May 12, 1931. C. P. DUBBS 1,804,553

APPARATUS FOR FRACTIONATION OF HYDROCARBONS

Filed Jan. 14, 1926

Fig. 1.

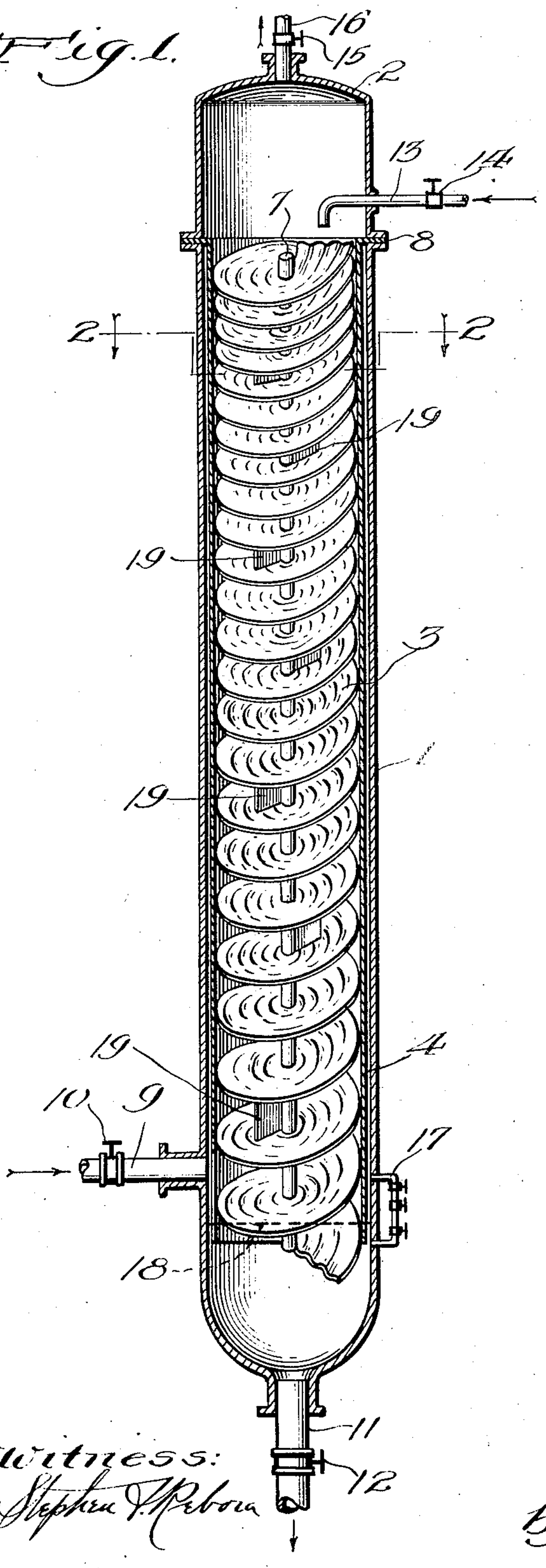


Fig. 2.

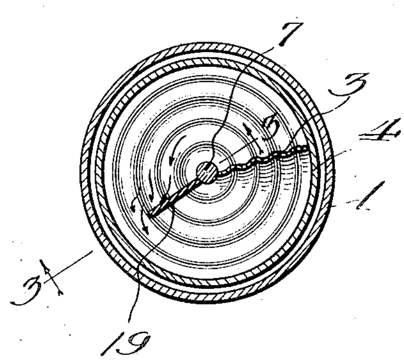
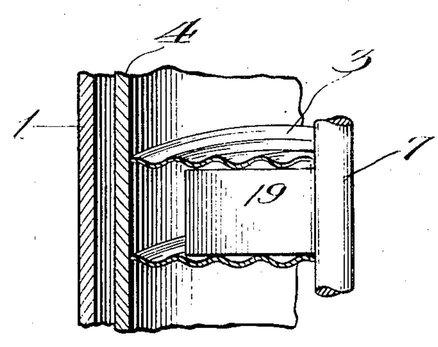


Fig. 3.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR FRACTIONATION OF HYDROCARBONS

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This invention relates to a process and apparatus for fractionation of hydrocarbons, and refers more particularly to a process and apparatus to be utilized in connection with processes for treating hydrocarbon oils to produce therefrom commercial products of light gravity.

