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TREATING HYDROCARBON OILS

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This invention relates to the manufacture of gasoline or naphtha or similar light oil products and has in view particularly the production of the maximum quantity of gasoline or naphtha from a given oil. The invention has particular reference to a process by which an oil containing gasoline or naphtha fractions may be treated to recover these fractions as well as to convert other higher boiling fractions contained in the oil into gasoline or naphtha products.

The invention relates in general to a process wherein crude petroleum is stripped of its natural gasoline or naphtha content, the resultant crude residuum subjected to cracking for the production of lower boiling products, and the tar or residue produced in the cracking operation subjected to vaporization to recover therefrom any gasoline or other light products contained therein and also to recover a distillate suitable for use in the cracking operation.

My invention contemplates a process wherein a liquid or condensate from a dephlegmator or fractionating column employed in dephlegmating or rectifying the evolved vapors formed in the cracking zone, is expanded into a distilling apparatus wherein a crude charge is stripped of its gasoline or naphtha content. In practicing the invention crude petroleum or other oil containing gasoline or naphtha fractions is conducted to a distilling apparatus in which the natural gasoline or naphtha content or other fractions desired are distilled off and the stripped crude is introduced to a cracking zone maintained under superatmospheric pressure. The evolved vapors while preferably still under superatmospheric pressure are subjected to dephlegmation or fractionation, the desired gasoline or naphtha distillate being taken off and the reflux condensate comprising essentially heavier constituents is directed to the crude stripping apparatus, preferably into a fractionating or dephlegmating tower included in such apparatus. The crude stripping apparatus is preferably operated at substantially atmospheric pressure and the cracking operation including the dephlegmation or fractionation of the evolved vapors from the cracking zone carried on under high pressure, such for example as several hundred pounds pressure, so that no pump is required to transfer the hot liquid from the pressure dephlegmator to the crude stripping equipment, the pressure differential being utilized to force the condensate from the pressure dephlegmator into the crude stripping apparatus. The hot liquid from the pressure dephlegmator supplies additional heat for the crude stripping

operation and furthermore the condensate from the pressure dephlegmator is stripped of its gasoline or naphtha content. In present systems of operation wherein the fractionation or dephlegmation of the evolved vapors from a cracking zone is carried on under pressure, the reflux condensate invariably contains greater or less amounts of gasoline or naphtha, and when this reflux condensate is brought back into the cracking zone the presence of the light constituents contained in the condensate increases the pressure that has to be carried on the pressure cracking apparatus. In accordance with my invention the reflux condensate is efficiently stripped of its gasoline or naphtha content by being expanded into a low pressure distilling system. The stripped crude, together with the stripped reflux condensate that has been drawn from the pressure dephlegmator, is then passed into the cracking zone.

Another process contemplated by the invention involves the production of pressure still residue, the distillation of this residue at reduced pressure, and the introduction of a distillate obtained from this distillation to a crude stripping apparatus arranged to remove volatile constituents from the charge to the pressure still. Thus the tar or residue stripping equipment may operate without any material fractionation of the evolved vapors, and these vapors may be condensed and the condensate introduced into a fractionating or rectifying tower which operates on the vapors evolved in distilling the initial crude oil charge.

Another process contemplated by the invention involves condensing under pressure the evolved vapors of the pressure still, and the introduction of condensate thus obtained to a fractionating tower operating to rectify the evolved vapors produced in vaporizing the initial crude charge, or this condensate may be introduced to a fractionating tower operating on the evolved vapors obtained in distilling the tar or residue from the pressure still, so as to thus in either case avoid the necessity of using pumps for introducing a reflux medium to the towers, and to thus introduce the condensate from the high pressure condenser directly into a low pressure rectifying column.

The invention also has in view the provision of a heating coil for heating the initial crude charge, a vaporizing chamber into which this coil discharges, a second coil which is adapted to raise to a cracking temperature an oil charge which may include the residue obtained from the vapor-

izing chamber employed in treating the initial crude charge, a drum or still adapted to receive the oil from the second coil in which still the oil may be maintained at a cracking temperature for a time sufficient for the desired molecular transformation, an expansion or vaporizing chamber in which tar or residue drawn from the pressure still is distilled to free it of its gasoline or naphtha content and also to produce distillates for cyclic return to the cracking zone, a dephlegmator for treating the evolved vapors from the cracking still and means for directing condensate from the dephlegmator into the distilling equipment for the initial crude charge.

