the lower end of the drain pipe may be sealed by the liquid normally carried by the subjacent tray. Some or all of the intermediate trays E, are provided with two side by side short drain pipes E^4 (see Figs. 4 and 5), each dipping into a corresponding receptacle I. Each receptacle I is formed with a weir notch or orifice I′ from which liquid overflows.

The liquid overflowing from the two receptacles I pertaining to the same tray E may fall wholly or partly onto the subjacent tray E, or may be received in part or in whole in an adjustable trough-like member K employed to pass liquid into a corresponding condensate outlet box H. While in any particular installation, operating under any particular condition of use, liquid is withdrawn from the tower through outlet boxes H associated with a small portion only of the total number of trays E, I consider it ordinarily desirable to provide the tower with an outlet box H associated with every other one of the trays E, so that the levels at which condensate fractions may be withdrawn from the tower through the outlet boxes H may be readily varied by changing the external pipe connections, but to simplify the drawings I have shown some only of the outlet boxes H ordinarily provided.

As shown, each outlet box H is bolted to the shell of the tower with an open side of the box in register with a corresponding opening D′ in the tower shell, and each outlet box is formed with a condensate outlet H′ which may be closed by a suitable cap or plate, or may be connected to an outlet pipe H^2, accordingly as condensate is, or is not, to be withdrawn from the tower through that box H. As shown, the trough K associated with each box H extends through the corresponding port D′ and is movable toward and away from the axis of the tower D on guides H^4 carried by the corresponding box H. The inner end of the trough K terminates in an uprising plate-like portion K′, having notched side edges which project into the weir notches I′ of the corresponding receptacles I. When said portion K′ is intermediate the ends of the corresponding weir notches it in effect divides each of the latter into two weir notches one of which discharges into the trough K, and the other of which discharges onto the subjacent tray E, and the relative amounts of liquid so discharged by the two portions of each weir notch may be precisely controlled and adjusted by moving the trough K toward and away from the axis of the tower D. This adjustment of the trough is provided for in the construction shown by means of a shaft extending through and rotatably mounted in the outer wall of each box H and having a threaded portion K^2 in threaded engagement with a lug K^3 of the corresponding trough member K, and carrying an external hand wheel K^4 by which the shaft is rotated. The position of each trough K may be indicated by an arm K^5 in threaded engagement with an externally threaded portion K^6 of the adjusting shaft, and arranged to move along a scale member K^7 secured to the corresponding box H.

The condensate fraction withdrawn from the tower D at any level through the corresponding outlet box H might pass directly from the latter to suitable cooling and collecting or storage means, but as shown, each condensate fraction withdrawn from the tower through an outlet box H is returned to the tower at a level somewhat below the level from which the fraction is withdrawn. To this end, the outlet pipe H^2 associated with each box H through which condensate is withdrawn, forms a bypass about a corresponding portion of the tower which we call a clean-up section.

As shown, there are four of these clean-up sections L′, L^2, L^3 and L^4. Each clean-up section comprises provisions for collecting and rectifying condensate and reflux liquid coming to the section from the bubble trays E above it. As shown each clean-up section comprises means providing a liquid pocket *e*, and means for scrubbing or removing low boiling components from the condensate collecting in the pocket *e* with steam supplied through a corresponding inlet S^3 from the pipe S^2, before the liquid is withdrawn from the pocket through the corresponding fractional condensate outlet. Associated with the clean-up section L′, L^2, L^3 and L^4 are corresponding fractional condensate outlet pipes M′, M^2, M^3 and M^4 which conduct from the tower the intermediate fractions of the oil being fractionated. As shown, the outer wall of each liquid pocket *e* is formed by the tower shell, and its inner and bottom walls are formed by a member L which may be described as of inverted funnel shape having at its bottom an outwardly extending flange which extends into contact with and is secured to the tower shell. As shown, the body of each member L is rectangular in cross section, and so proportioned as to fill central openings in two special superposed trays EA and EB. The trays EA and EB differ from the trays E hereinbefore described only in the omission of portions including some but not all of the gas ports E′.

