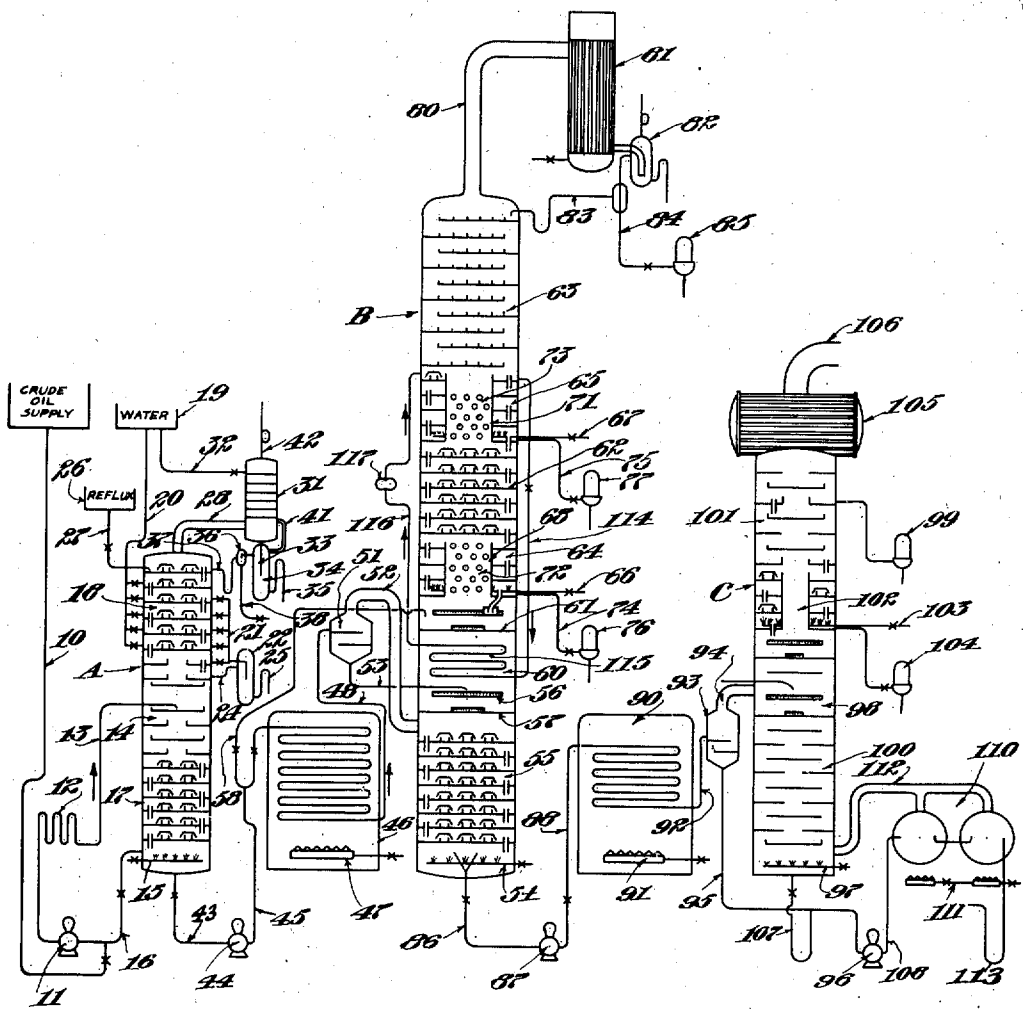
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METHOD OF AND APPARATUS FOR DISTILLING PETROLEUM MIXTURES

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METHOD OF AND APPARATUS FOR DISTILLING PETROLEUM MIXTURES

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Renewed July 10, 1936

6 Claims. (Cl. 196—73)

The present invention relates to an improvement in method of and apparatus for distilling petroleum mixtures.

The object of the invention is to reorganize and improve the construction of petroleum distilling apparatus and methods of distilling such mixtures with the purpose of increasing its efficiency, economy, the precision of cut, and variety of petroleum mixtures susceptible of being refined thereby. Further objects are to improve certain details of construction and methods of refining hereinafter described. The invention consists in the method and apparatus hereinafter described and particularly defined in the claims.

