

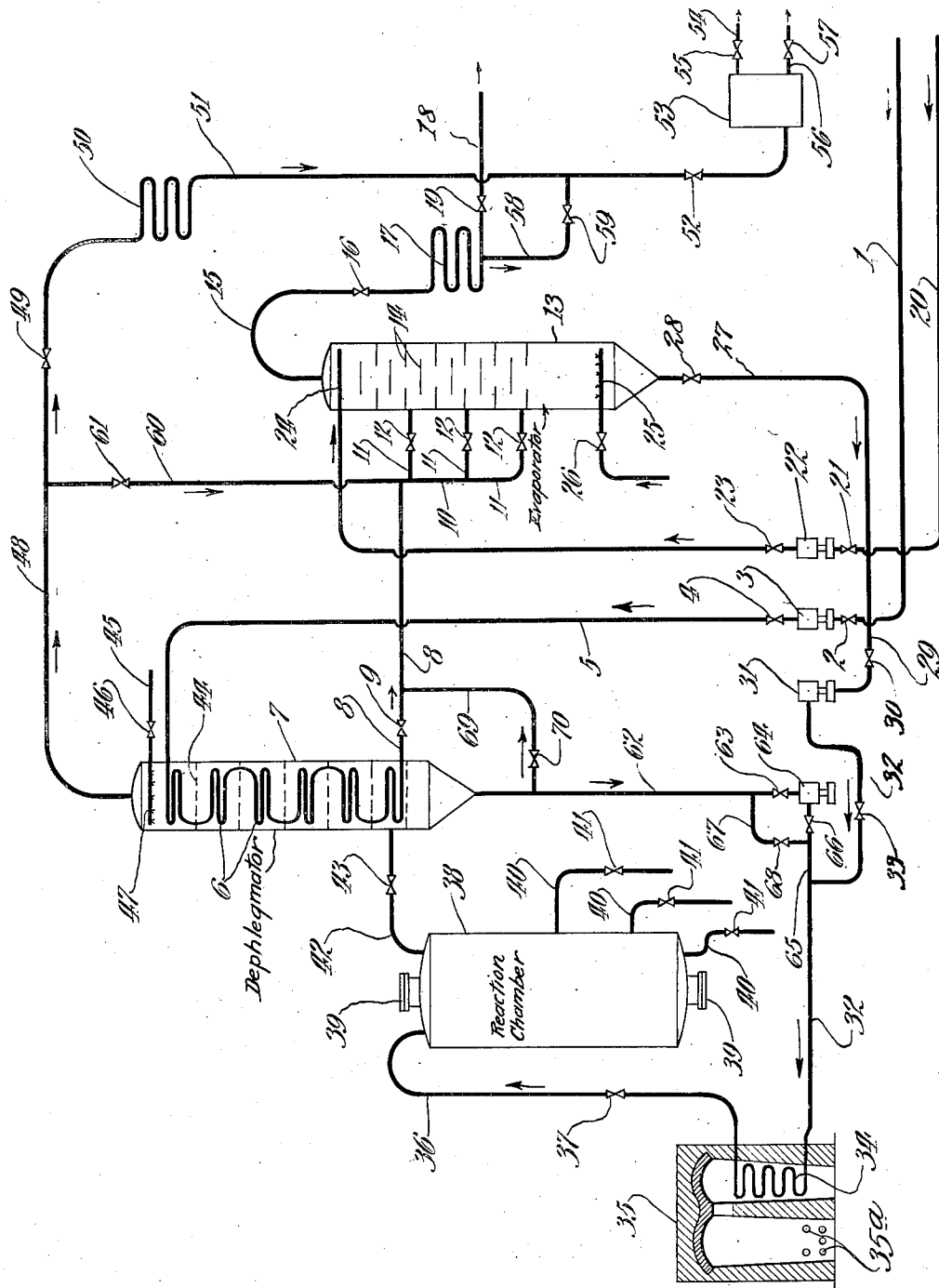
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PROCESS FOR HYDROCARBON OIL CONVERSION

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PROCESS FOR HYDROCARBON OIL
CONVERSION