The condensate outlet pipes M′, M^2, M^3 and M^4 are connected to heat exchangers O′, O^2, O^3 and O^4, respectively, which are successively traversed by the stock oil passing to the heater supply pipe B. Advantageously, and as shown, each outlet pipe comprises a depending U-shaped portion M^5 for maintaining a liquid seal at the outlet from the corresponding clean-up sections L′, L^2, L^3 and L^4. The condensate fractions cooled in the heat exchangers O′, O^2, O^3 and O^4, pass from the latter through pipe P′, P^2, P^3 and P^4, respectively to suitable purifying and storage apparatus (not shown). Uncondensed oil vapors and steam pass from the top of the tower D through an outlet D′ to a heat exchanger O through which the stock oil supplied by the pipe *b* passes to the heat exchangers O′, O^2, etc. The outlet from the space of the heat exchanger O receiving vapors from the pipe D′ is connected through coolers T′ and T^2 to a pipe T^3 which conveys the lightest fraction of the oil being fractionated from the tower to the gasoline purifying and storage apparatus (not shown). A branch pipe T^4 provides means through which a portion of the condensate formed in the heat exchanger O and cooler T′ may be returned by gravity, or by means of a pump (not shown) to the top of the tower D for reflux purposes. The unvaporized residue of the oil and vapor mixture entering the tower D from the heater A through the pipe C, and such portion of the reflux liquid and condensate formed in the upper portion of the tower as are not reevaporated in descending through the tower, constituting what will be termed the heaviest fraction of the oil being fractionated and is withdrawn from the bottom of the tower through an outlet pipe U connected to the inlet of a pump W through a heat exchanger O^5 through which the stock oil passes from the heat exchanger O^4 to the inlet of the heater A. Advantageously, a body of liquid is always maintained in the lower portion of the tower. Advantageously, also the outlet pipes P′, P^2, P^3 and P^4 for conveying the cooled condensate fractions from the heat exchangers O′, O^2, O^3 and O^4, each includes a corresponding cooler P for further cooling the fraction before it is delivered to the corresponding purifying or storage apparatus.

In the production of high grade lubricating oils, for example from crude paraffin base petroleum heated in the heater A to a temperature of about 775 degrees as mentioned above, the apparatus may be operated so that there will be withdrawn from the apparatus a high grade gasoline through the pipe T^3, kerosene through the pipe P′, gas oil through the pipe P^2, wax distillate having a viscosity of 80 Saybolt seconds at 100° F. through the pipe P^3, and lubricating stock oil having a viscosity of 150 Saybolt seconds at 210° F. through the pipe P^4. It will be apparent, of course to those skilled in the art that the relative amounts and the character of the ultimate fractions withdrawn, may be varied by varying the character of the stock oil employed, the temperature to which it is heated, and the temperature and amounts of superheated steam supplied to each of the inlets S^3. Furthermore, in addition to the control of the ultimate products obtained by regulating the factors just referred to, an important regulation or control of the ultimate fractions recovered can be had by adjusting the by-pass H^2 about each of the clean-up sections L′, L^2, L^3 and L^4. This adjustment may be made in either or both of two ways. First, by adjusting the trough K of the outlet box H to which the upper ends of each bypass is connected so as to vary the relative amounts of the liquid discharged through the corresponding weir notches I′ which pass to the immediately subjacent clean-up section and to the tower below that clean-up section. Secondly, by changing the levels at which either or both ends of each by-pass is connected to the tower.

The effect of thus adjusting the by-pass about each clean-up section is to vary the action and operative result of the clean-up section. The mere adjustment axially of the tower of the trough K above, and operatively associated with each clean-up section, is to increase or decrease the amount of liquid treated in that section. An increase or decrease in the amount of the liquid treated in the section, other things being equal, tends to a corresponding decrease or increase in the degree of rectification produced in the clean-up section. Generally speaking, if in any clean-up section there is supplied a pound of superheated steam per pound of condensate treated, the rectification will be more thorough and the rectified condensate discharged will be more homogeneous in character than if two pounds of condensate are treated for each pound of steam supplied. By changing the level of the upper end of the by-pass about each clean-up section the character of the condensate treated in the clean-up section is obviously modified. Similarly by varying the level of the lower end of each upper by-pass the character of the fraction collected in and treated in the immediately subjacent clean-up section is modified. The fractionating tower D comprises various novel features of construction and arrangement which are not claimed herein but which are claimed in my said prior application filed jointly with Harry R. Swanson under Serial No. 106,866, May 5, 1926. As in the construction described in the prior application just referred to, baffle plates or analogous liquid and gas separating screens X may advantageously be located between the trays E at various levels to eliminate entrained liquid from the vapors passing upward through the tower.

While a fractionating tower of the particular construction illustrated and described is especially well adapted for use in practicing the present invention, the latter in its broader and more general aspects is independent of the character of the fractionating tower employed.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, 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 my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The method of producing lubricating oil fractions with small overlapping from the viscosity standpoint, which consists in progressively heating stock oil to the desired maximum temperature in a tubular oil heater through which the oil is passed with such rapidity as to substantially avoid the cracking which would occur if the oil were heated to the same temperature more slowly, then subjecting the oil to fractional distillation and condensation in a fractionating tower in which the oil and the condensates and reflux

liquid, if any coming down through the tower are subjected to intimate contact with steam and vapors passing upward through the tower, collecting bodies of condensate within the tower at different levels, separately withdrawing fractions from the tower at the different levels and regulating the character of the fractions so withdrawn by introducing the steam separately into a plurality of the bodies collected and variably passing descending liquid about sections of said tower containing the collected bodies.