The accompanying drawing illustrating the preferred form of the apparatus is a sectional elevation.

The apparatus and method of the present invention are described as follows: The oil supply 10 leads to a pump 11 by which the oil is forced through a heater 12 from which it is discharged by the pipe 13 into the first column, indicated in a general way by the reference character A. This column is provided with a vaporizing portion 14, consisting of a series of decks upon which the hot oil is discharged. This oil flows down from deck to deck. Steam is admitted through the pipe 15, which is submerged in a body of oil in the bottom of the column. The oil as it flows down from deck to deck is in part vaporized in the presence of the ascending steam vapor mixture. Some of the oil in the bottom of the column passes out through the pipe 16 and finds its way back to the pump 11. The amount of oil drawn from the supply and that drawn from the bottom of the column and pumped through the heater 12 may be proportioned as desired, to secure the more rapid absorption of heat in the heater 12. Thus when oil is flowing through the heater at one rate of speed, the adhesion of the oil to the walls of the conduit through the heater retards the heating of the oil, but by causing the oil to flow faster through the heater, the portion of the oil adherent to the walls of the heater is reduced in thickness, and a much more rapid flow of heat to the oil is secured. In fact, the rate of absorption of heat by the heater increases more rapidly than the rate of flow increases, thereby securing a greater efficiency than would be secured by a lower rate of flow. Furthermore, the amount of oil discharged from the column for further treatment is made uniform by this means.

In the bottom of column A is a distilling zone 17 provided with a number of decks having boiling caps and down pipes by which the steam vapor mixture rising through the vapor tubes of the boiling caps is brought into intimate contact with the liquids descending. The mode of operation of this portion of the column is set forth in the application of Lummus filed December 30, 1926, Serial No. 157,956.

Above the vaporizing portion is a washer and rectifying zone 18 provided with a number of decks having boiling caps and down pipes, and a water supply 19 connected by a pipe 20 has pipes leading to a number of decks, and from a number of the decks water pipes lead to the pipe 21, by which the water is drawn off. By this means water may be admitted to one deck and drawn off from the next lower deck, or admitted to any higher deck and drawn off at any lower deck, and in the space between the ascending vapors will be washed by the water and impurities and salts removed in accordance with the method set forth in the application of Coubrough filed June 28, 1927, Serial No. 202,121.

The water drawn off through the pipe 21 is accompanied by some oil condensate, and the water and oil are separated in the decanter or separator 22, the oil being refluxed to the column by the pipe 24, and the water drawn off by the pipe 25. A reflux supply 26 is provided for delivering through the pipe 27 an oil of the constitution of that desired in the vapors discharged from the top of the column through the vapor pipe 28.

The vapor pipe 28 discharges into a condenser 31. The vapors entering this condenser pass upwardly around the staggered decks, or other devices for causing counter-current contact of the vapors with condensing water from the supply 19 carried to the condenser by the pipe 32. The distillate vapors condensed in the condenser 31 are discharged with the water through the pipe 33 into the decanter or separator 34, from which the water is drawn off through the pipe 35 and the condensed distillate is discharged into the bottle 36, from which a portion is returned by the reflux pipe 37 to the top of the column, and a portion is discharged as finished product through the pipe 38. A vent pipe 41 connects the lower part of the condenser 31 with the top of the separator 34. This equalizes the pressure in the condenser and the separator. From the top of the condenser 31 there leads a gas pipe 42, through which any uncondesed oil vapors or gases may be discharged, and will be then conducted to a furnace where they will be burned, or to some absorber where they will be absorbed in some product where they may find use.

This first column or tower A performs a preliminary operation upon the mixture to be refined. Thus, all of the water is removed, the oil is heated, and some of it is vaporized, and some of the lower boiling and substantially all of the gaseous constituents are separated and discharged as a final product. With one mode of operation this final product would be a low boiling naphtha. The remaining oil, free of water, flows down through the tower and is discharged at the bottom through a pipe **43** leading to the pump **44**, which pumps the oil mixture through the pipe **45** to the second column or tower indicated in a general way by the reference character B.