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This invention relates to improvements in process and apparatus for hydrocarbon oil conversion, and refers more particularly to those types of processes in which the oil is converted under pressure and heat into low boiling point hydrocarbons, while the heat spent for the conversion is recovered in other parts of the process and utilized for removing from crude petroleum or other charging stock, the lighter valuable fractions naturally contained therein, or other light fractions, after which the oil, from which said light fractions have been removed, is converted in the process. The characteristics of the light fractions removed from the crude oil before the topped crude or residue is subjected to conversion, are controlled either by the state of the market, or by the undesirability of passing through the cracking zone fractions which, by their refractory characteristics to cracking would decrease the capacity and efficiency of the cracking process.

Other features of the invention will appear more clearly from the following description, and from the attached drawing, in which the single figure is a diagrammatic view, partly in section and partly in elevation, of an apparatus suited to carry out the process.

It is understood that the process can be carried out in a number of types of apparatus which can be easily designed by any one skilled in the art, and while I have shown in the drawing and described hereafter a suitable type of apparatus, I do not wish in any way to be limited by the type described.

Referring to the drawing:

The oil which contains the natural light fractions which it is desirable to remove before passing the oil through the cracking zone, for instance, crude oil, from which it is desirable to remove gasoline or kerosene, or both, or a topped crude in which the lightest gasoline fractions have been removed, but in which the heavier naphtha, or the kerosene, have been left, is pumped through the line 1, controlled by valve 2, through pump 3, controlled by valve 4 and into line 5. From line 5 the oil is passed through a heat exchanging closed coil 6, positioned in the dephlegmator 7 of the cracking zone, which will be described later. The coil 6 may be positioned at various heights in the dephlegmator, and may extend throughout the height thereof, or may be limited to the upper or lower, or middle portion as desired, in such a manner that the heat transfer from the vapors undergoing dephlegmation in the dephlegmator 7, to the cold oil passing through the coil 6 brings said oil to the desired

temperature at the outlet of said coil 6. From said closed coil 6 the preheated oil passes out through the line 8 controlled by the valve 9 into a manifold header 10, to which are connected several branch lines 11, controlled by valves 12, and so positioned that each branch 11 leads to evaporator 13, being connected therewith at various points over the height of said evaporator. In this manner, by controlling the various valves 12 on said lines 11, it is possible to control the point at which the preheated oil enters the evaporator. Evaporator 13 may comprise fractionation means, such as plates 14, or other type, so that when the preheated oil enters the column 13 at the selected point thereof the fractions, which it is desired to remove from the oil before passing the latter through the cracking zone, separate at the same time that they are subjected to fractionation, thereby producing from the top of said column 13 a finished product. Said finished product, in the form of vapor, passes off the top of column 13 through line 15, controlled by valve 16, thence into a condenser 17, and from there through line 18, controlled by valve 19, it is directed to storage means not shown.

To assist in the fractionation of the oil in the evaporator 13, a cooling medium such as gasoline or the like, can be injected in the top of the evaporator through line 20, controlled by valve 21, in which are interposed pump 22 and valve 23, through which said cooling medium is introduced into a spray coil, or other injecting means, such as shown at 24.

It may be desirable to assist the separation of the lighter fractions from the heavier portions of the oil by injecting into evaporator 13, preferably at the bottom thereof, steam or other hot gas, such as for instance, non-condensable gases produced in the process after they have been heated to the proper temperature, and this can be effected through line 25 controlled by valve 26.

It may be here noted that while the pressure can be equalized on the oil passing through the preheating coil 6 and undergoing topping or separation in the evaporator 13, it may also be desirable to preheat the oil in the coil 6 under a pressure higher than that maintained on evaporator 13. If the operation is carried out with this latter method, separation of the lighter fractions from the oil through evaporator 13 is assisted by flashing or evaporation due to reduction of pressure.

