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PROCESS FOR DISTILLING PETROLEUM HYDROCARBONS

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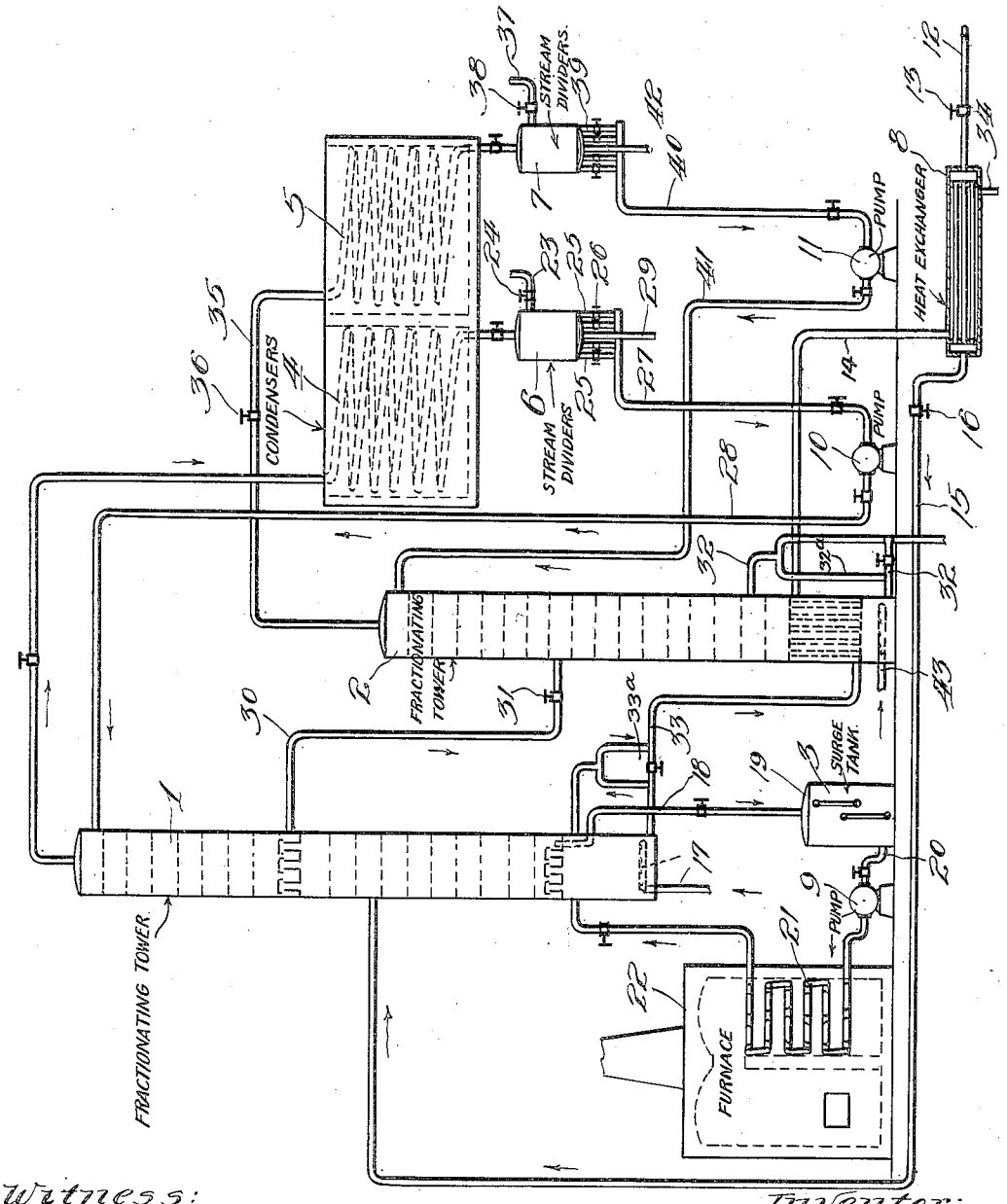


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## PROCESS FOR DISTILLING PETROLEUM HYDROCARBONS

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7 Claims. (Cl. 196—72)

This invention relates to improvements in a process for distillation petroleum hydrocarbons, and refers more particularly to a four-product continuous topping still adapted to produce gasoline, blending naphtha, kerosene and bottoms.

The single figure is a diagrammatic side elevational view of the apparatus. The important elements of the apparatus consist in two fractionating towers 1 and 2, a surge tank 3, two condensing coils 4 and 5 mounted in water cooled condensing boxes, two stream dividers 6 and 7, a heat exchanger 8 and pumps 9, 10 and 11.

