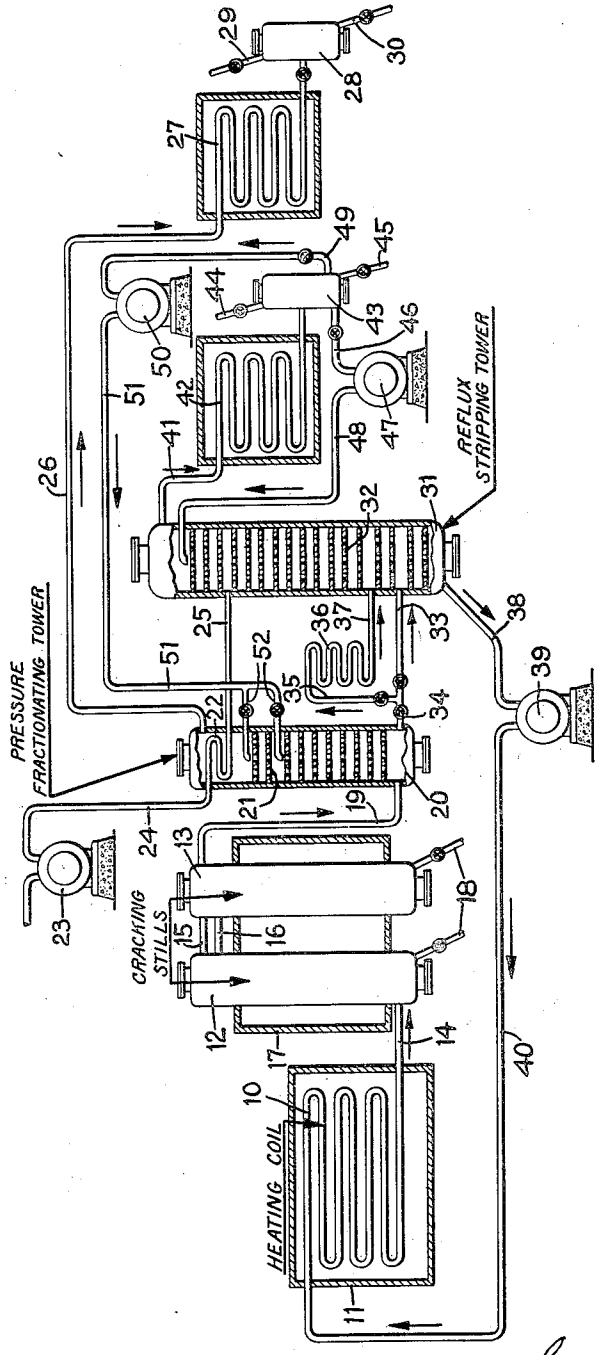
July 3, 1934. G. W. GRAY 1,965,074

TREATING HYDROCARBON OILS

Filed May 14, 1928



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Patented July 3, 1934

1,965,074

UNITED STATES PATENT OFFICE

1,965,074

TREATING HYDROCARBON OILS

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Application May 14, 1928, Serial No. 277,663

9 Claims. (Cl. 196—48)

This invention relates to the conversion of higher boiling hydrocarbons into lower boiling ones and contemplates a process in which the charging stock is preheated or stripped in contact with hot products derived from the cracking reaction. More particularly the invention has in view a process wherein the charging stock is heated or subjected to vaporizing temperatures in contact with hot reflux condensate obtained from the evolved vapors from a cracking still.

The invention contemplates a process wherein evolved vapors from a cracking still are subjected to dephlegmation or fractionation to form a reflux condensate and an overhead vapor fraction, which is condensed to form the naphtha or gasoline distillate desired. This dephlegmation or fractionation is carried on under superatmospheric pressure, such for example as substantially the same pressure as obtains in the cracking still. The reflux condensate thus obtained is directed into a lower pressure tower or distilling chamber for the purpose of distilling off from the reflux condensate lighter constituents, such as gasoline or naphtha constituents. Fresh charging stock is also introduced into the lower pressure distilling chamber or tower, so that the fresh charge may be thereby preheated by contact with the hot reflux condensate and in cases where the charging stock contains low boiling constituents such as gasoline or naphtha fractions, which it may be preferable not to introduce into the cracking zone, these lighter constituents are distilled off in the low pressure tower. The combined preheated or stripped charging stock and stripped reflux condensate is drawn off from the low pressure distilling chamber or tower and charged into the cracking zone.

