

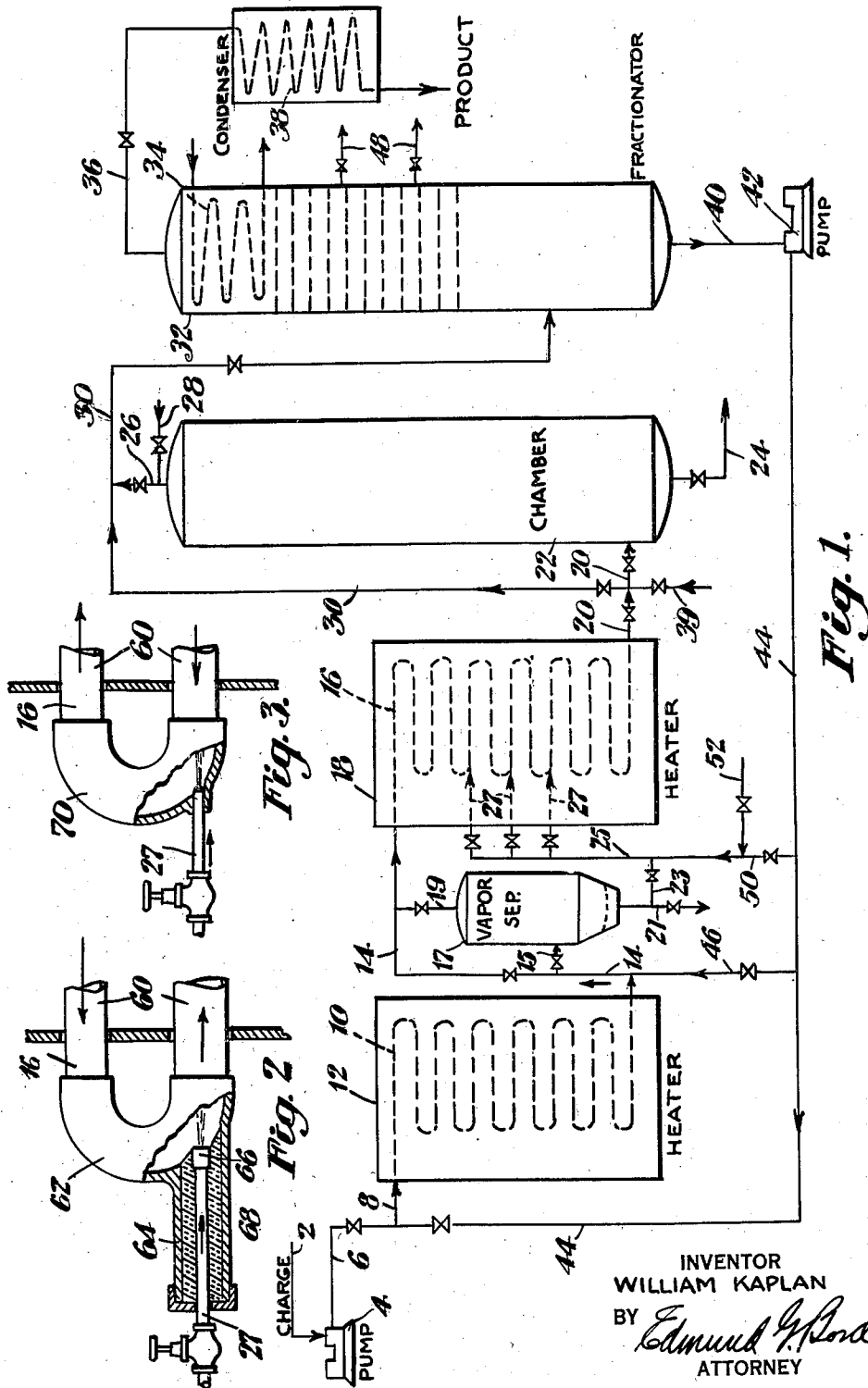
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COMPLETE CONVERSION OF PETROLEUM OILS

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COMPLETE CONVERSION OF PETROLEUM OILS

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This invention relates to a process for converting petroleum oils into lower boiling products of the gasoline motor fuel type, and more particularly to a process for converting the entire boiling range of petroleum oils, including the residual part, in the vapor phase.