The invention furthermore contemplates the provision of suitable process and apparatus adapted for commercial operation on a large scale whereby crude oil is charged to the system, distilled to free it of its natural gasoline or naphtha content, the residue thus obtained subjected to cracking for the production of further quantities of gasoline, the residue obtained from the cracking operation distilled under reduced pressure to recover gasoline therefrom and to form heavier distillates, the evolved vapors of the cracking operation dephlegmated or rectified and the reflux condensate thus formed directed into the crude oil distilling equipment, and the residue from the crude distilling equipment together with the stripped reflux condensate obtained from the dephlegmation of the vapors from the cracking zone and with distillates obtained from the distillation of the residue from the cracking zone, is introduced into the cracking zone.

The invention also has in view the provision of various modifications described hereinafter involving various elements and assemblies of elements and various methods of operation as more completely set forth hereinafter.

In order to more fully disclose the invention reference will now be had to the accompanying drawing which is a flow diagram of an apparatus constructed in accordance with the invention and constituting an embodiment thereof.

In the apparatus thus illustrated a pump 10 serves to introduce the charging stock, such as crude petroleum or other oil containing gasoline or naphtha constituents, through a charging line 11 into a heating coil 12. The latter coil is shown located in an economizer section or lower temperature portion of a furnace 13. The coil 12 communicates with a transfer line 14 by which the heated oil is removed from the coil and discharged into a vaporizing chamber 15. Baffles 16 are indicated in the chamber 15 for assisting in the separation of the vapors from the liquid portions of the oil. The still 15 is provided with a fractionating or rectifying tower 17. A vapor line 18 conducts vapors from the still 15 to the fractionating tower 17 and a reflux condensate line 19 conducts liquid from the tower 17 back to the vaporizing chamber 15. In some cases the vaporizing or stripping chamber 15 and the fractionating tower 17 may be constructed as a single chamber, the hot crude charge being introduced into a lower and preferably a baffled section of a column still while fractionation of the vapors takes place in upper sections of the column, but it is often desirable to provide the stripping still and fractionating vessel as separate units as illustrated. A cooling coil 20 is shown for supplying cooling to the tower 17, and a vapor line 21 serves to remove the vapors from the tower and conduct them to a condenser 22 having an outlet pipe 23 by which the gasoline or naphtha fraction is discharged from the condenser.

The stripped crude is removed from the still 15 and by means of a pipe 24, is conducted to a pump 25 which forces the oil through a pipe 26 into a coil 27 which is located in the furnace 13. A burner 28 is indicated for supplying heat to the furnace, and the arrangement is such that the oil in transit through the coil 27 may be raised to a cracking temperature under superatmospheric pressure. It is to be understood that the coil 12 is in a lower temperature section of the furnace 13 and does not receive the high temperature applied to the coil 27. An auxiliary burner 29 is indicated for supplying additional heat to the coil 12 in case the waste gases that have been employed in heating the coil 27 are inadequate for raising the temperature of the oil in the coil 12 to the desired degree. A transfer line 30 conducts the oil which has been heated to a cracking temperature in the coil 27 to a still or converter 31 wherein the oil is subjected to cracking or decomposition for the production of lower boiling point products. If desired a plurality of stills or converters may be employed in lieu of the single still shown in the drawing. A vapor line 32 conducts evolved vapors from the still to a fractionating or rectifying tower 33. The tower is shown equipped with a coil 34 for supplying cooling thereto, and a vapor line 35 conducts the vapor fraction to a condenser coil 36 having an outlet pipe 37 communicating with a receiving drum 38. The receiving drum is preferably maintained under superatmospheric pressure although the pressure in the drum may be reduced from that obtaining in the condenser 36. A pipe 39 conducts the cracked gasoline or naphtha distillate to a tank 40. The condensate separated out in the fractionating column 33 is removed by a valved line 41 and introduced into the tower 17.