In order to more fully disclose the invention, reference will now be had to the accompanying drawing which is a diagrammatic elevation partially in section illustrating a specific embodiment of the invention.

In the example of the invention thus illustrated a cracking system of the tube and tank, or coil and drum type is shown, but it is to be understood that the invention is not limited to this particular type of cracking system and may, as a matter of fact, be employed in any cracking process in which reflux condensate is formed. In the type of apparatus thus illustrated a heating coil 10 is shown mounted in a furnace 11 and there is a battery of cracking stills comprising stills 12 and 13 with a transfer line 14 for delivering the heated oil from the coil 10 to the stills. The stills are shown interconnected by vapor equalizing lines 15 and liquid level lines 16 and mounted in a furnace or heating chamber 17. The stills are provided with tar or residue draw off lines 18 and with an exit vapor line 19.

The vapor line 19 extends to a dephlegmator 20 which is preferably in the form of a rectifying or fractionating tower such as a bubble tower constructed with bubble trays 21. In the upper part of the tower is shown a coil 22 for supplying cooling to the tower. It is to be understood that if desired other cooling means in lieu of the coil 22 may be employed for furnishing a cooling reflux to the tower 20, thus, for example, the tower may be equipped with a separate reflux condenser arranged to condense a portion of the vapor from the tower and form a reflux condensate for refluxing to the top of the tower. A vapor line 26 is shown extending from the tower 20 to a condenser coil 27 and a receiving drum 28 having a gas outlet 29 and a distillate outlet line 30 is provided for withdrawing the distillate from the coil 27. The dephlegmator or fractionating tower 20 constitutes a primary dephlegmator or fractionating means for treating the evolved vapors from the cracking stills and is normally maintained under a relatively high pressure preferably being under a pressure approximating that of the cracking stills.

A secondary or lower pressure distilling chamber or dephlegmator 31 is provided for effecting contact between a fresh charging stock and the hot reflux condensate from the high pressure tower. The distilling chamber 31 is preferably constructed in the form of a rectifying or fractionating tower, such for example as a bubble tower, bubble trays 32 being indicated in the drawing. A charging pump 23 is shown having a line 24 extending to the cooling coil 22 in order to pass fresh charging stock through the coil 22 to supply cooling to the tower 20 and a line 25 extends from the coil 22 to the tower 31 in order that the charging stock thus preheated in the coil 22 may be discharged into the tower 31 for distillation or fractionation. If desired, a by-pass line may be provided so that the coil 22 may be by-passed and the oil passed directly into the tower 31. Ordinarily the charge when preheated by passage through the coil 22, or by other means, is admitted into the tower 31 at a point lower down in the tower than when the charge is introduced without any preheating.

A line 33 is provided for conducting reflux condensate or backtrap from the tower 20 to the tower 31. A pressure reducing valve 34 is shown which is preferably arranged to be operated by

suitable float mechanism actuated by the liquid level in the bottom of the tower 20. The pipe 33 is shown communicating with the lower portion of the tower 31, although as shown it preferably enters the tower at a point several trays removed from the body of the liquid that collects in the bottom of the tower. The pipe 33 is provided with a branch line 35 which communicates with a cooling coil 36 having an outlet pipe 37 which extends to the tower 31 so that if desired a portion or all of the reflux condensate removed from the tower 20 may be cooled before its introduction to the tower 31. If desired, the bottom of the tower 31 may be equipped with a steam coil or other heating means for heating the body of liquid in the bottom of the tower.