The aim of many cracking processes now in use, as well as others which have not been used commercially, is to crack residual charging stocks in the liquid phase and to subject the distillate charging stocks to converting conditions while in the vapor phase. In the liquid phase processes, distillate oils have been cracked extensively, a considerable proportion of the cracking being done in the heating coil with additional cracking in an enlarged zone. In these processes, part of the oil may be in the vapor state when leaving the heating coil. However, when charging stocks containing residual or tarry constituents; such as topped or reduced crude, or pressure still tar, are subjected to treatment, the degree of cracking in the heating coil is limited because of danger of coking the coil. With such charging stocks, one such process subjects the residual oil to light cracking or mere viscosity breaking conditions and then separates the distillate products from the heavy tarry constituents, the intermediate distillates being subjected to severe cracking conditions. Other processes subject the residual oil to limited cracking conditions in the heating coil and finish the cracking in an enlarged insulated chamber or in a chamber which is mildly heated externally. The vapors from the chamber are fractionated to remove the desired product and the heavier distillates are returned and reheated in the coil with the original charging stock or in a separate heating coil. In these processes the pressure still tar may be withdrawn from the enlarged chamber or the heavy oil residue may be allowed to remain in the chamber and become converted to coke.

In some liquid phase processes, the residual oils are subjected to milder cracking conditions than the distillate oils in the same coil by introducing the residual oil in the latter portion of the cracking coil. One such process is illustrated in the U. S. Patent No. 1,981,914 to E. C. Herthel. In this process distillate oil is passed under high pressure through two cracking coils in series, being heated to an average temperature of about 915° F. in the first cracking coil, and then mixed with residual tar before entering the second cracking coil. The resulting mixture is heated from about 700° F. at the inlet to 825°

F. at the outlet in the second coil, the pressure at the outlet of the coil being 400–700 pounds per square inch.

In vapor phase processes, that is processes in which a major part of the cracking occurs while the oil is in the vapor phase, it is generally recognized that only distillate oil may be used as charging stock, except when a separating chamber is used for separating the residual part of the oil. If a residue containing oil is charged directly to the heating coil, the coil soon becomes stopped with coke before the oil is completely vaporized. In order to obviate this difficulty, some vapor phase processes separate the residual tarry portion of the oil from the easily vaporizable portion by interposing an enlarged separating chamber in the heating coil circuit when the desired vaporization has occurred; the residual portion being usually removed as fuel oil and the vapors superheated to the desired cracking temperature.

In some cracking processes, residual stocks are handled by passing the oil through a separate heating coil in which the oil is subjected to a mild viscosity breaking operation, then separating the vaporized gas oil portion from the heavy residual portion which is withdrawn as fuel oil, and finally subjecting the gas oil together with distillate reflux condensates to vapor phase cracking conditions in another heating coil. In these processes, the residual portion of the oil is not subjected to vapor phase cracking conditions. However according to the features of the present invention residual oil stock may be successfully cracked in vapor phase without encountering the difficulties previously met with.

The primary object of the present invention is to provide a process for vaporizing residual oils to be cracked without coke formation.

Another object is to provide a process for cracking all types of charging oils in the vapor phase, particularly oils containing residual tarry constituents.

Still another object is to provide a process for producing high antiknock gasoline by subjecting all of the charge, including the normally residual part, to full vapor phase cracking conditions.

A further object is to provide a means for controlling the cracking temperature when exothermic aromatic hydrocarbon forming reactions are initiated.