The heavier fractions of the charging stock which have separated from the lighter fractions in evaporator 13, collect in the bottom of the

evaporator and are withdrawn from the bottom thereof through line 27, controlled by valve 28, and passed through line 29, controlled by valve 30. They are then passed through pump 31, line 32, controlled by valve 33, to the heating coil 34, positioned in furnace 35 of conventional type, which may be of any design found suitable. This furnace is heated by burners such as shown at 35—A. By passing through heating coil 34 the oil is brought to the proper temperature for conversion under suitable pressure, and the heated oil from such coil is discharged through transfer line 36, controlled by valve 37, into a reaction chamber 38, which has been shown of the vertical type, but which may be of any other type. This chamber is provided with suitable cleaning man-holes 39. In said reaction chamber the heated oil undergoes reaction and the products of reaction separate into vapors, and into both liquid, solid residues, or solid residue alone. The liquid residue, if any, is discharged preferably in a continuous manner from reaction chamber 38, through residue drawoffs 40, controlled by valves 41, from where the residuum can be passed to suitable storage (not shown) through cooling means (not shown), or from where it can be directed to further treatment in a similar or different process.

If any solid residue is formed in the reaction chamber, it may be removed through the man-holes 39.

The vapors separated in the reaction chamber pass out therefrom through vapor line 42, controlled by valve 43, and thence into the lower part of the dephlegmator 7. Dephlegmator 7 is provided with suitable fractionation means such as perforated plates 44, and these fractionating means are so arranged that they provide for the room necessary to mount the heat exchanging coil 6 above described.

In the dephlegmator 7 vapors undergo fractionation in the usual manner, assisted by the cooling effected by the oil passed through coil 6. The fractionation may be assisted also by means of an additional cooling agent introduced into the upper part of the dephlegmator, such as through line 45, controlled by valve 46, and spray coil 47. This cooling agent may be a portion of the pressure distillate produced in the process, or any other agent such as gasoline, or the like.

Vapors which have not been condensed in the dephlegmator 7 pass off the top thereof through line 48 controlled by valve 49, through condenser 50, and thence through line 51, controlled by valve 52, into receiver 53, which is provided with the gas release line 54, controlled by valve 55, and with a distillate drawoff 56, controlled by valve 57.

According to the characteristics of the cracked product from the cracking zone, and withdrawn in the form of vapor at the top of dephlegmator 7, it may be desirable to mix the said cracked product with the fractions originally removed from the oil in evaporator 13, and this can be effected, for instance, by means of connections such as by-pass 58, controlled by valve 59, between the outlet of the condenser 17 and the outlet line from condenser 50 to receiver 53.

As a further feature of my invention, it may be desirable also to submit the vapors leaving the top of dephlegmator 7 to a secondary fractionation so as to obtain cracked products similar in characteristics to the light products removed originally from the crude oil, or other charging stock in evaporator 13, and it is to be understood that

the invention contemplates that when using this method of operation, the vapors leaving dephlegmator 7 can be diverted from line 48, valve 49 being closed, through line 60 controlled by the valve 61, and connecting at its other end with the manifold 10, whereby said vapors will combine with the preheated raw oil leaving the coil 6 and the mixture will be passed through evaporator 13 for separation of the light fractions and fractionation thereof. The fractions of said vapors which may condense in evaporator 13, pass to the cracking coil with the non-vaporized fractions of the original crude oil through lines 27, 29, 32 and pump 31, as heretofore described. In this case, if, as has been heretofore mentioned, the pressure on evaporator 13 is lower than that on the preheating coil 6, and lower also than that maintained on dephlegmator 7, said pressure may be reduced on the vapors from said dephlegmator by means of valve 61. It may be here noted that the pressure which can be maintained on the oil passing through the coil 6 may be different from that maintained on the vapors undergoing fractionation in dephlegmator 7, and that these pressures will be set according to the characteristics of the oil treated, and of the products desired, and valves 9, 61 and other valves and pumps shown, permit of controlling the pressures, as desired.

Returning to dephlegmator 7, the reflux condensate which has been formed and which accumulates at the bottom thereof, is withdrawn through line 62, controlled by valve 63, and passed through pump 64 and line 65 controlled by valve 66, where said reflux condensate mixes with the oil directed to the heating tubes through line 32. If desirable, the pump 64 may be by-passed by means of line 67, controlled by valve 68, by proper regulation of said valve, and of valves 63 and 66.