The operation is as follows:

Crude oil is introduced to the system through the line 12 regulated by the valve 13, and is circulated through the heat exchanger 8 where it picks up heat from the bottoms discharged from the tower 2 and directed to the heat exchanger through the line 14. The preheated oil passing from the heat exchanger is directed through the pipe 15 in which is interposed a valve 16, and is introduced to a feed deck in the fractionating tower 1 which is located intermediate between the top and bottom. These towers are preferably of the bubble tower type having a plurality of decks upon which a liquid level is maintained and through which the vapors percolate as they rise from the bottom to the top of the towers. The feed flows down through the tower 1 which is so arranged that the gasoline and kerosene are both stripped from the liquid by the time the feed has reached the bottom deck. Heat may be supplied to the lower part of the tower by means of the steam pipe 17 positioned in the bottom of the tower. The tower is preferably heavily insulated to prevent excessive loss of heat by radiation. The down pipe 18 from the bottom deck of the tower 1 is led outside of the tower and the liquid from the bottom deck flows to the surge tank 3, from whence it is drawn through the line 20 and forced by means of the pump 9 through the tube still 21 positioned in the furnace 22. The hot oil from the tube still enters the bottom chamber of the tower and the vapors coming off from it aid in supplying heat for the operation of the tower.

Refluxing is done at such a rate that the vapors leaving the tower 1 consist of substantially only the gasoline vapors and these are condensed and cooled in the condensing coil 4. The stream from the discharge end of the condenser coil 4 passes through the stream divider when undesirable gases are liberated by means of the pipe 23 controlled by a valve 24 and the stream is divided into two portions, one of which is drawn off through the pipes 25 controlled by valves 26 and recirculated to the top of the tower 1 by means of a line 27, pump 10 and return line 28. This recirculated material is introduced to the top of the tower 1 as a refluxing medium, while the other portion of the gasoline distillate passes off through the pipe 29 to storage.

At a point between the feed deck and the top of the tower 1, a portion of the reflux liquid is drawn off through the line 30 controlled by a valve 31 and is directed to the tower 2. This liquid will be composed of kerosene containing a considerable portion of lower boiling point substances whose boiling point range is between that of gasoline and kerosene. The liquid enters the tower 2 at a point intermediate the top and bottom and during its passage through the tower, which is constructed similarly to the tower 1, all of the lighter portions are removed. The effluent from the tower is kerosene which is drawn off through the line 32 regulated by suitable valves, and directed to storage. A pool of oil may be maintained in the bottom of tower 2 by closing the valve shown in line 32 and employing the liquid level control by-pass 32—*a*.

The bottoms from the tower 1 are drawn off through the pipe 33 and introduced to the lower section of the tower 2 which has positioned therein a tubular heat exchanger through which they pass, thus supplying heat for the operation of the tower 2. After circulating through the lower part of the tower 2, this liquid material is directed through the line 14 through the heat exchanger 8 and discharged through the pipe 34 to storage. When it is desired to maintain a pool of oil in the bottom of the tower 1 the valve in line 33 is closed and the liquid level control by-pass 33—*a* employed.

The vapors from the tower 2 pass over through the line 35 in which is interposed a valve 36 to the condensing coil 5 where they are condensed and cooled. The fluid products pass through the stream divider which liberates the uncondensable gases through the pipe 37 controlled by a valve 38 and returns the refluxing liquid through the pipes 39, return line 40, pump 11 and line 41 to the top of the tower 2 in the manner previously described in connection with the initial tower. The other portion of the distillate from that separated and returned is directed through the pipe 42 to storage not shown. The product from the tower 2 directed through the line 42 will be a blending naphtha, and the operation of the equipment can be so regulated that the end point will be that of the usual gasoline, although the initial boiling point and the first part of the distillation curve may be higher than that of Navy

specification gasoline. As explained, boiling cap or bubble towers are illustrated, and it has been found that they offer a most efficient type of apparatus for the proper operation of the unit, but it is possible that some other type of tower could be employed. A tube still is shown, but any ordinary means of heating such as a shell still may be used in its place. The heating element for the tower 2 is illustrated as a tubular heat exchanger, but this type of construction may also be varied without departing from the spirit of the invention.

In the drawing, a refluxing medium is provided by recirculating a portion of the product. This also may be done by the introduction of any suitable type of refluxing medium such as cooling the top of the tower with water or cool oil of a suitable character.

Saturated or superheated steam may be injected into the bottom sections of the towers through the pipes 17 and 43. The supplying of heat in this manner is optional and may be unnecessary in the treatment of different types of oil.

As an example of the temperatures prevailing in the different parts of the apparatus, it is obvious that different oils will require varying conditions of temperature. By using Mid-Continent crude, satisfactory operation has been effected by maintaining the temperature substantially at 625° F., at the bottom of the first tower and 350° F., at the top of the first tower, while temperatures of 550° F. and 380° F., were the approximate temperature conditions respectively in the bottom and top of the second tower.

I claim as my invention:

1. A process for distilling hydrocarbon oil comprising maintaining a substantial body of heated oil in a zone wherein substantial vaporization occurs, passing vapors evolved in said zone to a second zone, introducing the oil to be distilled to said second zone, passing oil to be distilled separated from the vapors in said second zone from said second zone through a heating zone, thence delivering the heated oil to said body of heated oil in said first mentioned zone, passing vapors from said second zone to a third zone wherein further condensation is effected, delivering the condensate separated from the vapors in said third zone to a fractionating zone, simultaneously passing unvaporized oil constituents from said first mentioned zone to said fractionating zone to supply the heating medium employed therein, and taking off vaporized constituents from said fractionating zone, subjecting the same to condensation, and recovering the resulting distillate.