A line 38 is provided for removing the combined preheated or stripped charging stock and stripped reflux condensate from the tower 31 and conducting it to a high pressure hot oil pump 39 which operates to force the combined fresh charge and reflux condensate into the heating coil 10. In some cases it is desirable to provide a separate chamber or tower arranged to receive the liquid from the bottom of the tower 31 and subject it to a further stripping or fractionating action, and in such cases the pump 39 is arranged to draw reflux condensate from this chamber and a vapor line from this chamber may be connected to the tower 31 at some convenient point above the body of the liquid collected in the bottom thereof, but ordinarily if the tower 31 is of ample volume it is unnecessary to have the additional stripping chamber.

The evolved vapors from the tower 31 which consist of light constituents distilled or fractionated out of the reflux condensate obtained from the tower 20 together with light constituents distilled or fractionated out of the fresh charging stock, in case the charging stock contains such light constituents, are removed by a vapor line 41 to a condenser coil 42 and the condensate is collected in a receiver 43 provided with a gas outlet 44 and a liquid condensate outlet 45. The receiver 43 is also provided with an outlet pipe 46 which extends to a low pressure pump 47 having a discharge line 48 communicating with the upper end of the tower 31 so that, if desired, distillate collected in the receiver 43 may be pumped to the top of the tower 31 to serve as a cooling medium therefor. Another distillate outlet pipe 49 is shown extending to a high pressure pump 50 provided with a discharge line 51 extending to the tower 20 so that distillate from the receiver 43 may be conducted to the tower 20 to serve as a cooling medium therefor. The pipe 51 is shown provided with several branch lines 52 so that the reflux distillate may be admitted at different points in the tower.

In practicing the invention with the apparatus thus illustrated the heating coil 10 and cracking stills 12 and 13 are ordinarily maintained under a high super-atmospheric pressure, the exact pressure used varying of course with the particular charging stock employed and with other variable conditions as are well known in the art. Generally speaking the stills 12 and 13 are held under several hundred pounds pressure and the fractionating tower 20 is preferably maintained at a pressure approximating that of the stills, in this way retaining the advantages of carrying on a primary separation or fractionation of the evolved vapors under high pressure as well as the advantage of effecting condensation of the overhead vapor fraction from the tower 20 under relatively high pressure in the condenser 27. In such a method of operation however the reflux condensate collected in the bottom of the tower 20 almost of necessity, contains proportions of gasoline constituents, approximating 10% by volume, or sometimes even greater amounts and in the practice of my invention this reflux condensate is delivered to the tower 31 maintained under a pressure reduced from that obtaining in the tower 20 so that this condensate may be thus subjected to fractionation or stripping under the reduced pressure to substantially free it of gasoline constituents. The reflux condensate withdrawn from the bottom of the tower 20 is ordinarily in a highly heated condition, for example, it is preferable to have it at temperatures of the order of 700° F. and this heated oil, on coming in contact with the fresh charging stock, operates to preheat the charge and to distill off lighter fractions, such as gasoline or naphtha, in cases where the charging stock contains such light constituents. The combined stripped reflux condensate and preheated or stripped charging stock is withdrawn from the low pressure tower 31 through the line 38 and is introduced by the pump 39 into the coil 10, wherein the oil is raised to a cracking temperature for delivery to the cracking stills.

The distillate obtained from the overhead vapor fraction taken off from the low pressure tower 31 and collected in the receiver 43 may be removed from the system as a separate cut and the conditions in the tower 31 may be maintained so that this distillate may have substantially the end boiling point of the distillate collected in the receiver 28, or if desired the distillate collected in the receiver 43 may have a higher end point. However, if desired, distillate collected in the receiver 43 may be conducted to the high pressure tower 20 so as to thus subject the distillate received from the low pressure tower to the polymerizing or stabilizing action that may take place in the higher pressure tower. Consequently a desirable method of operation is to employ the low pressure pump 47 in delivering to the tower 31 such quantities of distillate from the receiver 43 as may be desired to supply cooling for the tower 31, and the remaining portion of the distillate instead of being drawn off as a separate cut through the line 45 is picked up by the high pressure pump 50 and discharged into the high pressure fractionating tower 20 so as to thus supply cooling to the tower 20 and also to bring this distillate into a high pressure zone so that it may thus be subjected to polymerization or stabilization. In this way a single cut of gasoline or light distillate of desired boiling point and color and which is furthermore relatively stable is produced and collected as a distillate in the receiver 28.