A line 42 is shown for introducing a gasoline or naphtha distillate to serve as a reflux medium for the tower 17, the liquid thus introduced being employed either in addition to the cooling supplied by the coil 20 or in lieu of the cooling supplied by the coil 20. The pipe 42 is shown with two branch lines 43 and 44, the line 43 connecting with the pipe 37 at a point therein before the pressure has been reduced by the valve indicated in the line 37 and the pipe 44 extending to the line 39, so that condensate may be drawn either from the outlet from the coil 36 or from the outlet of the receiving drum 38 and the pressure on the condenser coil 36 or in the receiving drum 38 utilized to force the liquid into the lower pressure tower 17. The pipe 42 is also shown with a branch line 45 extending to a pump 46 which has a discharge line 47 terminating in the upper part of the fractionating tower 33 so that if desired condensate either from the coil 36 or from the receiving drum 38 may be introduced into the top of the tower 33 to serve as a reflux medium therein. The cooling supplied in this manner may be used either in addition to that furnished by the coil 34 or in lieu of the cooling supplied by the coil 34. The outlet 23 of the cooling coil 22 is shown extending to the tank 40 so that the gasoline or naphtha distillate obtained from the condenser 22 may be combined with that obtained from the condenser coil 36, although if desired separate receiving or storage tanks may be provided.

The tar or residue formed in the pressure cracking still 31 is withdrawn through a line 48 having a pressure reducing valve 49 and the

residue is discharged into a distilling chamber 50 which is maintained under reduced pressure preferably approximately atmospheric pressure. The still 50 is preferably insulated and ordinarily requires no heat other than that furnished by the hot incoming oil, and under the reduced pressure vapors are given off which are removed through a vapor line 51 to a condenser coil 52 and the condensate passes thence into a receiving tank 53.

This condensate may be referred to as a light gas oil stock and if desired it may be introduced into the pressure cracking system or more specifically it may be charged into the coil 27 to be commingled therein with the residue received from the still 15. The distillate collected in the tank 53 however, ordinarily contains more or less gasoline or naphtha constituents and therefore it is preferable to conduct this distillate to the crude stripping apparatus in order that the lighter constituents may be removed. Accordingly a pump 54 is provided having a connection 55 to the tank 53 and having a discharge line 56 which terminates at a midpoint in the tower 17. Thus the unfractionated distillate obtained from the still 53 is freed of its gasoline or naphtha content and combined with the stripped crude being introduced to the coil 27 and cracking still 31.

The residue from the still 50 is withdrawn through a line 57 into a second still 58. This still is supplied with a line 59 by which steam preferably superheated is introduced into the still. It is convenient to operate the still 50 at a pressure slightly above atmospheric, such for example as about ten pounds, and maintain the still 58 at substantially atmospheric pressure, so that residue from the still 50 may be readily discharged into the still 58. Vapors from the still 58 pass through a vapor line 60 into a condenser coil 61 and the condensate is collected in a tank 62. This condensate ordinarily contains minimum proportions if any of the gasoline or naphtha fractions and consequently this distillate may be introduced directly into the pressure cracking system. A pump 63 is provided having a line 64 communicating with the tank 62, and having a discharge line 65 which extends to the coil 27 or more specifically which connects with pipe 26. The distillate collected in the tank 62 may be designated a heavy gas oil. This distillate is thus combined with the stripped crude and reflux condensates obtained in the crude stripping apparatus. The stripped residue from the still 58 which may be termed fuel oil is drawn off through a line 66, passed through a cooling coil 67, and admitted to a tank 68.

In practicing the invention crude petroleum or other oil containing light constituents, such as gasoline, is passed through the coil 12 wherein it is brought to the desired vaporizing temperature. The heated oil is discharged into the vaporizing chamber 15 which as stated is maintained under approximately atmospheric pressure so that separation of the lighter constituents from the heavier takes place readily. The vapors are drawn off through the vapor line 13 into the rectifying or fractionating column 17 and a gasoline condensate is obtained in the condenser 22. If desired the oil may be heated sufficiently in the coil 12 to take off in addition to a gasoline fraction heavier distillates, such for example as kerosene, and the fractionating equipment may be so designed as to take off gasoline and kerosene fractions. The stripped residue is drawn off from the vaporizing chamber 15 and forced by the pump 25 through the coil 27 wherein the oil is brought to a crack-

ing temperature. The oil is then discharged into the cracking still 31 where cracking conditions are maintained. The vapors are fractionated in the column 33 while still under superatmospheric pressure preferably at substantially the pressure of the still 31. An overhead vapor fraction is taken off through the vapor line 35, condensed in the condenser 36 and passed to the receiver 38 from which it may be discharged into the tank 40.