Accordingly, the present invention comprises the step of vaporizing and cracking a residual oil by spraying the oil into a superheated oil vapor stream flowing through an elongated zone of re-

stricted cross-section, the quantity of oil sprayed in being such that the temperature of the stream is always above the dew-point of the resulting mixture. If the pressure is above the critical pressure, the temperature is not allowed to fall below the maximum critical temperature. For example, a gas oil which is completely vaporized at 900° F. may be heated in a coil so as to vaporize the oil and superheat the vapors to a temperature of 1000° F. A fuel oil containing residual constituents which when admixed in the proportions of 20% fuel oil and 80% gas oil may require a temperature of 935° F. to prevent condensation and subsequent coking of the heaviest asphaltic constituents, is sprayed into the gas oil vapor stream in such quantities that the temperature is reduced to say 950° F. and in no event to below 935° F., assuming that a maximum of 20% fuel oil is injected. Of course, if the fuel oil is preheated to 750° F. a greater quantity can be added in a single jet without reducing the temperature below 950° F. than if the oil were cooler. Greater quantities of residual oil can be introduced by admitting the oil at a plurality of points in the heating coil by reheating to 1000° F. before each subsequent injection. The exact temperature employed will depend on the nature of the charging oil, the extent to which cracking has occurred, the pressure employed and the amount of fuel oil which has been previously introduced into the stream.

Having in mind these features and objects of the present invention, the improved process will be described in detail to illustrate the method of practicing the invention. Other objects and features will also be apparent to those skilled in the art from the following description made in connection with the accompanying drawing in which:

Fig. 1 is a diagrammatic flow sheet showing an apparatus particularly adapted for carrying out the improved process.

Fig. 2 is an enlarged view partly in section of a portion of the heating coil, particularly showing a return bend provided with means for introducing heavy oil constituents into the vapor stream being cracked, and

Fig. 3 is a view similar to Fig. 2 showing a modified construction for introducing heavy oil into the vapor stream.

Referring to Fig. 1 of the drawing, the oil charging stock which is preferably crude oil or topped crude, is introduced into the apparatus through a line 2 and forced by means of a pump 4 at a pressure of from about 400 to 1500 pounds per square inch through a valved line 6 and a line 8, into a heating coil 10 mounted in a pipe still heater 12. The oil is heated in the coil 10 to a temperature of say about 850° F., the temperature being sufficient to vaporize substantially the gas oil portion of the charge. The heated oil mixture at this temperature is discharged into a line 14, and passed through a valved connecting line 15 into a vapor-liquid separating chamber 17. The oil and vapor constituents in the separator 17 are maintained at a high superatmospheric pressure and the vapors are discharged therefrom through a valved line 19 into the upper portion of line 14 and then into a conversion coil 16. Since the vapors entering the coil 16 under this mode of operation will have a temperature of only approximately 850° F. they are preferably raised to a temperature of from 950° to 1075° F. in the first part of the conversion coil 16, so that

a sufficiently long portion of the coil 16 will remain for effecting the conversion reaction.

The conversion coil 16 is a long coil through which the vapor stream passes at a relatively high velocity and at high pressure, and it has been found that heavy residue oils may be distributed into this vapor stream and successfully converted to lower boiling products without coking up the apparatus. Therefore in accordance with the features of the present invention, the oil residue from the separator 17 is allowed to flow under pressure through a discharge line 21 and a valved connecting line 23 into a header 25, from which it is injected into the conversion coil 16 through one or more of the valved branch lines 27. The point at which the heavy liquid residue is introduced is adjusted to correspond with the temperature gradient in the coil 16, care being taken to be sure that the temperature is not reduced so low that liquid drops will be formed in the stream.

The residue injected through one or more of the lines 27 is preferably sprayed into the vapor stream in such a fine mist that it is vaporized immediately in the vapor stream without coming into substantial contact with the walls of the heating tubes. The enlarged views shown in Figs. 2 and 3 of the drawings show means particularly adapted for spraying this heavy oil into the vapor stream passing through the coil 16. In Fig. 2 tubes 60 of the coil 16 are connected by means of a special type of return bend 62 which includes an extended housing 64 through which the injection line 27 extends and terminates in a spray nozzle 66. The space between the line 27 and the housing 64 is packed with refractory insulating material 68 which serves to prevent cooling of the vapors by the line 58, with consequent formation of coke. As shown in Fig. 2, the heavy oil residuum is sprayed directly into the vapor stream as it passes into the lower tube 60. This lower tube 60 as shown, may be of slightly greater diameter than the upper tube 60 in order to accommodate the larger quantity of oil flowing therethrough without excessive frictional resistance.