The pressure in the tower 31 may be reduced to approximately atmospheric pressure, but it is generally preferable to have some super-atmospheric pressure in the tower 31, since this pressure facilitates the delivery of distillate from the condenser coil 42, and so long as the pressure is not too great permits the proper stripping of the reflux condensate in the tower 31. A pressure of approximately 25 pounds may be recommended for carrying on the fractionating or stripping operation in the tower 31, although higher pressures may be employed. The temperature in the bottom of the tower 31 is ordinarily about 500° F. or 600° F.

Obviously many modifications and variations

of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

What I claim is:

1. In the conversion of higher boiling hydrocarbons into lower boiling ones, the process that comprises subjecting hydrocarbon oil in a cracking still to cracking and vaporization under superatmospheric pressure, subjecting evolved vapors to dephlegmation to form a vapor fraction and a reflux condensate, forming a condensate from the vapor fraction, conducting the reflux condensate into a fractionating tower maintained under reduced pressure, subjecting said condensate to a predetermined degree of cooling prior to its introduction into said tower, introducing prior to any distilling treatment thereof into the fractionating tower charging stock containing low boiling constituents, subjecting the commingled fluids to fractionation therein under the reduced pressure to thereby form a vapor fraction comprising low boiling constituents contained in the reflux condensate and charging stock and a liquid fraction comprising the stripped and fractionated reflux condensate and charging stock and conducting the commingled reflux condensate and charging stock thus stripped and fractionated to the cracking zone.

2. In the conversion of higher boiling hydrocarbons into lower boiling ones, the process that comprises subjecting hydrocarbon oil in a cracking zone to cracking and vaporization under superatmospheric pressure, subjecting evolved vapors to dephlegmation while still under superatmospheric pressure to form a reflux condensate, separately withdrawing the reflux condensate and discharging it directly into the lower portion of a combined distilling and fractionating zone maintained under a materially reduced pressure whereby said condensate is distilled substantially entirely by its contained heat, separately introducing fresh oil charging stock, prior to any distilling treatment thereof, into the upper portion of said combined distilling and fractionating zone whereby said fresh oil flows counter-currently to the evolved vapors of said condensate, thereby effecting distillation of said fresh oil and fractionation of the evolved vapors of said condensate, separately removing resulting fractionated vapors from said distilling and fractionating zone and condensing them, separately collecting in said low pressure distilling and fractionating zone the resulting mixture of residues of said condensate and fresh oil and passing the said mixture to the aforesaid cracking zone.

3. In the conversion of higher boiling hydrocarbons into lower boiling ones, the process that comprises subjecting hydrocarbon oil in a cracking zone to cracking and vaporization under superatmospheric pressure, subjecting evolved vapors to dephlegmation while still under superatmospheric pressure to form a reflux condensate, separately withdrawing the reflux condensate and discharging it directly into the lower portion of a combined distilling and fractionating zone maintained under a materially reduced pressure whereby said condensate is distilled substantially entirely by its contained heat, separately introducing fresh oil charging stock, prior to any distilling treatment thereof, into the upper portion of said combined distilling and fractionating zone whereby said fresh oil flows counter-currently to the evolved vapors of said condensate thereby effecting distillation of said fresh oil and fractionation of the evolved vapors of said condensate, separately removing resulting fractionated vapors from said distilling and fractionating zone and condensing them, introducing at least a portion of the latter condensate into the high pressure dephlegmating operation for distillation therein under high superatmospheric pressure, separately collecting in said low pressure distilling and fractionating zone the resulting mixture of residues of said condensate and fresh oil and passing the said mixture to the aforesaid cracking zone.