Due to the high pressure at which fractionation takes place in the chamber 33 which may for example be several hundred pounds, the reflux condensate collected at the bottom of the chamber contains greater or less proportions of gasoline constituents. This condensate is discharged through a pressure reducing valve in the line 41 and introduced into the tower 17 so that the gasoline or other light constituents may be removed and the stripped condensate combined with the other liquid in the tower. The liquid is refluxed through the line 19 into the distilling chamber 15 and thus combined with the stripped residue. The pump 25 is adapted to handle hot oil so that the hot residue is drawn off and without any material loss in heat is passed directly into the heating coil 27.

The residue from the cracking still is stripped at reduced pressures in the stills 50 and 58. The lighter distillate obtained from still 50 contains quantities of gasoline and may also contain other heavier constituents such as fractions of the gas oil type. This condensate is passed through the line 56 and introduced to the fractionating column 17 so that the gasoline or lighter constituents may be removed and the heavier portions combined with the reflux condensate that ultimately forms a part of the charging stock to the cracking zone. The heavier distillate obtained from the still 58 should be relatively free of gasoline and this distillate may be passed through the line 65 and thus introduced directly into the stream of oil entering the heating coil 27. The residue stripping apparatus may thus be operated without any fractionating or rectifying towers and yet by introducing distillate obtained therefrom into the tower 17 all of the gasoline constituents may be recovered, while at the same time the heavier constituents in the distillate are adequately utilized as part of the charging stock to the cracking zone.

The receiver 38 in which the cracked gasoline or naphtha distillate is collected is ordinarily held at superatmospheric pressure but at a pressure reduced from that obtaining in the condenser 36, and thus a portion of the distillate may be drawn off either through the line 43 or 44 and the pressure differential utilized to force the distillate through the line 42 and into the low pressure fractionating chamber 17 to serve as a reflux medium therein.

In one modification of the invention additional heating may be supplied to the oil to be distilled in the stripping still 15 by bringing hot products from a higher temperature portion of the system into contact with the products to be distilled. Thus a valved line 69 may be provided connecting the transfer line 30 with the line 14 so that a portion of the highly heated oil leaving the coil 27 may be directed into the line 14. In this way the oil leaving the coil 12 may be brought to the distilling temperature desired either with or without the aid of the auxiliary heating means 29. Another way of accomplishing the same result may be effected by directing a portion of the hot reflux condensate from the

fractionating tower 33 into the line 14, as by providing a valved connection 41a between the lines 41 and 14. Another method of operation may be provided when the hot condensate from the tower 33, instead of being expanded into the tower 17, is picked up by a hot oil pump 17a and forced through valved line 18a into the line 26 to thus combine the condensate with the stripped residue received from the still 15 for passage through the heating coil 27. The passage of the heated oil from the higher temperature and pressure zone into the lower temperature and pressure zone may be carried on continuously or it may be intermittently employed to meet emergency conditions.

Other modifications may be effected within the spirit and scope of my invention, and I desire no limitation other than those imposed by the appended claims.

What I claim is:

1. The process of treating hydrocarbon oils that comprises passing a charging stock containing low boiling constituents through a heating coil to thereby heat the oil to a temperature sufficient to vaporize a given fraction, discharging the heated oil into an enlarged chamber wherein vaporization takes place under substantially atmospheric pressure, passing the vapors to a low pressure fractionating column and subjecting them to the fractionation therein, removing from the enlarged chamber the oil thus stripped of its lighter constituents and passing the oil under superatmospheric pressure through a coil wherein the oil is heated to a cracking temperature, discharging the oil into an enlarged chamber maintained at cracking temperature under superatmospheric pressure wherein conversion of higher boiling hydrocarbons into lower boiling ones takes place, removing vapors and residue from the cracking chamber, subjecting the vapors to fractionation to form a vapor fraction and a reflux condensate, condensing the vapor fraction, releasing the reflux condensate into the low pressure fractionating column to thereby strip the condensate of its lower boiling constituents and to combine the condensate with the other liquid in the fractionating column, distilling the residue withdrawn from the cracking still under reduced pressure to thereby form a lighter and a heavier distillate, introducing the lighter distillate into the low pressure fractionating column to thereby release lower boiling constituents and to combine the heavier portion of the distillate with the other liquid in the fractionating column, withdrawing the combined liquid from the column, and combining the heavier distillate with the charge being introduced to the high temperature heating coil in which the oil is raised to a cracking temperature.

