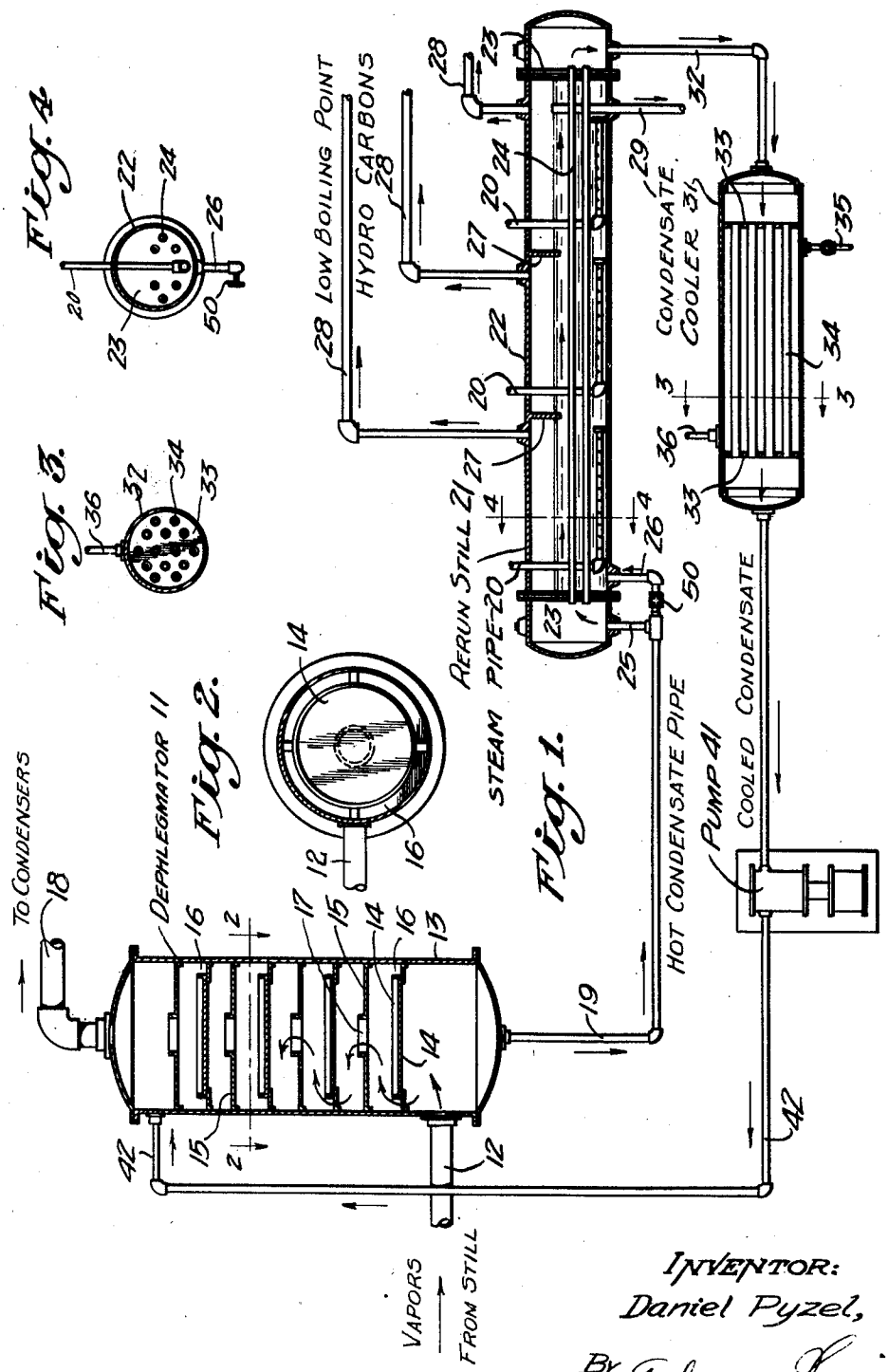
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PROCESS OF SEPARATING HYDROCARBON FRACTIONS

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PROCESS OF SEPARATING HYDROCARBON FRACTIONS.