In this second tower B the important and final separation of a number of products is secured. It is described as follows: The pump **44**, carrying previously cleansed and degasified and dehydrated petroleum mixture discharges through this pipe **45** into a heater **46** operated by a furnace **47**. The oil from the furnace is discharged through the pipe **48** into the vapor separator **51**. A substantial amount of heat is imparted to the oil mixture by the furnace. The amount of heat imparted is that required to vaporize the components of the mixture having boiling points when in the presence of steam below the initial of the mixture discharged as a residue from the tower.

The oil enters the vapor separator **51** in a foaming mass and spreads over the plates, and vapors from the oil separate and rise which are carried off from the top of the separator by the vapor pipe **52**, which leads to a mediate point in the second column B. The liquid portions of the oil are discharged from the bottom of this vapor separator **51** and are led by the pipe **53** into the tower above the admission point of the vapor pipe **52**. The bottom of the column is provided with a steam admission pipe **54**.

In the lower part of the column is a distilling portion **55**, which contains a series of decks having boiling caps and down pipes over which the unvaporized oils flow downwardly, and any vapors arising therefrom flow upwardly. The heater and this distilling portion of the column or tower B operate in accordance with the method described in the Lummus application filed December 30, 1926, Serial No. 157,956. The oil pipe **53** leads into the column above this distilling portion **55**, and discharges the heated oil upon a plate **56**, having an upturned lip over which the oil flows down upon a lower deck **57**, having a central hole provided with an upturned lip over which the oil flows down into the distilling portion below. Vapors entering the column from the heater start upwardly and the heated oil and condensates descending through the column here meet in counter-current fashion, and separation of the lighter oils from the heavier begins at this point. This part of the column is hot, in fact, the hottest part of the column, and it has been found that, in some cases, sufficient heat can be imparted to a portion of the oil introduced into the column B without heating all of the oil. Consequently a portion of the oil may be carried from the pump **44** through the pipe **58** to a point in the column above the admission point of the hot oil through the pipe **53**. This oil is discharged upon the deck **61** located next above the deck **56**. This oil spreads over the deck and overflows the upturned lip of the opening in its center, and is caught upon the deck **56** below. During its passage downwardly it is heated by the hot vapors rising, and by the time it reaches the top of the distilling portion **55**, the portion of the oil entering through the pipe **58** and that entering through the pipe **53** become of the same temperature, and thus pass into the top of the distilling portion **55** in the bottom of the tower B.

The vapors discharged into the tower through the vapor pipe **52** are superheated by contact with the hot oil entering through the pipe **53**.

Above this portion **60** of the column where the vapors and crude oil are admitted, which is a vaporizing portion, are located two rectifying portions **62** and **63**. The portion **62** is provided with decks having boiling caps and down pipes, and the portion **63** is provided with reticulated decks so that a reflux admitted at the top will flow over the surface of the decks through the holes therein upon the decks below, and thus downwardly in counter-current fashion to ascending vapor mixtures. The lower parts of the rectifying sections **62** and **63** of the tower B may each be considered a stripping portion, the lower one being the portion **64**, and the upper one being the portion **65**. Into the bottom of each of these stripping portions is introduced steam through the pipes **66** and **67**. These stripping portions parallel vapor passages from lower portions of the tower to portions above. Thus, the vapor passage **68** leads from the vaporizing portion **60** to the mediate portion of the rectifying portion **62**, and the vapor pipe **71** leads from the top of the rectifying portion **62** to a mediate portion of the rectifying portion **63**. In these vapor passages are provided heat absorbers, the lower one being the heat absorber **72**, and the upper one being the heat absorber **73**. These heat exchangers consist of coils of pipe in the vapor pipes which operate to cool the vapors rising from the top of the preceding section and passing to the mediate portion of the section above and remove a portion of the heat of the vapor distillate passing therethrough and condense some of the vapor mixtures, thereby heating the cooling liquid passing through the pipes. These heat absorbers **72** and **73** have the double function of heating the liquids passed through them and cooling the vapors passing up around them. At the bottom of each rectifying section **62** and **63**, and specifically at the lowermost deck are pipes **74** and **75**, through which portions of the condensates collecting at the bottoms of the stripping sections are removed. These pipes **74** and **75** lead to look boxes **76** and **77**, which draw off portions of the condensates collected or stripped from the ascending vapors.