4. The method of converting hydrocarbon oils into lower boiling oils which comprises subjecting said oil to cracking conditions of temperature under a substantial superatmospheric pressure, separately withdrawing vaporous cracked products from said cracking operation and passing said vapors to a fractionating operation wherein said vapors are fractionated under said superatmospheric pressure thereby forming a vapor fraction comprising mainly desired low boiling products and a reflux condensate comprising mainly undesired higher boiling products and a limited proportion of desired low boiling products, passing relatively cool fresh oil in indirect heat exchange with the said vapors undergoing said fractionation thereby supplying the desired cooling for said fractionating operation and effecting preheating of said fresh oil, separately withdrawing the fractionated vapors and condensing them to form the desired low boiling product, separately withdrawing reflux condensate from said fractionating operation and discharging it directly into the lower portion of a combined distilling and fractionating zone maintained under a materially reduced pressure whereby said condensate is distilled substantially entirely by its contained heat, separately discharging the said preheated fresh oil, prior to any distillation thereof, into the upper portion of said combined distilling and fractionating zone whereby said preheated fresh oil flows countercurrently to the evolved vapors of said condensate, thereby effecting distillation of said fresh oil and fractionation of the evolved vapors of said condensate, separately removing resulting fractionated vapors from said distilling and fractionating zone and condensing them, separately collecting in said low pressure distilling and fractionating zone the resulting mixture of residues of said condensate and said fresh oil and passing the mixture to the aforesaid cracking operation.

5. The method of converting hydrocarbon oils into lower boiling oils which comprises subjecting said oil to cracking conditions of temperature under a substantial superatmospheric pressure, separately withdrawing vaporous cracked products from said cracking operation and passing said vapors to a fractionating operation wherein said vapors are fractionated under said superatmospheric pressure thereby forming a vapor fraction comprising mainly desired low boiling products and a reflux condensate comprising mainly undesired higher boiling products and a limited proportion of desired low boiling products, passing relatively cool fresh oil in indirect heat exchange with the said vapors undergoing said fractionation thereby supplying the desired cooling for said fractionating operation and effecting preheating of said fresh oil, separately withdrawing the fractionated vapors and condensing them to form the desired low boiling product, separately withdrawing reflux conden-

sate from said fractionating operation and discharging it directly into the lower portion of a combined distilling and fractionating zone maintained under a materially reduced pressure whereby said condensate is distilled substantially entirely by its contained heat, separately discharging the said preheated fresh oil, prior to any distillation thereof, into the upper portion of said combined distilling and fractionating zone whereby said preheated fresh oil flows countercurrently to the evolved vapors of said condensate, thereby effecting distillation of said fresh oil and fractionation of the evolved vapors of said condensate, separately removing resulting fractionated vapors from said distilling and fractionating zone and condensing them, introducing at least a portion of the latter condensate into the higher pressure fractionating zone for distillation therein under high superatmospheric pressure, separately collecting in said low pressure distilling and fractionating zone the resulting mixture of residues of said condensate and said fresh oil and passing the mixture to the aforesaid cracking operation.

6. The method of converting hydrocarbon oils into lower boiling oils which comprises subjecting said oil to cracking conditions of temperature under a substantial superatmospheric pressure, separately withdrawing vaporous cracked products from said cracking operation and passing said vapors to a fractionating operation wherein said vapors are fractionated under said superatmospheric pressure thereby forming a vapor fraction comprising mainly desired low boiling products and a reflux condensate comprising mainly undesired higher boiling products and a limited proportion of desired low boiling products, passing relatively cool fresh oil in indirect heat exchange with the said vapors undergoing said fractionation thereby supplying the desired cooling for said fractionating operation and effecting preheating of said fresh oil, separately withdrawing the fractionated vapors and condensing them to form the desired low boiling product, separately withdrawing reflux condensate from said fractionating operation and discharging it directly into the lower portion of a combined distilling and fractionating zone maintained under a materially reduced pressure whereby said condensate is distilled substantially entirely by its contained heat, regulating the temperature of said condensate prior to its discharge into said low pressure distilling and fractionating zone, separately discharging the said preheated fresh oil, prior to any distillation thereof, into the upper portion of said combined distilling and fractionating zone whereby said preheated fresh oil flows countercurrently to the evolved vapors of said condensate, thereby effecting distillation of said fresh oil and fractionation of the evolved vapors of said condensate, separately removing resulting fractionated vapors from said distilling and fractionating zone and condensing them, separately collecting in said low pressure distilling and fractionating zone the resulting mixture of residues of said condensate and said fresh oil and passing the mixture to the aforesaid cracking operation.