For the treatment of certain oils under certain pressures, the reflux condensate formed in the dephlegmator 7 may contain, on account of the solubility of the fractions at the pressure employed, an objectionable amount of light fractions, the presence of which in the reflux condensate tends to reduce the capacity and the efficiency of the cracking zone. If this is prohibitive it may be desirable to separate such light fractions from the bulk of the reflux condensate, and this may be done, for instance, by diverting the reflux condensate from line 62 through branch line 69, controlled by valve 70, which can be used to control the pressure, into the line 8, through which, as heretofore described, the preheated raw oil is passed, in the first cycle of operation, from the preheating coil 6 to the evaporator 13. In this manner, the reflux condensate undergoes separation in said evaporator 13, and can be relieved thereby of its lightest fractions, and the non-vaporized portion of the reflux condensate combined with the non-vaporized portion of the crude petroleum, or other charging stock is directed from said evaporator 13, through line 29, pump 31, line 32 into the cracking coil 34, as heretofore described.

The temperature in the heating coil 34 is regulated in correlation with the pressure maintained in said coil, and it may vary from say 800 to 1000 degrees F., more or less, while the pressure maintained thereon may be of from 200 to 1000 pounds, more or less.

The reaction chamber 38 and dephlegmator 7, and the balance of the system, may be maintained under the same pressure as the heating coil 34, or differential pressures may be main-

tained between the various zones of the plant from heating coil 34 to receiver 53. Furthermore, as has been pointed out throughout this description, differential pressures may be maintained between the fractionating zone 7, preheating coil 6 and evaporating zone 13, by means of the various valves and pumps shown; so that, by proper regulation of the pressures and temperatures used throughout the system, the maximum efficiency and capacity may be maintained during the separation in evaporator 13, as well as during the cracking and fractionation in the cracking zone.

I claim as my invention:

1. A method of treating hydrocarbon oil which comprises subjecting oil to cracking conditions in a cracking zone, passing resultant vapors to a dephlegmator, flowing charging oil for the cracking zone in heat interchange relation but out of contact with the vapors in the dephlegmator, uniting the charging oil subsequent to its passage in heat interchange relation with the vapors in the dephlegmator with reflux condensate separated from the vapors in the dephlegmator, passing the commingled oil and reflux condensate to an evaporating zone and vaporizing the more volatile constituents therein, removing and condensing said more volatile constituents, removing vaporized fractions from said dephlegmator and condensing the same, and passing unvaporized oil from said evaporating zone to said cracking zone for treatment therein.

2. In the art of hydrocarbon oil conversion, steps which comprise subjecting charging stock to a preheating, non-cracking temperature while maintaining superatmospheric pressure thereon, in then permitting the release of volatile constituents therefrom in the form of vapors, in separately removing the non-vaporized con-

stituents of the charging stock and subjecting same to cracking conditions of temperature and superatmospheric pressure to effect substantial vaporization, separating the vapors and subjecting same to reflux condensation, in withdrawing the reflux condensate formed thereby, combining same with the preheated charging stock prior to the release of the volatile constituents therefrom, and materially reducing the pressure before the said reflux condensate and preheated charging stock have been merged, whereby lighter fractions entrained in said reflux condensate will be released in the form of vapors.

3. A method for cracking hydrocarbon oil comprising subjecting the oil to cracking conditions in a still, passing vapors evolved from the oil to a dephlegmator, flowing charging oil for the process in heat interchange relation but out of contact with the vapors in the dephlegmator, uniting the charging oil subsequent to its passage in heat interchange relation with the vapors in the dephlegmator with reflux condensate separated from the vapors in the dephlegmator, passing the commingled oil and reflux condensate to an evaporating zone wherein the more volatile constituents vaporize, and maintaining a lower pressure on the commingled charging oil and reflux condensate in said evaporating zone than is maintained on the vapors undergoing dephlegmation or the charging oil during its passage through the dephlegmator in heat interchange relation with the vapors, taking off dephlegmated vapors from said dephlegmator, injecting the same into the commingled reflux condensate and charging oil in the evaporating zone, and passing unvaporized oil from said evaporating zone to the still.

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