From the top of the column B the vapors pass off through the pipe **80** to the condenser **81**, where practically the entire vapor discharge (including the steam) is condensed. The condensate from the condenser **81** flows into the separator **82**, and a portion flows back through the reflux pipe **83** to the top of the column, while the remainder is discharged through the pipe **84** leading to the look box **85** in the tail house.

In this column B the principal separation of the products in the crude originally entering the apparatus takes place. From the look box **85** is discharged gasoline; from the look box **77** is discharged kerosene; from the look box **76** is discharged gas-oil; and from the pipe **86** at the bottom of the column is discharged the residue, which contains the heaviest oils.

The residue discharged from the column B through the pipe **86** is led to a pump **87**, by which it is pumped through the pipe **88** to the heater

90, operated by the furnace 91, where it is again heated, and from which it passes to the third column indicated in a general way by the reference character C. This pump 87 is regulated by a float control which maintains the oil level in the bottom of the tower B constant so as to continuously preserve a uniformity of operating conditions in this tower. From the heater 90, the pipe 92 leads the hot oil to the vapor separator 93, into which the hot foaming oil from the heater 90 is discharged. From this the vapors pass through the pipe 94 to a mediate point in the column C, while the liquid discharged from the separator 93 is carried by the pipe 95 to the pump 96.

The column C is provided with a steam admission pipe 97 in its bottom. The portion 98 of the column C into which the vapors from the separator 93 are discharged, is a vaporizing portion provided with plates or decks upon which the oil is spread and from which it overflows through openings into the lower parts of the column. Below this vaporizing portion is a counter-current distilling section 100, where ascending vapors entering the bottom of the column rise in counter-current fashion to the descending condensates in the column, all in the presence of steam. Above the vaporizing section 98 of the column is a low pressure rectifying section 101, into which the vapors from the vaporizing section pass through the vapor pipe 102. This vapor pipe leads up through several decks and discharges into a mediate portion of the rectifying section 101. The lower portion of the section 101 is a stripping section which is provided with a steam admission pipe 103, and a draw-off or discharge pipe 104, through which any condensate from this portion of the column is drawn off. From the bottom of the rectifying section 101 a down pipe leads to the top of the vaporizing section 98. This rectifying section has an upper portion which effects a further separation of the products—a condensate from its bottom is drawn off at 99. Vapors effluent from the column C pass through the condenser 105 and are there in part condensed. The uncondensed vapors pass out through the vapor pipe 106.

From the bottom of the tower C an outlet pipe 107 is provided through which any liquid effluent or condensate from the tower may be drawn into the pipe 95 leading to the pump 96. This pump discharges through the pipe 108 into the first of a series of shell stills 110, which are heated by a furnace 111. In these stills any vapors separable from the liquid residue are discharged through the pipe 112 into the bottom of the tower C, and any unvaporizable residue from these shell stills is discharged through the pipe 113 as a final residue of the process.

In connection with the tower B, it is sometimes found desirable to re-heat condensates from portions of the tower in order to prepare them for further treatment. Thus, at the top of the stripping section 65 it may be desirable that the condensates flowing downwardly through the distilling section 63 be re-heated before passing into the stripping section 65 below. For this purpose a pipe 114 is provided which leads from the top deck of the stripping section 65 downwardly to a coil 115, located in the vaporizing section 60 of the column, and from this coil the pipe 116 leads to the pump 117 by which the oil is returned after having been heated in the coil 115 to the same deck in the column B from which it was drawn. This affords a convenient mode of heating a portion of the condensate in the column at the beginning of the stripping or other operation carried on at the points below it by means of heat found in the column at a distance therefrom, and involves the method of stripping refluxed liquid condensates from liquefied petroleum vapor mixtures to produce a liquid residue having a predetedmined initial boiling point, which consists in heating the reflux liquid condensate in a hotter part of the refining path to a temperature corresponding to the initial boiling point of the desired residue, and distilling it in a counter-current of steam sufficient to vaporize all components boiling below the predetermined initial boiling point of the residue. Thus, in the particular instance under consideration, the liquid residue from the distilling section 63 is re-heated in the hotter portion of the column found in the vaporizing section 60 before it is introduced into the stripping section where it is stripped of all components boiling below the predetermined initial point of the desired residue, namely kerosene. It is to be observed that, in its broader aspects, it is immaterial how this refluxed liquid condensate is heated.