7. The method of converting hydrocarbon oils into lower boiling products which comprises heating such oils to a cracking temperature while maintaining them under a substantial superatmospheric pressure, separately withdrawing vaporous and non-vaporous products from said cracking operation while maintaining said vaporous products under super-atmospheric pressure extending from the said cracking operation, subjecting said vapors to fractional condensation while maintaining them under said pressure to condense and thereby separate from said vapors undesired higher boiling constituents, withdrawing and condensing the fractionated vapors to form the desired low boiling distillate product, separately withdrawing the said condensate formed in said fractional condensation operation and discharging it into a fractionating zone maintained under a relatively low pressure whereby a substantial portion of said condensate including light constituents thereof desired in the final low boiling distillate product is vaporized, subjecting the latter vapors to fractionation against a refluxing medium in said low pressure fractionating zone to separate as a vaporous cut substantially only the said constituents thereof desired in the low boiling distillate product, said refluxing medium comprising fresh oil charging stock for the cracking operation, withdrawing and condensing the said desired fractionated vapors, and withdrawing the reflux condensate-fresh oil mixture from the latter fractionating operation and passing the same to said heating and cracking operation.

8. The method of converting hydrocarbon oils into lower boiling products which comprises heating such oils to a cracking temperature while maintaining them under a substantial superatmospheric pressure, separately withdrawing vaporous and non-vaporous products from said cracking operation while maintaining said vaporous products under super-atmospheric pressure extending from the said cracking operation, subjecting said vapors to fractional condensation while maintaining them under said pressure to condense and thereby separate from said vapors undesired higher boiling constituents, withdrawing and condensing the fractionated vapors to form the desired low boiling distillate product, separately withdrawing the said condensate formed in said fractional condensation operation and discharging it into a fractionating zone maintained under a relatively low pressure whereby a substantial portion of said condensate including light constituents thereof desired in the final low boiling distillate product is vaporized, subjecting the latter vapors to fractionation against a refluxing medium in said low pressure fractionating zone to separate as a vaporous cut substantially only the said constituents thereof desired in the low boiling distillate product, said refluxing medium comprising fresh oil charging stock for the cracking operation, withdrawing and condensing the said desired fractionated vapors, introducing at least a portion of the said condensed fractionated vapors into the said first-named fractional condensation operation as a refluxing medium therefor, and withdrawing the reflux condensate-fresh oil mixture from the latter fractionating operation and passing the same to said heating and cracking operation.

9. In the conversion of higher boiling hydrocarbons into lower boiling ones, the process that comprises subjecting hydrocarbon oil in a cracking zone to cracking and vaporization under superatmospheric pressure, subjecting evolved vapors to dephlegmation while still under superatmospheric pressure to form a reflux condensate, separately withdrawing the reflux condensate and discharging it directly into the lower portion of a combined distilling and fractionating zone maintained under a materially reduced pressure

whereby said condensate is distilled substantially entirely by its contained heat, introducing fresh oil charging stock, prior to any distilling treatment thereof, into said combined distilling and fractionating zone thereby effecting distillation of said fresh oil and fractionation of the evolved vapors of said condensate, separately removing resulting fractionated vapors from said distilling and fractionating zone and condensing them, separately collecting in said low pressure distilling and fractionating zone the resulting mixture of residues of said condensate and fresh oil and passing the said mixture to the aforesaid cracking zone.

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