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My invention relates to the art of oil refining and particularly to the art of fractionating oil vapors.

In the art of oil refining an oil vapor is usually produced by the still, this vapor being made up of a complex series of hydrocarbons, the different hydrocarbons having various boiling points.

It is an object of the present invention to provide means whereby a hydrocarbon of definite characteristics can be separated from such a complex mixture.

It is further an object to separate from a vapor containing a complex mixture of hydrocarbons a condensate having a definite range of boiling points, and it is further an object of this invention to separate from such a condensate any hydrocarbons which may be entrained in the condensate as originally formed, and which have boiling points below the desired range.

Further objects and advantages will be made evident hereinafter.

Referring to the drawing which is for illustrative purposes only,

Fig. 1 is an elevation partly in section showing diagrammatically one form of apparatus embodying my invention.

Fig. 2 is a section on a plane represented by the line 2—2 of Fig. 1.

Fig. 3 is a section on a plane represented by the line 3—3 of Fig. 1.

Fig. 4 is a section on a plane represented by the line 4—4 of Fig. 1.

In the form of the invention illustrated I use a dephlegmator 11, a rerun still 21, a cooler 31 and a pump 41. Vapor from an oil still, not shown, is delivered to the dephlegmator 11 through a pipe 12, the dephlegmator consisting of a tight shell 13 in which are placed pans 14 and 15. The pans 14 are smaller in diameter than the shell, leaving an annular opening 16 therearound. The pans 15 fit tightly in the shell and have a central opening 17. The vapor entering the dephlegmator passes in a tortuous course around the pans 14 and through the center of the pans 15, being finally withdrawn through a pipe 18 and delivered to additional dephlegmators or condensers, not shown. Cold condensate is delivered into the top of the dephlegmator through a pipe 42 from the pump 41, being taken through the cooler 31 through a pipe 32 from the rerun still, as will hereinafter be explained. The cold condensate in its passage downwardly through the dephlegmator fills the pans 14 and 15, passing successively down from these pans and into the bottom, from which it is withdrawn through a pipe 19. In its passage through the dephlegmator the cooled condensate acts as both a cendensing and an absorbing medium, that is to say it acts upon the oil vapors to cool them, thereby causing the higher boiling point fractions to condense, and it also acts directly, especially in the cooler upper part of the dephlegmator, to absorb from the oil vapors certain of the lower boiling point vapors carried therein. On the other hand the hot vapors in the lower part of the dephlegmator tend to evaporate from the condensate part of the low boiling point oils which are absorbed therein. The vapors condensed or absorbed add to the volume of the condensate and the mixture from the bottom of the dephlegmator 11 is carried through the pipe 19 to the rerun still 21.

This still consists of a tight shell 22 having false heads 23 therein, between which tubes 24 extend. A large portion of the hot condensate is delivered by means of a pipe 25 into the space at one end of the rerun still 21 outside one of the heads 23, this portion of the condensate flowing through the tubes 24 into a space at the opposite end of the rerun still and being taken off therefrom by means of a pipe 32. The other smaller portion of the condensate is delivered through a pipe 26 to the space between the heads 23, flowing from left to right through this space, in which it is in contact with the outside of the tubes 24 through which the larger portion of the hot condensate is flowing. The interior of the space between the heads 23 is divided into several parts by partitions 27 which extend down into the liquid therein, forming separate vapor spaces from which independent vapor takeoffs 28 lead to suitable condensers, not shown. Steam is supplied to these spaces through perforated pipes 20, and the level of the liquid is maintained above the bottom of the partitions 27 by means of the pipe 29, which projects up into the rerun still to the necessary height to accomplish this result. The injection of steam through the perforated pipes 20 causes an evaporation from the body of liquid in the rerun still, the vapors, consisting of the low boiling point fractions, being withdrawn

through the pipes 28 so that the body of condensate in the still is freed of low boiling point fractions. The evaporation of these fractions requires a considerable amount of heat and would reduce the temperature of the liquid in the still below the temperature required for efficiently freeing it from such low boiling fractions. To prevent this, heat is supplied to the liquid in the rerun still by the tubes 24, through which the larger part of the hot condensate from the dephlegmator flows. After giving off part of its heat, through the tubes 24 to the liquid in the rerun still, this condensate is carried off by the pipe 32 to the cooler 31, this cooler having intermediate heads 33, between which tubes 34 extend. Cold water or another cooling medium is delivered to the space between the heads 33 by a pipe 35, the heated cooling medium being withdrawn through the pipe 36. The function of the cooler 31 is to still further cool the condensate which is then forced by the pump 41 through the pipe 42 into the top of the dephlegmator.