Another feature of the present invention consists in the method of superheating vapors by re-contact with the residue, which consists in heating the mixture to a temperature sufficient to vaporize a desired portion thereof, permitting the vapors to separate, passing the separated vapors in counter-current contact with the heated liquid residue, and rectifying the resulting superheated steeam vapor mixture. Thus, in this apparatus a portion of the oil entering the furnace 46 is heated to a temperature sufficient to vaporize a desired portion thereof. This heated oil is discharged into the separator 51, where the vapors formed are permitted to separate. These separated vapors are then passed in counter-current contact with the heated liquid residue from the separator 51, so that the residue is further heated by the counter-current contact with the hot vapors. Then the resulting vapors are rectified in portions of the column above.

One feature of the method and apparatus herein described consists in utilizing the excess heat of vapors of a portion of the crude to heat an additional crude. This method may be said to consist in the process of separating petroleum mixtures by introducing hot petroleum mixture vapors and petroleum into a vaporizing zone, and introducing an additional supply of the petroleum mixture in the upper part of the zone so that in its passage therethrough it may be heated by the excess heat in the zone. This affords a convenient method of introducing the requisite amount of heat into a given volume of oil. The heater is made of such size as to be capable of imparting more heat to a given volume of oil passing through it than is requisite for the distillation of such oil, and the efficiency of this heater is contributed to by the velocity with which the oil flows through the heater. Then an unheated portion of oil is, or may be, introduced above the introduction point of the heated oil, and the temperature of the resulting mixture is a proper temperature for the operations to be performed. This affords a nice means of regulating the temperature of the oil introduced without changing the operation of the furnace. Regulation of the temperature of the oil introduced by increasing and decreasing the heat imparted to it at the furnace would be difficult, but by imparting a

uniform amount of heat to the oil passing through the furnace, the amount of heat imparted to the total oil introduced may be regulated by introducing a separate and unheated portion of oil to the tower above the point where the heated oil is introduced.

The present apparatus illustrates a method of dehydrating and de-gasifying crude oil supply which forms the subject of the application of Coubrough Serial No. 92,238, filed March 4, 1926. Thus, from the heater **12** the hot oil is discharged into the vaporizing portion of column A, from which there descends an unvaporizing portion into the distilling section below, and from the top of which ascends a vapor portion, together with steam. The heat imparted to the entering oil serves to free the permanent gases and lighter vapors as well as the water which is subsequently condensed out, together with some of the impurities in the oil.

The method of re-stripping refluxed condensates in the apparatus illustrated, is practiced at two points, not only as above described at the top of the column B, but in the section next below, and in both of these places a portion of the condensate stripped from the refluxed condensate in the rectifying section is returned to the top of the next preceding rectifying zone. Thus, at the bottom of the stripping section **65** a down pipe leads oil to the top of the distilling section next below, and from the bottom of the stripping section **64** a similar down pipe leads to the vaporizing portion next below.

The return of a portion of the condensate from the bottom of each of these stripping sections to the top of the next lower zone controls the constitution of the vapors effluent from those zones. This is of importance, and enables the initial boiling point of the kerosene, for example, to be nicely controlled. Thus, the flow of condensate from the stripping zone **65** to the top of the distilling section **62** controls the temperature of the top of such distilling zone. By closing the valve in the pipe **75** a ltle more, a greater amount of condensate will be returned to the top of the distilling zone **62**, and consequently the initial boiling point of the kerosene will be lowered. This method may be defined as steam distilling a petroleum mixture in a distilling zone (**62**), introducing the steam vapor mixture from the distilling zone into the mediate point of a rectifying zone (**63**) in which the condensation of the higher boiling components is controlled by a counter-current refluxed distillate (**83**) of the vapors from such rectifying zone, stripping the condensate falling below the mediate point of the rectifying zone to a predetermined initial boiling point by contact with a counter-current of steam admitted in the lower part (**65**) of the rectifying zone, and returning a portion of the stripped condensate to the top of the distilling zone (**62**) for the purpose of controlling the end point of the steam vapor mixture discharged therefrom.