2. The method of producing lubricating oil fractions with small overlapping in viscosity which comprises progressively heating stock oil to the desired maximum temperature in a tubular oil heater through which the oil is passed at sufficient velocity to substantially avoid cracking, then passing the oil and the vapor formed during the heating into a fractionating tower in which the uprising vapors are subjected to intimate contact with condensates and reflux liquid descending through the tower, collecting and maintaining substantial bodies of condensate of different boiling ranges at different levels in the tower, scrubbing said bodies of condensate with superheated steam, separately and continuously withdrawing portions of said condensate at said different levels, and variably passing descending condensate and reflux liquid about said bodies of condensate.

3. In the art of fractionally distilling hydrocarbon oils, the method which comprises passing vapors of the oil counter-current to and in contact with reflux oil in a fractionating zone, dividing the flow of liquid oil intermediate the lightest and heaviest fractions into portions, passing one portion counter-current to steam in contact therewith in the fractionating zone to remove low boiling components, thereby yielding an intermediate fraction of higher flash point and continuing the other portion of the liquid oil counter-current to the vapors in an earlier stage of the fractionating system.

4. In the art of fractionally distilling hydrocarbon oils, the method which comprises passing vapors of the oil counter-current to and in contact with reflux oil in a fractionating zone, dividing the flow of liquid oil intermediate the lightest and heaviest fractions into portions, passing one portion into contact with steam in the fractionating zone to remove low boiling components, thereby yielding an intermediate fraction of higher flash point and continuing the other portion of the liquid oil counter-current to the vapors in an earlier stage of the fractionating system.

5. The method of producing lubricating oil from petroleum containing asphalt which comprises passing the oil partially vaporized into a fractionating tower wherein the vapors pass counter-current to and in contact with descending reflux oil, dividing the downward flow of reflux oil intermediate the lightest and heaviest fractions, passing a portion so divided counter-current to steam in contact therewith in the tower to remove low boiling components therefrom, thereby yielding an intermediate fraction of lubricating oil having high flash point and withdrawing from the bottom of said system an asphaltic residuum.

6. In the art of fractionally distilling hydrocarbon oils, the method which comprises heating oil to produce vaporization thereof, introducing the oil into a fractionating tower, passing the vapors of the oil counter-current to and in contact with downflowing liquid oil, dividing the downward flow of liquid oil in the tower intermediate the lightest and heaviest fractions, collecting a divided portion of liquid oil within the tower, introducing steam into direct contact with the liquid oil collected in the tower and passing the steam counter-current to flow of oil into the body collected, withdrawing the liquid of the collected body as an intermediate fraction product and by-passing the other divided portion of liquid oil around said collected body downward to an earlier stage of the fractionating system.

7. In the art of fractionally distilling hydrocarbon oils, the method which comprises heating oil to produce vaporization thereof, introducing the oil into a fractionating tower, passing the vapors of the oil counter-current to and in contact with downflowing liquid oil, dividing the downward flow of liquid oil in the tower intermediate the lightest and heaviest fractions, collecting a divided portion of liquid oil within the tower, scrubbing the body of liquid oil by introducing steam directly thereinto to remove low boiling components, withdrawing the liquid of the collected body as an intermediate fraction product and by-passing the other divided portion of liquid oil within the tower, scrub-body downward to an earlier stage of the fractionating system.

8. The method of producing lubricating oil from petroleum which comprises heating petroleum to produce vaporization thereof, introducing the same into a fractionating tower, passing the vapors of the oil counter-current to and in contact with downflowing liquid oil, dividing the downward flow of liquid oil in the tower intermediate the lightest and heaviest fractions, collecting a divided portion of liquid oil within the tower, introducing steam into the tower into direct contact with the liquid oil collected, withdrawing the liquid of the collected body as an intermediate fraction product, by-passing the other divided portion of liquid oil around said collected body downward to an earlier stage of the fractionating system and withdrawing from a lower portion of said

tower a residual oil heavier than said lubricating oil.

9. The method of producing lubricating oil from petroleum containing asphalt which comprises heating the petroleum to produce vaporization thereof, introducing the same into a fractionating tower, passing the vapors of the oil counter-current to and in contact with downflowing liquid oil, dividing the downward flow of liquid oil in the tower intermediate the lightest and heaviest fractions, collecting a divided portion of liquid oil within the tower, introducing steam into the tower into direct contact with the liquid oil collected, withdrawing the intermediate fraction lubricating oil of the collected body and withdrawing from the bottom of the tower an asphaltic residuum.