2. The process of treating hydrocarbon oils that comprises passing a charging stock containing low boiling constituents through a heating coil to thereby heat the oil to a temperature sufficient to vaporize a given fraction, discharging the heated oil into an enlarged chamber wherein vaporization takes place under approximately atmospheric pressure, passing the vapors to a low pressure fractionating column and subjecting them to fractionation therein, removing from the enlarged chamber the oil thus stripped of its lighter constituents and passing the oil under superatmospheric pressure through a coil wherein the oil is heated to a cracking temperature, discharging the oil into an enlarged chamber maintained at cracking temperature under superatmospheric pressure wherein conversion of higher boiling oils

takes place, removing vapors and residue from the cracking chamber, subjecting the vapors to fractionation to form a vapor fraction and a reflux condensate, condensing the vapor fraction, releasing the reflux condensate into the low pressure fractionating column to thereby strip the condensate of its lower boiling constituents and to combine the stripped condensate with the liquid in said fractionating column, withdrawing the combined liquid from said column, distilling the residue withdrawn from the cracking still under reduced pressure to thereby form a volatile fraction and a heavier distillate, and combining the heavier distillate with the charge being introduced to the high temperature heating coil in which the oil is raised to a cracking temperature.

3. The process of treating hydrocarbon oils that comprises passing charging stock through a heating coil, passing the heated oil into a vaporizing chamber maintained at relatively low pressure, removing residue from the low pressure vaporizing chamber and flowing it in a restricted stream while heating it to a cracking temperature under a relatively high pressure, discharging the said heated stream of oil directly into an enlarged reaction zone and diverting a portion of the highly heated stream of oil prior to its discharge into the said reaction zone and passing the said diverted oil directly into contact with the charging stock received from the said heating coil to thereby raise the temperature of the oil passing into the said low pressure vaporizing chamber.

4. The process of treating hydrocarbon oils that comprises maintaining oil at cracking temperatures under superatmospheric pressure to effect conversion of higher boiling hydrocarbons into lower boiling ones, introducing an oil containing low-boiling constituents into a distilling apparatus comprising a first fractionating zone; which is maintained under a materially lower pressure than said first mentioned cracking pressure to thereby distill off a low-boiling fraction, passing the residue thus obtained as charging stock to the high-pressure cracking zone, separating resulting cracked products into vapors and residue, dephlegmating the vapors in a second fractionating zone at a pressure materially higher than the pressure maintained in the said distilling apparatus and first fractionating zone to thereby obtain an overhead vapor fraction and a reflux condensate, subjecting the residue from the cracking zone to distillation under a materially reduced pressure by its contained heat without further cracking to thereby obtain a distillate containing low-boiling constituents, introducing reflux condensate obtained in dephlegmating the cracked vapors and distillate obtained in distilling the residue from the cracking zone into the first-named low-pressure distilling apparatus to thereby distill off low-boiling constituents, combining resulting unvaporized portions of said distillate and said reflux condensate with the liquid being introduced into the cracking zone, and condensing the overhead vapor fraction from said second fractionating zone obtained in dephlegmating the vapors from the cracking zone.

5. The process of treating hydrocarbon oils that comprises maintaining oil at cracking temperatures under superatmospheric pressure to effect conversion of higher boiling hydrocarbons into lower boiling ones, introducing an oil containing low-boiling constituents into a distilling apparatus which is under materially lower pressure than the cracking zone to thereby distill off a low-boiling fraction, passing the resi-

due thus obtained as charging stock to the high-pressure cracking zone, separately removing residue and vapors from the cracking zone, deplegating the vapors in a separate zone while still maintaining them under a pressure materially higher than the pressure in said distilling apparatus to thereby obtain an overhead vapor fraction and a reflux condensate, subjecting the residue from the cracking zone to distillation to thereby obtain a lighter distillate and a heavier distillate, introducing the light distillate and the reflux condensate obtained in deplegating the vapors from the cracking zone into the first-named low-pressure distilling apparatus to thereby distill off low-boiling constituents from said reflux condensate and lighter distillate and to combine the heavy portions of these liquids with the oil being introduced to the cracking zone, passing said heavier distillate directly to the oil being introduced to the cracking zone, and condensing the overhead vapor fraction obtained in deplegating the vapors from the cracking zone.