It is not to be understood that in treating every crude all parts of the apparatus will be employed, or will be employed in the same manner and with the same adjustment. Thus, in the treatment of some petroleum mixtures the reflux heaters **72** and **73** will be employed, while in treating others they will not be employed. Their use will depend upon the constitution of the given crude. Where there is a larger percentage of higher boiling oils their use will be indicated, and where a greater percentage of lower boiling oils is present their use may be lessened or discontinued. These reflux heaters form the subject of the Lummus Patent No. 1,216,334, dated February 20, 1917.

The re-circulation of a portion of the crude through the heater **12** effects two very substantial advantages. In the first place it increases the efficiency of the heater by increasing the rapidity of flow of the oil therethrough, and in the second place, and more important still, it affords a provision for equalizing the supply of oil mixture taken by the second column B. In order to preserve a continuity of operative conditions it is important that the oil supply for column B should be uniform in constitution and in rate of flow, as otherwise, with variations in the amount of mixture delivered to the column B, the adjustment of the column to produce the desired cuts would be difficult. It will be readily appreciated that with more oil entering this column, more heat would be required to heat such oil, and therefore that the furnace supplying such heat would be required to be speeded up. Regulation of a furnace heat is difficult and tedious, whereas when the supply of oil furnished to this column is uniform, the temperature of the furnace may be kept uniform. Now, the pump **44** is provided to draw from column A a constant amount of oil mixture for use in column B, and the column A, therefore, re-circulates a portion of the oil which is not required by column B, replenishing its supply continuously from the oil supply as column B's demands necessitate. So this re-circulation of oil in column A affords a most simple and convenient method of supplying a continuous and uniform petroleum mixture to column B, irrespective of variations in the supply or in the temperature of the entering crude.

The principal advantage of this construction is the constant supply of uniform mixture to column B, and the incidental, but not unimportant, advantage is in the more efficient operation of the heater for column A.

So far as I am aware, it has never before been proposed to provide an oil distilling and rectifying column with a constant feed. It is therefore believed that this feature of the invention is one of very substantial importance, because of the contribution which it makes to the efficiency and certainty of operation of the distilling and rectifying processes. The invention, viewed in its broader aspects, may be said to consist in the method of distilling and rectifying petroleum mixtures which consists in carrying on the operations in two separated zones, in the first of which a body of oil in excess of that required for the operation of the second zone is continuously circulated and kept in condition to be supplied to the second zone, being replenished constantly from the supply whereby the second distilling and rectifying zone operates continuously on a uniform quantity of petroleum mixture supplied to it at a uniform temperature. An incidental feature of this portion of the invention consists in preparing crude petroleum for distillation and rectification into a plurality of products by introducing crude to a heater and re-circulating such crude through a preliminary refining zone for preparing a uniform body of crude to be supplied to a second distilling and refining operation.

The apparatus of the present invention may be used in different ways with different crudes. In the case of crude containing, say, 40% gasoline, the modus operandi would be as follows: The crude supply will be led first to the pump **11** by which it will be pumped through the heater **12** into column A. In practice, for the purpose of