In Fig. 3 the tubes 60 are shown as connected by means of an ordinary return bend 70 in which means is provided for introducing residuum through the line 27. As shown in this modification, the residuum is sprayed directly into the approaching stream of high temperature vapors in the lower tube 60. This procedure tends to aid in the intimate distribution of the residuum in the vapor stream and prevents substantial contact with the tube walls before it attains the normal temperature of the vapors. The spray line 27 may be insulated as in Fig. 2.

The converted vapor product formed in the coil 16 is discharged through a valved transfer line 29 directly into the lower portion of an enlarged carbon separating chamber 22 in which the vapors pass upwardly at relatively low velocity while the suspended carbon settles out and collects in the lower part of the chamber. A substantial superatmospheric pressure is maintained in the chamber 22 and the fine carbon may be blown therefrom at intervals through a valved line 24 into a carbon collecting receptacle (not shown) by opening the valve in line 24. A pressure of from 150 to 600 pounds per square inch may be maintained in the carbon settling chamber 22 and since the vapors in this chamber remain therein for a substantial period of time at the cracking temperature, there is some additional

conversion therein. The major portion of the conversion reaction however takes place in the coil 16.

The highly heated vapors which reach the top of the chamber 22 are conducted therefrom through a valved transfer line 26 and as they discharge from the chamber they are suddenly reduced in temperature to a point below that of further decomposition by introducing into the vapor stream a relatively cool medium such as water, steam or other fluid through a valved injection line 28. The vapors are preferably cooled to a temperature below about 700° F. or to a temperature which will prevent coke formation in the vapor line. The mixture of cooled vapors and cooling medium discharged through the line 26 are conducted through a valved vapor line 30 into the lower portion of a fractionating tower 32 in which the higher boiling portion of the vapors are condensed. The upper portion of the fractionating tower is provided with a cooling coil 34 which may be used for the purpose of preheating charging stock and for controlling the cut temperature on the tower. In the manufacture of gasoline motor fuel the cut temperature is preferably maintained such that the gasoline motor fuel is taken overhead as vapors through a valved vapor line 36 and condensed in a condenser 38.

The primary function of the carbon settling chamber 22 is to remove suspended carbon from the vapors discharged through the transfer line 26. However, if this carbon is not objectionable in the final product and can be removed readily from the distillate collected in the tower 32 (or when the distillate withdrawn therefrom is used as fuel oil), the chamber 22 may be cut out of the system. If the chamber 22 is not to be used the appropriate valves in lines 20 and 26 are closed, the valve in the line 30 opened, and the vapors in the transfer line 20 are introduced directly into the vapor line 30, and discharged into the tower 32. As the vapors enter the line 30 they are preferably reduced in temperature to a point below that of coke formation in the line 30 by introducing a cooling medium into direct contact with the vapors from a valved injection line 39.

The heavy reflux condensate or synthetic crude bottoms collected in the bottom of the tower 32 may be withdrawn through a line 40 and forced by means of a pump 42 and a valved connecting line 44 into the feed line 8, if the stock being introduced through line 2 contains residual constituents, or the oil in line 44 may be introduced into line 14 through a valved line 46. In either case a portion of the oil from line 44 is vaporized in separator 17 and the unvaporized part is injected into the coil 16 through one or more of the lines 27. Light condensates may be withdrawn as side streams from tower 32 through valved lines 48, if separate products are desired for use or for cracking. When the hot oil in the line 40 contains only minor proportions of readily vaporizable constituents, it or any part thereof may be passed directly to the coil 16 through a valved line 50 and lines 25 and 27.