A valve 50 is provided in the pipe 26 for the purpose of regulating the proportion of the condensate delivered by the pipe 19 which will be passed through the pipe 26 into the central chamber of the rerun still.

By the use of the dephlegmator 11, it is possible to separate from the vapor all of the condensate which will condense below a certain temperature. At the same time the condensate in the dephlegmator 11 must necessarily contain certain fractions which have a lower boiling point than the desired product. These lower boiling point fractions are re-evaporated in the rerun still and taken over by the pipes 28 so that the condensate delivered to the pipe 29 is free from these low boiling point fractions which are, however, valuable and which are saved and utilized for other purposes. By the use of my invention a condensate having a very definite range of boiling points is continuously delivered through the pipe 29, certain other condensates having lower boiling points being delivered as vapors through the pipes 28.

The vapors delivered through the pipe 12 from the still, not shown, to the dephlegmator 11 consist at any instant of a complex mixture of hydrocarbon vapors, all of which vaporize below the still temperature and substantially none of which require a higher vaporizing temperature. This mixture delivered through the pipe 12 therefore consists of hydrocarbons boiling at a temperature below that of the still.

In the dephlegmator 11 a portion of the vapors are cooled and partly condensed by a circulating stream of cold condensate entering through the pipe 42, the proportion so condensed being determined by the exit temperature of vapors leaving the condenser by the pipe 18. The condensate delivered from the bottom of the dephlegmator therefore consists chiefly of hydrocarbons which will condense below this exit temperature or boil above this temperature. In addition, however, these hydrocarbons of high boiling point will absorb considerable quantities of lighter vapors which normally boil considerably below the exit temperature of the dephlegmator. These lighter vapors, in many cases, when condensed form products which are much more valuable than the condensate itself. For example, the condensate may be chiefly a heavy and relatively low priced gas-oil distillate and the lighter vapors absorbed may be gasoline having a considerably greater value. It is the purpose of the rerun still 21 to remove these lighter vapors from a part of the condensate equal in quantity to the condensate formed in the dephlegmator.

This is accomplished by means of the heat already in the liquid flowing from the dephlegmator 11 through the pipe 19. A portion of this liquid flows through the tubes 24 and a portion surrounds these tubes. Since it is desired to extract heat from the liquid inside the tubes, it is necessary that the temperature of the liquid outside the tubes be lowered. It is obvious that if it is desired to cause an evaporation from the liquid outside the tubes at this lower temperature, it will be necessary to lower the absolute pressure on this liquid, which could be done by means of a vacuum pump, or to lower the partial pressure by the injection of steam, which is the expedient I adopt herein.

By injecting steam into the liquid outside the tubes 24, I not only agitate the liquid but I also produce in the space above the liquid a mixture of steam and oil vapors, and thereby greatly lower the partial pressure of the oil vapors. As a result I am able to evaporate from the liquid in the rerun still all the low boiling point vapors carried therein, this evaporation taking place at a temperature considerably below that of the liquid flowing through the pipe 19.

Due to the reduction in the partial oil vapor pressure inside the rerun still 21, which is due in turn to the presence of steam, I am able to evaporate such low boiling point vapors at this lower temperature, the latent heat of vaporization being supplied by heat conduction from the liquid in the tubes 24.

The function of the injected steam is solely the reduction of the partial oil vapor pressure necessary to cause the liquid to boil, notwithstanding the reduction in temperature caused by the evaporation of its lighter constituents. The temperature of the injected steam is, therefore, immaterial. If it is higher than that of the oil, it will give off a small amount of heat to this oil; if it is lower, it will be heated to the temperature

of the oil, the heat required for this purpose being supplied by the hotter oil inside the tubes.