10. The method of producing oil fractions with small overlapping of viscosity values which comprises heating liquid oil so as to vaporize the same, passing the vapors upwardly in contact with downflowing condensate in a fractionating tower to provide a fractionating path of vapor flow of progressively decreasing temperature, dividing the downward flow of condensate at a plurality of points of different temperature in the fractionating path, collecting bodies of condensate so divided of different average boiling point in the tower and continuing the remainder of each condensate division downward to a higher temperature stage of the fractionating path but of lower temperature than any point of condensate division of higher temperature, introducing separate streams of steam into each of the collected bodies to drive off low boiling point constituents and passing each of the plurality of streams of introduced steam together with accompanying oil vapor into a lower temperature stage of the fractionating path but of higher temperature than any point of condensate division of lower temperature.

11. That improvement in the art of oil fractionation in a fractionating tower having downflow of condensed oil over contact surfaces and in contact with upflowing vapors which consists in collecting condensate at a plurality of levels in the tower to obtain fraction products, introducing steam into a plurality of the bodies collected to remove low boiling point constituents and introducing the steam and oil vapors carried thereby into the downflowing liquid and regulating the relative amounts collected to the remaining downflowing liquid to regulate the condensing effect to reduce the percentage of high boiling point constituents of the collected bodies.

12. The method of producing oil fractions with small overlapping of viscosity values which comprises heating liquid oil so as to vaporize the same but to substantially avoid cracking thereof by passing the oil with relatively high velocity through a tubular oil heater, introducing the oil so heated into a fractionating tower, passing the vapors of the oil upwardly in the tower in contact with downflowing condensate whereby the vapors have an upflow path of gradually decreasing temperature in the tower, dividing the downward flow of condensate in the tower at a plurality of points of different temperature, collecting divided portions of condensate in the tower at levels below the points of condensate division, introducing separate streams of steam into a plurality of the collected bodies to drive off low boiling point constituents, by-passing the condensate not collected at each point of division into the higher temperature zone of the tower next below the level of the respective collected bodies and passing each of the plurality of streams of introduced steam together with accompanying oil vapor into the lower temperature zone of the tower next above the level of the respective collected bodies.

13. The method of producing oil fractions with small overlapping of viscosity values which comprises heating liquid oil so as to vaporize the same but to substantially avoid cracking thereof by passing the oil with a relatively high velocity through a tubular oil heater, introducing the oil so heated into a fractionating tower, passing the vapors of the oil upwardly in the tower in contact with downflowing condensate whereby the vapors have an upflow path of gradually decreasing temperature in the tower, dividing the downward flow of condensate in the tower at a plurality of points of different temperature, collecting divided portions of condensate in the tower at levels below the points of condensate division, introducing separate streams of steam into a plurality of the collected bodies to drive off low boiling point constituents, variably by-passing the condensate not collected at each point of division into the higher temperature zone of the tower next below the level of the respective collected bodies and passing each of the plurality of streams of introduced steam together with accompanying oil vapor into the lower temperature zone of the tower next above the level of the respective collected bodies.

14. The method of fractionally distilling hydrocarbon oils which comprises heating the oil to vaporization temperature, introducing the heated oil into a fractionating tower, separating the vaporized and unvaporized portions of the oil in the tower, passing the vaporized portion of the oil in a path counter-current to and in contact with reflux oil in the tower, collecting in the tower in the path of flow of the vapors but out of contact therewith, reflux oil intermediate the lightest and heaviest fractions of the oil, subjecting the collected reflux to contact with steam, withdrawing the steamed reflux from

the tower, passing the unvaporized portion of the oil counter-current to and in contact with steam and withdrawing the steamed unvaporized portion from the tower.

15. The method of fractionally distilling hydrocarbon oils which comprises heating the oil to vaporization temperature, introducing the heated oil into a fractionating tower having a plurality of bubble trays therein, separating the vaporized and unvaporized portions of the oil in the tower, passing the vaporized portion of the oil in a continuous path counter-current to and in contact with reflux oil in the tower, collecting reflux oil in the tower above the point of introduction of oil thereinto and out of contact with the vapors of the oil flowing through the tower, subjecting the collected reflux to contact with steam, withdrawing the steamed reflux from the tower, passing the unvaporized portion of the oil counter-current to and in contact with steam, commingling the oil vapors evolved by said steam with the vaporized portion of the oil introduced into the tower and withdrawing the steamed unvaporized portion from the tower.

16. The method of fractionally distilling hydrocarbon oils which comprises heating the oil to vaporization temperature, introducing the heated oil into a fractionating tower, separating the vaporized and unvaporized portions of the oil in the tower, passing the vaporized portion of the oil in a continuous path counter-current to and in contact with reflux oil in the tower, collecting reflux oil in the tower above the point of introduction of oil thereinto in the path of flow of the vapors but out of contact therewith, subjecting the collected reflux to contact with steam, and separately withdrawing the steamed reflux and unvaporized portion of the oil from the tower.

Signed at New York city, in the county of New York, and State of New York, this 6th day of April, A. D. 1927.

JOHN PRIMROSE.