In the treatment of hydrocarbon vapors having different ranges of boiling points, and in attempting to separate and separately collect certain ranges of boiling points, it has been found that these separated products are more or less contaminated with a substantial portion of higher and lower boiling point products, which in most instances is undesirable. For instance, assume that a standard still is charged with crude petroleum containing gasoline, kerosene, gas oil, etc. By the application of external heat, the oil is progressively distilled and the released vapors condensed and collected, the lowest boiling point vapors distilling off first, and the vapors of higher boiling points following progressively.

For instance, say a gasoline cut will consist of that portion of oil distilling off from the lowest temperature up to 437° F. This cut is condensed and separately collected; the cut taken above 437° F. is known as the kerosene cut.

In the ordinary apparatus, the gasoline will be found to contain boiling points higher than 437° F., and the kerosene cut will be found to contain boiling points lower than 437° F. In other words, there will be some kerosene in the gasoline cut, and some gasoline in the kerosene cut. Heretofore, these were known as crude cuts of kerosene and gasoline, and were redistilled to separately free the gasoline from the kerosene and to free the kerosene from the gasoline.

In recent practice, rectifying columns have been put on the crude still to accomplish the same purpose on the first distillation, thus avoiding redistillation of these cuts. In continuous tube stills the operation is somewhat different. In this case the total oil to be distilled off is vaporized, and the mixed vapors passed through rectifying columns or dephlegmators and the different cuts fractionally condensed therein. As an illustration, if it is desired to distill the gasoline and kerosene cuts from the crude oil, the crude oil is subjected to a temperature at which both of these cuts are vaporized. These vapors, having a wide range of boiling points, are then passed through the rectifying columns where the portions having boiling points higher than kerosene, are first condensed and withdrawn separately, and the remaining vapors passed to a second rectifying column in which the portions containing boiling points forming the kerosene are condensed and collected separately.

The remaining vapors containing boiling points forming gasoline, are then withdrawn, condensed and separately collected.

In some cases, it is only desirable to obtain and collect gasoline, while in other cases it is desirable to collect separately the gasoline, kerosene, and sometimes gas oil.

The process and apparatus for fractionation hereinafter described, will be found to be suitable for all of the above purposes. If more than a gasoline cut is desired, then more dephlagmating or fractionating columns will have to be used in proportion to the number of cuts of different boiling points desired.

It will be apparent to those skilled in the art, that great savings will be made by having a rectifying column so designed as to bring about an efficient separation of the different fractions for use with distilling and cracking processes, which will obviate the necessity of redistilling these condensed vapors. It is highly desirable to provide a rectfying column that will efficiently function to condense therein only those portions of the vapors having boiling points higher than those belonging to the gasoline fractions while leaving the gasoline fractions in the vapor phase to be withdrawn and separately condensed.

In the drawings, Fig. 1 is a diagrammatic side elevational view in vertical section, of a rectifying column. Fig. 2 is a cross sectional view taken on line 2—2 of Fig. 1. Fig. 3 is a cross sectional view taken on line 3—3 of Fig. 2.

Referring more in detail to the drawings, 1 designates the outer shell having the head 2. Disposed vertically in the height of the shell 1 are helices 3 contained in an inner shell 4. The outer edge of the helices 3 is solidly joined to the inner wall of the inner shell 4 so that no vapors can pass between the outer edge of the helices and the inner wall of shell 4. A core rod 7 projects downwardly through the center of the helices for the purpose of forming a supporting connection. The inner shell 4 may be flanged as shown at 8 to fit between the flanges of the shell 1 and head 2. It will be immediately apparent that when the head 2 is removable, the inner shell 4 containing the helices can be readily withdrawn, as said inner shell 4 hangs freely in the bottom of the outer shell 1. 9 designates the vapor inlet having throttle valve 10. 11 designates the liquid condensate drawoff having valve 12. 13 designates an inlet for a cooling medium such as pressure distillate, crude oil, or other liquid cooling medium, which line 13 is controlled by the valve 14. 15 designates a vapor outlet pipe controlled by valve 16. 17 designates a liquid level gauge and 18 the approximate liquid level line in the rectifying column.

At various intervals throughout the height of the helices may be interposed baffles 19. The operation of the rectifying column should be apparent from the foregoing description.