securing all heat economies possible, the crude will first be passed through the heat absorber 73, then the heat absorber 72, then the condenser 105, and from this condenser led to and discharged into the vaporizing portion 14 in column A. These heaters may be considered to be diagrammatically represented in the heater 12. When the oil enters column A its distilling action immediately begins. As the vapors are liberated they ascend through the column and the oils from which the vapors are separated descend. The vapors passing upward are washed and afterwards condensed, and an effluent product containing about half the gasoline is drawn off at the look box at 38; that is to say, about 20% of the total crude. In column A all of the water in the crude as well as the permanent gases and part of the gasoline are removed so that the residue from column A delivered to the pump 44 is a dehydrated and degasified crude. This crude is pumped through the heater of column B and vaporized, distilled and rectified in this column and separated into a number of products. Thus, at the top of the column is drawn off, say, an equal amount of gasoline with that withdrawn from column A, that is to say, about 20% of the total crude. At the look box 77 all of the kerosene is drawn off; at the look box 76 all of the gasoline is drawn off; each about 7½% of the total crude oil supply. There remains, therefore, about 45% of the total crude supply. This residue is put through the heater of column C and the vapors therefrom are introduced into the column and the residue carried to the stills. In passage up through column C the vapors introduced from the heater and the vapors from the stills are drawn upon at two points of the rectifying path to supply different products, that from 99 being light wax distillate amounting to about 10% of the total, that from 104 being heavy wax distillate, amounting to about 15% of the total, the ultimate vapor discharged at the top of the column C being a small quantity of cracked products amounting to, say, 5% of the total, and the discharge from the stills being a residue of high boiling substances, and comprising about 15% of the total crude oil introduced to the system.

In case the apparatus was used for distilling a crude containing, say, 30% of gasoline, column A would be operated to remove about 10% of the total as gasoline, and column B would still be operated in the same manner as before, removing 20% of the total as gasoline. In this case, however, it might not be necessary to employ any steam in the bottom of column A.

In the case of crude containing, say, 20% of gasoline, little or no gasoline would be removed in column A. Its function would simply be to wash the supply to remove permanent gases and water and to act as an equalizer for the supply of crude to column B.

In most cases column A, or some preparing apparatus, would be employed, in order to obtain the best results with column B. That is to say, it should be de-gasified and de-hydrated in such preparation and brought to a certain uniform temperature and admitted at a certain rate of speed into column B in order to secure the best operation of that column.

The apparatus taken as a whole is, therefore, well adapted to handle a large variety of crude petroleum mixtures. When using the apparatus with crudes in which a large amount of lighter oils are present, an additional amount of work will be thrown upon column A. With lesser amounts of lighter oils present, this column will have less work to perform. With column B, the remainder of the lighter oils are removed; also all of the kerosene. Some of the gas-oil is removed. In the case of crudes containing a relatively small amount of gas-oil, substantially all of the gas-oil will be removed from column B. In the case of crudes containing a larger amount of gas-oil, part of this mixture will be taken off at column B and the remainder at column C. Also at column C will be taken off all of the wax distillates. The apparatus, therefore, taken as a whole affords provision for handling widely differing varieties of crudes, column A taking care of variations in the lighter oils and column C taking care of variations in the heavier oils, so that column B may always be operated at its full capacity and at a uniform rate during the treatment of any given crude.

Specifically considered, and for the purpose of pointing out certain definite temperatures which would be employed in connection with this distilling apparatus, the oil, in the case of a Mid-Continent crude, would be admitted into column A at a temperature from 250° to 300° F., the oil from the furnace of column B would be pumped in at a temperature of from 525° to 550° F., and the oil from the heater of column C introduced into the separator at a temperature from 600° to 650° or 675° F. The temperature at which the stills would be run would be determined by the results desired to be secured. They might be run at a coking temperature, or at such a temperature that the residue drawn off might be liquid at the temperature of eduction.

Having thus described the invention, what is claimed is:

1. The method of distilling petroleum mixtures which consists in vaporizing constituents from the mixture, rectifying the vapors by counter-current with a reflux liquid in a rectifying zone, withdrawing reflux liquid from the bottom of the rectifying zone, heating the reflux liquid so withdrawn to a temperature equal to the initial boiling point of the desired residual product, and distilling the heated reflux separately from other materials in a counter-current of steam in sufficient quantity to vaporize all components boiling below the predetermined initial boiling point of the residue and withdrawing a part of the reflux as a product.

2. Apparatus for distilling petroleum mixtures comprising a heater, a vaporizing section, a rectifying section in which the vapors pass from the vaporizing section, the rectifying section having a stripping section in the lower part thereof, means for introducing steam into the bottom of the stripping section, a draw-off pipe from the bottom of the stripping section, a heating coil subjected to the heat of the vapors in the vaporizing section, and pipes leading from the top of the stripping section to the heating coil and back to the stripping section for conveying reflux to the heating coil and back to the top of the stripping section.