6. A process of treating liquids containing high and low boiling hydrocarbons which comprises fractionally distilling said liquid in a zone under relatively low pressure to separate certain of said low boiling hydrocarbons, subjecting the liquid stripped of said lower boiling constituents to materially greater pressure and to a temperature sufficient to effect conversion of at least a portion of said higher boiling hydrocarbons into lower boiling hydrocarbons, maintaining said liquid at said greater pressure and temperature to effect said conversion and to vaporize a portion of the liquid so treated, fractionating the last named vapors in a zone separate from the first named fractional distillation zone at materially greater pressure than that maintained in the said first named fractional distillation zone, removing lower boiling vapors from the high pressure fractionating zone and collecting them, refractionating the condensate produced in said high pressure fractionating zone in the first mentioned fractional distillation zone, passing residual liquid resulting from said conversion directly into a separate unheated distilling zone of reduced pressure without further cracking and therein separating a lighter fraction from the residual liquid, fractionating said last named lighter fraction in said first named fractional distillation zone, removing low boiling point vapors from said fractional distillation zone and liquefying and collecting the desired fraction therefrom, and passing to the said pressure conversion operation the reflux condensates and unvaporized liquids resulting in the said fractional distillation zone from the lighter fraction of the residual liquid and from the high pressure fractionated condensate together with the first named stripped liquid.

7. A process of treating oils containing high boiling hydrocarbons which comprises subjecting oil stock to relatively high pressure and to a temperature sufficient to effect conversion of at least a portion of said higher boiling hydrocarbons into lower boiling hydrocarbons, maintaining said oil at said temperature and pressure to effect said conversion and to vaporize a portion of said liquid, fractionating the resulting vapors at relatively high pressure to condense a portion of said vapors, liquefying and collecting the desired fraction of the remaining vapors, refractionating the condensate resulting from said

first mentioned fractionation in a separate zone at materially reduced pressure, vaporizing a portion of the residual liquid resulting from said conversion at reduced pressure in a separate distilling zone without further cracking thereof, fractionating the last named portion in said separate refractionating zone, preheating fresh relatively heavy charging stock and introducing it into said separate refractionating zone, condensing vapors issuing from said separate refractionating zone to remove the desired fraction therefrom and collecting said fraction, and passing to the conversion operation the reflux condensate and unvaporized liquids from said refractionating zone together with said first mentioned oil stock, the latter comprising unvaporized portions of said fresh relatively heavy charging stock.

8. A process of treating high boiling point hydrocarbons which comprises subjecting said hydrocarbons to a relatively high pressure and to a temperature sufficient to effect conversion of at least a portion of said higher boiling point hydrocarbons into lower boiling point hydrocarbons, maintaining said hydrocarbons at said pressure and temperature to effect said conversion, separately withdrawing vapor products from said conversion operation, fractionating the said vapors at a relatively high pressure to condense a portion of said vapors, liquefying and collecting the desired fraction of the remaining vapors, refractionating the reflux condensate produced in said fractionating zone in a separate zone under materially reduced pressure to vaporize a portion of said condensate, preheating fresh relatively heavy charging stock and introducing it into said separate refractionating zone, separately withdrawing residual liquid products from said conversion operation and distilling them to separate a lighter fraction and a heavier fraction, fractionating said lighter fraction in said refractionating zone to remove the desired lower boiling constituents therefrom, condensing vapors issuing from the refractionating zone to liquefy the desired fraction and collecting said fraction, and passing the condensate produced in the refractionating zone and the said heavier fraction from the residual liquid to said conversion operation together with the said first named high boiling hydrocarbons being charged thereto.