When it is desired to crack an oil containing a relatively small proportion of readily vaporizable constituents, a primary charging stock which is preferably a distillate oil such as gas oil, kerosene, or naphtha, is introduced through the line 2 into the heating coil 10. In the heating coil 10, the temperature of the distillate is raised to a suitable vapor phase cracking temperature,

which may be from 950° F. to 1100° F. The thus heated vapors pass directly to the cracking coil 16 through line 14, the liquid-vapor separator being omitted from the system by closing the valves in the lines 15 and 19 and opening the valve in line 14. The oil to be cracked, and which contains little or no readily vaporizable constituents, according to this modified procedure, is introduced into the system under high pressure (preferably preheated to about 750° F.) through a valved line 52 and passed directly to the oil stream in coil 16 through lines 50, 25 and 27. Heavy oil from the tower 32 may also be passed to the coil 16 through lines 40, 44, 50, 25 and 27.

The process of the present invention may be operated primarily for the vapor phase cracking of the more readily vaporizable stocks referred to above, while a residue stock may be introduced into the coil 16 as a temperature or reaction control medium and incidentally cracked. It has been found that the reaction in coil 16 and chamber 22 has a tendency to go into highly destructive exothermic phases if the temperature is permitted to rise too high or if an extremely long coil is used. Certain exothermic reactions are desirable in the process for the production of aromatic hydrocarbons and these may be effectively controlled by introducing regulated quantities of residuum through one or more of the lines 27. In this way the reactions are controlled and the residuum is cracked.

In connection with the process of the present invention, it will be appreciated that the coil 16 is extremely long and heated only sufficiently to maintain the highly heated oil vapors at approximately their entrance temperature. In the initial part of the coil 16 the oil vapors are cracked to a very substantial extent into lower boiling products, while in the latter part of the coil the high temperature products are converted into relatively stable aromatic and cyclic compounds. In general when an oil of higher boiling point than gasoline is being cracked, the high temperature vapors entering the coil 16 are converted into products, which would be of progressively lower specific gravity and then of progressively higher specific gravity, as the vapors advance through the conversion coil. In the cracking of such stocks the percentage of gasoline range constituents in the vapors passing through the coil 16 increases to a maximum of from 50 to 60% of the stream and then decreases as the vapors advance through the coil to from 40 to 50%. The residual oil introduced into the coil 16 is preferably sprayed into the vapor stream at a point therein at which the vapor stream has commenced to decrease in gasoline content from the maximum content attained or at a point in the stream where the specific gravity has commenced to increase after the stream has attained its minimum specific gravity. The products discharged from the coil 16 contain relatively large proportions of aromatic hydrocarbons and a relatively small proportion of carbon in the form of free carbon in suspension in the vapor stream. The gasoline fraction obtained contains from 25 to 85% of aromatic hydrocarbons and comprises from 40 to 50% of the oil stream. The free carbon is removed from the vapors in chamber 22 which may be constructed in any suitable way. A cyclone or centrifugal type separator or other efficient separating means may be used for the purpose of effectively separating

the carbon from the vapors instead of the chamber 22.

It is to be understood that various modifications may be made in the details of procedure and in the apparatus used for carrying out the process, without departing from the spirit and scope of the invention as defined by the claims.

What is claimed as new is:

1. The process of completely converting a crude petroleum oil stock into high anti-knock gasoline, gas and carbon, which comprises heating the crude oil while passing the same in a confined stream of restricted cross section to a temperature sufficiently high to vaporize most of the readily vaporizable constituents thereof, discharging the resulting heated oil into a vapor-liquid separating zone, passing vapors separated in said zone through a long coil of restricted cross section mounted in a heating zone, heating the oil vapors in said zone to a relatively high cracking temperature to convert them into gasoline constituents containing substantial proportions of non-knocking compounds, withdrawing the separated unvaporized crude oil residue from the separating zone and spraying and intimately distributing it directly into the vapor stream passing through and while in the mid-portion of said long cracking coil, controlling the temperature in said cracking coil so as to effectively maintain the temperature of the mixture above its dew-point, discharging the mixture of cracked products comprises substantially only vapors and free carbon suspended therein from said long coil into an enlarged carbon settling chamber in which the cracking reaction is continued and any carbon suspended in the vapor mixture is separated from the cracked vapors, passing the separated vapors from said carbon settling chamber and simultaneously therewith suddenly chilling the vapors to a temperature below that of further decomposition, fractionating the cooled vapors to separate out the desired gasoline product from the higher boiling constituents, and returning the separated higher boiling constituents to said vapor-liquid separating zone.