3. Apparatus for distilling petroleum mixtures comprising a source of supply, a heater, a vaporizing column having in the lower part thereof a counter-current distilling portion, a pump between the source and the heater for pumping the mixture through the heater into the column above the counter-current distilling portion, and a connection from the bottom of the column to the inlet of the pump to maintain a continuous circulation of a portion of the oil through the

pump, the heater and the column, whereby the velocity of flow through the heater is greater than would be the case if the circulating connection between the column and the pump were omitted.

4. Apparatus for distilling petroleum mixtures having, in combination, a source of supply, a heater, a pump between the source and the heater, a preliminary column, a connection from the heater to a mediate point of the preliminary column, a second column, means for passing a part of the residue from the bottom of the preliminary column to the second column, and means for circulating the remainder of the residue from the bottom of the preliminary column to the inlet of the pump, and means for regulating the quantity thus circulated to control the feed to the second column.

5. In a fractionating tower through which heated vapor is adapted to be passed upwardly, means for introducing heated vapors into the tower, an indirect heat exchange device disposed in the path of the heated vapors, means for conducting liquid from a relatively cool upper portion of the tower through the exchange device located in the lower portion of the tower, a receptacle in the relatively cool upper portion of the tower, and means for conducting the liquid from the exchange device to the receptacle.

6. The method of distilling crude petroleum oil containing water which consists in heating the crude only by heat exchange with previously heated oil fluid to a temperature in excess of the boiling point of water, feeding the oil thus heated into an intermediate point of a column, introducing steam below the point of feed in counter-current flow to descending liquid to vaporize gasoline, condensing the vapor mixture of steam and gasoline, refluxing gasoline condensate to the column above the point of feed and in counter-current flow to the ascending vapors to control the composition of some of the gasoline as a distillate product, withdrawing residue from the column, heating the residue in a fired heater, and introducing it into a second column for distilling additional gasoline and fractions heavier than gasoline, a distillate of the second column being used to supply the heat for the crude fed to the first column.

GEORGE B. COUBROUGH.

CERTIFICATE OF CORRECTION.

Patent No. 2,092,528. September 7, 1937.

GEORGE B. COUBROUGH.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 29, for the word "gasoline" read gas-oil; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of October, A. D. 1937.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.

pump, the heater and the column, whereby the velocity of flow through the heater is greater than would be the case if the circulating connection between the column and the pump were omitted.

4. Apparatus for distilling petroleum mixtures having, in combination, a source of supply, a heater, a pump between the source and the heater, a preliminary column, a connection from the heater to a mediate point of the preliminary column, a second column, means for passing a part of the residue from the bottom of the preliminary column to the second column, and means for circulating the remainder of the residue from the bottom of the preliminary column to the inlet of the pump, and means for regulating the quantity thus circulated to control the feed to the second column.

5. In a fractionating tower through which heated vapor is adapted to be passed upwardly, means for introducing heated vapors into the tower, an indirect heat exchange device disposed in the path of the heated vapors, means for conducting liquid from a relatively cool upper portion of the tower through the exchange device located in the lower portion of the tower, a receptacle in the relatively cool upper portion of the tower, and means for conducting the liquid from the exchange device to the receptacle.

6. The method of distilling crude petroleum oil containing water which consists in heating the crude only by heat exchange with previously heated oil fluid to a temperature in excess of the boiling point of water, feeding the oil thus heated into an intermediate point of a column, introducing steam below the point of feed in counter-current flow to descending liquid to vaporize gasoline, condensing the vapor mixture of steam and gasoline, refluxing gasoline condensate to the column above the point of feed and in counter-current flow to the ascending vapors to control the composition of some of the gasoline as a distillate product, withdrawing residue from the column, heating the residue in a fired heater, and introducing it into a second column for distilling additional gasoline and fractions heavier than gasoline, a distillate of the second column being used to supply the heat for the crude fed to the first column.

GEORGE B. COUBROUGH.

CERTIFICATE OF CORRECTION.

Patent No. 2,092,528. September 7, 1937.

GEORGE B. COUBROUGH.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 29, for the word "gasoline" read gas-oil; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of October, A. D. 1937.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.