2. A process for distilling hydrocarbon oil comprising maintaining a substantial body of heated oil in a zone wherein substantial vaporization occurs, passing vapors evolved in said zone to a second zone, introducing the oil to be distilled to said second zone, passing oil to be distilled separated from the vapors in said second zone from said second zone through a heating zone, thence delivering the heated oil to said body of heated oil in said first mentioned zone, passing vapors from said second zone to a third zone wherein further condensation is effected, removing vapors from said third zone, subjecting such vapors to condensation, returning portions of the resulting distillate to said third zone, delivering the condensate separated from the vapors in said third zone to a fractionating zone, simultaneously passing unvaporized oil constituents from said first mentioned zone to said fractionating zone to supply the heating medium employed therein, and taking off vaporized constituents from said fractionating zone, subjecting the same to condensation, and recovering the resulting distillate.

3. A process for distilling hydrocarbon oil comprising maintaining a substantial body of heated oil in a zone wherein substantial vaporization occurs, passing vapors evolved in said zone to a second zone, introducing the oil to be distilled to said second zone, passing oil to be distilled separated from the vapors in said second zone from said second zone through a heating zone, thence delivering the heated oil to said body of heated oil in said first mentioned zone, passing vapors from said second zone to a third zone wherein further condensation is effected, removing vapors from said third zone, subjecting such vapors to condensation, returning portions of the resulting distillate to said third zone, delivering the condensate separated from the vapors in said third zone to a fractionating zone, simultaneously passing unvaporized oil constituents from said first mentioned zone to supply the heating medium employed therein, removing vaporized constituents from said fractionating zone, subjecting the same to condensation, returning a portion of the resulting distillate to said fractionating zone, and recovering the remaining portion of the distillate.

4. A process for the fractional distillation of hydrocarbon oils which comprises passing a stream of charging oil through a heating zone maintained at a vaporization temperature, passing the stream of heated oil from said zone into a combined evaporating and fractionating zone, removing unvaporized oil from said combined zone and passing the same in heat exchange relation with said charging oil being supplied to said heating zone, removing gasoline vapors from the upper portion of said combined zone and subjecting the same to condensation and collection as a final product of the process, removing a fraction heavier than gasoline from said combined zone at a point below the upper portion thereof but above the point at which said stream of heated oil is introduced, introducing said fraction heavier than gasoline into a second fractionating zone, supplying heat to the lower portion of said second fractionating zone to effect reboiling of said fraction heavier than gasoline, removing liquid oil from the lower portion of said second fractionating zone as a final product of the process, and removing vapors from the upper portion of said second fractionating zone and collecting and condensing the same independently of said gasoline vapors.

5. A process for the fractional distillation of hydrocarbon oils which comprises effecting fractionation of oil in a combined evaporating and fractionating zone, passing charging oil to be fractionated in the process in heat exchange relation with vapors of oil fractionated in said combined zone, subsequently passing said charging oil in a stream through a heating coil maintained at a vaporizing temperature, introducing the stream of heated charging oil to said combined zone for fractionation therein, removing unvaporized liquid from said combined zone, and passing the same in heat exchange relation with the charging oil being supplied to said heating zone, removing gasoline vapors from the upper portion of said combined zone and subjecting the

same to condensation and collection as a final product of the process, removing a condensed kerosene fraction from said combined zone at a point below the upper portion thereof and above the point at which said stream of heated charging oil is introduced, introducing said kerosene fraction into a second fractionating zone, supplying heat to the lower portion of said fractionating zone to effect reboiling of said kerosene fraction, removing unvaporized kerosene from the lower portion of said second fractionating zone and collecting the same as a final product of the process, and removing vapors from the upper portion of said second fractionating zone and collecting and condensing the same independently of said gasoline vapors.

6. In the fractional distillation of hydrocarbon oil, the method which comprises introducing the oil at an intermediate point of a primary fractionating zone and passing the same downwardly therethrough in contact with ascending vapors, removing unvaporized oil from the lower portion of said zone and heating the same to distillation temperature and then reintroducing it to the lower portion of said zone for vapor separation, removing a liquid fraction from said zone at a point between the upper portion thereof and said intermediate point, introducing said liquid fraction into a secondary fractionating zone at a point substantially below the top thereof and separating the same therein into vapor and liquid, removing a light vapor fraction from the upper portion of said primary zone and condensing the same, recycling a portion of the resultant condensate to the upper portion of said primary zone, removing said vapor and liquid from the upper and lower portions respectively of said secondary zone, condensing the vapor and recycling a portion of the resultant condensate to the upper portion of said secondary zone.

7. The method as defined in claim 6 further characterized in that a liquid residue is withdrawn from the bottom of said primary zone and utilized as a heating medium for the lower portion of said secondary zone.

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