The mixture of vapors entering the rectifying column through the vapor inlet 9 are discharged into the bottom section of the helices 3. It will be noted that the liquid level is shown in the drawing below this vapor inlet 9, but sufficiently high so as to cause the lower portion of the helices 3 to be submerged therein. The object of this is to keep the portion below the helices filled with liquid and thus prevent any vapors entering that section, since such vapors would not be compelled to travel up through the helices. The apparatus of course, can be operated efficiently without any liquid level in this part of the chamber if desired. As the vapors are forced to travel upwardly in a helical path around the helices, they are decreased in temperature and condensation of part of the vapors continuously takes place. By the time those vapors which are still uncondensed, reach the top of the helices, all of the vapors having boiling points higher than those desired, have been condensed. Therefore, the vapors withdrawn from the rectifying column through the pipe 15 are of the desired low boiling points. The condensate in the rectifying column contains more or less of that portion having boiling points lower than those it is desired to condense in the rectifying column, but as these condensed vapors flow back down the surface of the helices, they are progressively subjected to higher heat so that any low boiling point portions contained therein are revaporized by the hot ascending vapors so that by the time the condensate reaches the bottom of the spiral, it has been freed of substantially all that fraction having the desired low boiling point. The function of the baffle plates 19 is to direct the vapors to the outer periphery of the spiral.

It will be noted that the surface of the spiral helices is shown as corrugated in the drawing. This is not necessary, but may be preferable. It is also to be noted that the spacing of this helix gradually grows smaller in an upward direction, for the reason that since part of the vapors are condensed as they pass upward about the helix, the remaining volume of vapors is smaller, and to maintain the same velocity, it is necessary to decrease the space between the helices. It is of considerable advantage to have the spiral 3 made of a thin metal of great heat conductivity so that the heat from the ascending vapors can be readily transmitted from one side of the spiral to the film of liquid flowing over the upper side, thus promoting the evaporation of the light ends of this condensate.

If the material being cracked, contains more or less of a product having boiling points similar to those produced by cracking, it may be fed directly into the top of the fractionating column through the inlet pipe 13, but preferably this oil should be preheated and brought to the temperature of the vapors in this part of the rectifying column before being discharged therein. If it is not desired to preheat such oil, pipe 13 should preferably enter the rectifying column at approximately the center of the spiral. By doing this, the light ends will be vaporized from the cooling material and pass out as vapors from the dephlegmator while the heavier ends will flow downwardly along the surface of the helix, together with any condensate. The rectifying column may be maintained under atmospheric pressure, superatmospheric pressure, or under vacuum.

The rectifying column should be so designed, that the velocity of the vapors through the spiral will not be sufficient to pick up by entrainment any substantial portion of the condensate.

The fractionating column may be say five feet in diameter and forty feet high more or less. The spacing at the lowest part of the helix may be say eight inches more or less, progressively decreasing until the space at the upper part of the helix is say five inches.

The charging stock treated per day may be 1,000 barrels, and the vapors entering the rectifying column through the pipe 9 may be 830° F. more or less. The vapors discharging through the pipe 15 may be at a temperature of say 350° F. more or less.

The above figures are merely illustrative.

The corrugation instead of running in the same direction as the spiral, may extend at right angles to impede the downward flow of the condensate.

I claim as my invention:

1. Apparatus for rectifying hydrocarbon oil vapors, comprising in combination a vertical cylindrical shell, means near the bottom thereof for admitting vapors to be rectified, means near the top thereof for withdrawing uncondensed vapors and gases, means also near the top thereof for discharging a cooling liquid into said shell, a baffle in said shell comprising a thin strip of metal of corrugated cross section, a central vertical core rod for supporting said baffle, the inner edge of said baffle being wrapped or wound around said core rod forming a series of spaced convolutions, the spacing of said convolutions being decreased toward the top of said rod, and the strip extending radially from said rod at all points of contact therewith, the outer edge of said strip being in contact with said shell, the corrugations of said strip being parallel and concentric and extending substantially the full length of said strip.

2. In a rectifier for hydrocarbon oils, a helical baffle provided with a plurality of concentric, parallel corrugations extending the full length of said baffle, a vertical rectangular intercoastal baffle positioned between the convolutions of the helical baffle with its upper edge contacting the lower portions of said corrugations, and with its lower edge contacting the upper portions of said corrugations, said corrugations providing apertures below the vertical baffle for passage of cooling liquid and apertures above the vertical baffle for the passage of uncondensed vapors.

3. Apparatus for rectifying hydrocarbon oil vapors, comprising in combination, a vertical cylindrical shell, means near the bottom thereof for admitting vapors to be rectified, means near the top thereof for withdrawing uncondensed vapors and gases, means also near the top thereof for discharging a cooling liquid into said shell, a baffle in said shell, comprising a thin strip of metal of corrugated cross section, a central vertical core rod for supporting said baffle, the inner edge of said baffle being wrapped or wound around said core rod forming a series of spaced convolutions, and the strip extending radially from said rod at all points of contact therewith, the outer edge of said strip being in contact with said shell, the corrugations of said strip being parallel and concentric and extending substantially the full length of said strip.

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