2. The process of completely converting a vaporizable petroleum oil stock of higher boiling point than gasoline into high anti-knock gasoline, gas and carbon, which comprises passing the stock to be converted under a high superatmospheric pressure in a confined stream of restricted cross-section through a heating zone in which the oil stock is heated to a temperature of from 950° to 1075° F. and vaporized, thereafter further heating the oil vapor stream as it passes through a second heating zone to substantially maintain the temperature attained in said first-mentioned zone, continuing the heating in said second zone for a sufficient length of time to convert at least 40% of the oil of said stream into constituents boiling in the gasoline range and finely divided carbon suspended in the vapor stream passing through the second zone, discharging the products from the second heating zone separating any suspended carbon therefrom and fractionating the vapor products to separate out the constituents boiling in the gasoline range from higher boiling constituents, passing the higher boiling constituents thus separated to said second heating zone and spraying and intimately distributing them directly into the vapor stream passing therethrough at an intermediate point in the oil vapor stream whereby said returned constituents are converted into lower boiling products and finely divided carbon.

3. The process of completely converting a petroleum oil stock of higher boiling point than gasoline to constituents boiling within the gasoline range, carbon and gas, which comprises subjecting such stock to treatment in a cracking system and removing therefrom substantially only liquid constituents boiling within the gasoline range, carbon and gas, said stock being passed under a superatmospheric pressure in a confined stream of restricted cross-section through a first heating zone in which the stock is heated to a cracking temperature in excess of 950° F. and then in a second heating zone in which said stock is heated in the vapor phase for a substantial period of time, heating the vapor stream in said second heating zone to progressively convert the constituents of said stream into a total condensible product of progressively decreasing specific gravity to a minimum and then of progressively increasing specific gravity from said minimum as the stream of vapors advance through said second heating zone, discharging the oil constituents from said second heating zone separating suspended carbon therefrom and fractionating the vapor products to separate out constituents of higher boiling point than those in the gasoline range, returning at least a portion of said higher boiling point constituents to said second heating zone and spraying the same into the vapor stream passing therethrough at a point in said stream directly following its attainment of said minimum specific gravity, and heating the vapor stream containing the sprayed constituents to substantially maintain the temperature of the stream at conversion conditions for a time sufficient to convert a substantial proportion of said sprayed constituents to products boiling within the gasoline range.

4. The process of converting petroleum oils of higher boiling point into oils of lower boiling point of the type of gasoline, which comprises passing a distillate higher boiling point oil stock to be converted in a confined stream of restricted cross-section through a first heating zone in which the oil is heated to a cracking temperature in excess of 950° F. and completely vaporized, continuing the heating of the oil stream in a second heating zone for a substantial period of time during which the gasoline boiling point range content of the stream progressively increases to a maximum and then progressively decreases from said maximum as the vapor stream passes through said second heating zone, spraying and intimately distributing into the vapor stream passing through said second heating zone a residuum type oil stock containing substantial proportions of heavy aromatic hydrocarbons, said residuum type stock being sprayed into said stream at a point therein at which said vapor stream has commenced to decrease in gasoline boiling point range constituents from said maximum content, and maintaining the vapor stream containing said sprayed residual stock at a temperature of at least about 950° F. for a period of time sufficient to convert a substantial proportion of said residual stock to products boiling in the gasoline range.