9. A process of treating oils containing high boiling hydrocarbons which comprises subjecting said oil to relatively high pressure and to a temperature sufficient to convert higher boiling hydrocarbons into lower boiling hydrocarbons, maintaining said oil at said temperature and pressure to effect said conversion, separately withdrawing vaporous and residual liquid products of said conversion, fractionating said vapors in a zone maintained at relatively high pressure to thereby condense a portion of said vapors, separately withdrawing the fractionated vapors and condensing them, refractionating the reflux condensate from said fractionating zone in a separate combined distilling and fractionating zone maintained at a pressure materially lower than said first mentioned fractionating zone, separately distilling the residual liquid products resulting from said conversion operation by their contained heat, without additional cracking thereof to remove lighter constituents therefrom, fractionating said lighter constituents in said combined distilling and fractionating zone to separate a lighter fraction therefrom, introduc-

ing fresh crude charging stock into said combined distilling and fractionating zone, distilling said fresh crude stock and fractionating the vapors resulting from said distillation to separate lighter constituents therefrom, separately removing fractionated vapors from said combined distilling and fractionating zone and condensing them, collecting in said combined distilling and fractionating zone heavier constituents of said fresh oil together with reflux condensates resulting from refractionation of said reflux condensate and from fractionating said lighter distilled constituents, and passing the same as charging stock to the aforesaid conversion zone.

10. The process of treating hydrocarbon oil which comprises passing relatively heavy charging oil through a heating zone in a stream of restricted cross-sectional area and therein heating said oil to a distilling temperature sufficient to vaporize only part of the desirably light constituents thereof, the amount of heat supplied by the passage of the oil through said heating zone being insufficient for the complete distilling operation desired, introducing the resulting heated oil into a fractional distilling zone wherein lighter constituents vaporize and are fractionally condensed to separate desirably light constituents as vapors from undesirably heavy constituents as liquid, removing liquid constituents from said distilling zone and passing them through a cracking zone wherein they are raised to a cracking temperature and subjected to conversion, subjecting resulting cracked vapors to fractionation in a separate fractionating zone to separate desired light fractions as vapors from undesirably heavy fractions as reflux condensate, said reflux condensate having a temperature considerably higher than that of said heavy charging oil after the passage thereof through said heating zone first-mentioned, removing and condensing said desired light fractions as a desired product, removing reflux condensate so formed and introducing it into said fractional distilling zone first-mentioned so that the temperature of the heated heavy charging oil introduced into said distilling zone is raised to a value sufficient to carry out the complete operation first-mentioned and heavy fractions of said reflux condensate mingle with heavy fractions of the heated charging oil, removing light fractionated vapors from said fractional distilling zone and condensing them as a desired product, and passing heavier constituents of said reflux condensate

to said cracking zone with said heavier liquid constituents.

11. The process of treating hydrocarbon oil that comprises passing charging stock containing crude residual constituents and lower boiling constituents and natural gasoline fractions through a heating coil to thereby heat the oil to a temperature sufficient to vaporize a given fraction, discharging the heated oil into a distilling and fractionating zone wherein vaporization takes place under approximately atmospheric pressure, fractionating the vapors so evolved to separate a distillate comprising natural gasoline fractions, removing from said distilling and fractionating zone the oil thus stripped of its lighter constituents and passing the oil, under superatmospheric pressure, through a coil wherein the oil is heated to a cracking temperature, discharging the heated oil into an enlarged chamber maintained at a cracking temperature under a relatively high pressure, wherein conversion of higher boiling oils into lower boiling oils takes place, passing evolved vapors into a fractionating column and subjecting them to fractionation therein, out of contact with the vapors from said heated charging stock, while still under pressure materially greater than that maintained in said distilling and fractionating zone, to form an overhead vapor fraction and a reflux condensate, condensing the overhead vapor fraction, passing only the reflux condensate into said distilling and fractionating zone to thereby strip the reflux condensate of its lower boiling constituents and combining the heavier portions thereof with the liquid in said distilling and fractionating zone, and withdrawing the combined liquid from said distilling and fractionating zone and passing it to said cracking coil as charging stock.

12. A process in accordance with claim 11 wherein liquid residue from said enlarged chamber is passed directly, without further heating, to a separate distilling zone wherein a portion thereof is vaporized by its contained heat, resulting vapors being out of contact with vapors from said heated charging stock, liquefying and collecting the desired fraction of the vapors so evolved, introducing resulting condensate into said distilling and fractionating zone for refractionation, and combining unvaporized constituents thereof with the liquid withdrawn from said zone last-mentioned for passage through said cracking coil.

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