Preferably, the steam is supplied at about the same temperature as that of the liquid outside the tubes 24, which is determined by the evaporation of low boiling point vapors therefrom, and the consequent extraction of heat therefrom.

By allowing the liquid to flow inside the rerun still 21 from left to right, as shown in Fig. 1, and subjecting it to this evaporation under partial pressure, I am able to distill therefrom substantially all the low boiling point hydrocarbons which are delivered as vapor through the pipes 28, so that the liquid finally withdrawn through the pipe 29 is substantially free from such low boiling point hydrocarbons.

It is further to be noted that by regulating the quantity of circulating distillate and by regulating the flow of steam through the pipes 20, the operator can accurately determine the amount of vaporization produced in the rerun still 21 and the character of the liquid delivered through the pipe 29. It will also be noted that this is accomplished by the use of the sensible heat carried in that part of the liquid delivered from the pipe 19 by the pipe 25 to the inside of the heating tubes.

This part of the liquid, after supplying the heat required in the rerun still, is then delivered by the pipe 32 to a cooler 31 where it is further cooled, after which it is pumped back through the pipe 42 to the top of the dephlegmator as a cooling medium.

I claim as my invention:

1. A process of separating hydrocarbon fractions from a heated mixture of said fractions in a liquid state which comprises: lowering the partial vapor pressure on a portion of said mixture by injecting therein vapor having a different vapor tension; supplying heat to said portion from the remainder of said mixture, said remainder being held under its initial vapor tension; and removing the mixture of vapors produced by said injection and heating.

2. A process of separating hydrocarbon fractions from a heated mixture of said fractions in a liquid state which comprises: lowering the partial vapor pressure on a portion of said mixture by injecting steam therein; supplying heat to said portion from the remainder of said mixture, said remainder being held under its initial vapor tension; and removing the mixture of vapors produced by said injection and heating.

3. A process of separating a hydrocarbon fraction having definite boiling point limits from a mixture of hydrocarbon vapors which comprises: condensing from said vapors a condensate; passing a portion of said condensate at a temperature slightly below its initial boiling point at the pressure at which it is condensed into a space in which its partial pressure is sufficiently reduced to cause vaporization of light hydrocarbons therefrom; and supplying a portion of the heat necessary to produce said vaporization by conduction from the remainder of said condensate.

4. A process of separating a hydrocarbon fraction having definite boiling point limits from a mixture of hydrocarbon vapors which comprises: condensing from said vapors a condensate; passing a portion of said condensate at a temperature slightly below its initial boiling point at the pressure at which it is condensed into a space in which its partial pressure is sufficiently reduced by the introduction of steam to cause vaporization of light hydrocarbons therefrom; and supplying a portion of the heat necessary to produce said vaporization by conduction from the remainder of said condensate.

5. A process of separating a hydrocarbon fraction having definite boiling point limits from a mixture of hydrocarbon vapors which comprises; condensing from said vapors a condensate; passing a portion of said condensate at a temperature slightly below its initial boiling point at the pressure at which it is condensed into a space in which its partial pressure is sufficiently reduced to cause vaporization of light hydrocarbons therefrom; supplying a portion of the heat necessary to produce said vaporization by conduction from the remainder of said condensate; and passing said remainder back into direct contact with said vapors.

6. A process of separating a hydrocarbon fraction having definite boiling point limits from a mixture of hydrocarbon vapors which comprises: condensing from said vapors a condensate; passing a portion of said condensate at a temperature slightly below its initial boiling point at the pressure at which it is condensed into a space in which its partial pressure is sufficiently reduced to cause vaporization of light hydrocarbons therefrom; supplying a portion of the heat necessary to produce said vaporization by conduction from the remainder of said condensate; cooling said remainder; and passing said remainder back into direct contact with said vapors.

In testimony whereof, I have hereunto set my hand at San Francisco, California, this 16th day of August, 1923.

DANIEL PYZEL.