5. The process of converting petroleum oil distillates into high anti-knock gasoline products containing substantial proportions of aromatic hydrocarbons, which comprises passing the distillate to be converted in a confined stream through a first heating zone in which the distillate is heated to a cracking temperature in excess of 950° F. and then through a second heat-

ing zone in a confined stream of restricted cross-section in which the oil distillate is maintained at approximately the temperature attained in said first heating zone, injecting and intimately distributing a residuum type oil stock into the vapor stream in the mid-portion of said second heating zone, maintaining the resulting mixture above its dew-point, maintaining the oil constituents in the second heating zone at a temperature of at least about 950° F. for a sufficient period of time to convert the same into a condensible product containing in excess of 40% of constituents boiling in the gasoline range which is comprised of at least 25% of aromatic hydrocarbons.

6. The process of converting a petroleum oil distillate into a high anti-knock motor fuel product, which comprises passing said distillate in a confined stream of restricted cross-section through a long heating coil in the first portion of which the distillate is vaporized and raised to a temperature in excess of 950° F., continuing the heating of the resulting vapor stream in the latter portion of said coil under conditions of temperature and pressure sufficient to initiate an exothermic reaction in the stream of products passing through said coil, spraying and intimately distributing into the vapor stream at a point therein directly after said exothermic reaction has been initiated a residuum type oil stock in sufficient quantity to partially check said exothermic reaction and prevent a destructive reaction, maintaining the temperature of the vapor stream after the introduction of said residuum type stock sufficiently high to maintain the constituents thereof in the vapor phase and for a sufficient time to convert a substantial proportion of the said stock into lower boiling products.

7. The process of cracking residue oils in the vapor phase, which comprises injecting the residue oil into a high temperature stream of hydrocarbon vapor passing through a long tube of restricted cross-section mounted in a heating zone, intimately spraying the residue into the stream in such a ratio to the vapor stream that the residue is instantly vaporized and the constituents thereof carried in intimate dispersion in the vapor stream, controlling the heating of said stream in said zone to maintain the same above the dew-point of the mixture, and continuing the heating of the vapor mixture for a sufficient period of time to convert a substantial proportion of the oil residue into constituents boiling in the gasoline range.

8. The process of cracking an oil residuum in the vapor phase, which comprises injecting the oil residuum to be cracked into a high temperature stream of hydrocarbon vapors passing through a long restricted coil mounted in a heating zone, intimately spraying the oil residuum into the high temperature vapor stream in the coil in such a manner as to effect an intimate dispersion of the constituents of the residuum in the vapor stream and prevent the cooling of the coil or the oil stream by the injection means, controlling the quantity of oil residuum injected into said stream in relation to the temperature of the hydrocarbon vapors of said stream so as to maintain the stream at a temperature above the dew-point of the resulting mixture, and continuing the heating of the vapor mixture at a high cracking temperature for a time sufficient to convert a substantial proportion of said oil

residuum into high anti-knock compounds boiling within the gasoline range.

9. The process of converting petroleum oils into lower boiling products, which comprises passing a distillate oil in a confined stream through a first heating zone in which the distillate is vaporized and heated to a cracking temperature in excess of 950° F., thereafter passing the resulting vapors through a second heating zone in a confined stream of restricted cross section in which the temperature is maintained at or above approximately the temperature attained in said first heating zone, injecting and intimately distributing a residual containing oil into the vapor stream passing through said second heating zone at a point in said stream after the vapor stream has been heated and substantially cracked, controlling the rate of heat input and quantity of residual oil injected into said second zone to maintain the temperature of the mixture passing therethrough above its critical temperature, and maintaining the oil constituents in the second zone for a sufficient time to obtain substantial conversion of the residual oil into lower boiling point products.

10. The process of converting petroleum oils into lower boiling point products, which comprises passing an oil containing residual constituents in a confined stream through a first heating zone in which a substantial proportion of the oil is vaporized and heated to a relatively high temperature, passing the mixture of vapors and unvaporized oil constituents into a vapor liquid separating zone in which the vapors are separated from unvaporized oil constituents, passing the separated vapors through a second heating zone in a confined stream of restricted cross section in which a temperature of 950° F. or above is maintained, withdrawing separated residual oil from said separating zone and injecting it into the vapor stream passing through said second heating zone at an intermediate point thereof, controlling the rate of heat input and quantity of residual oil injected into said second zone to maintain the temperature of the mixture passing therethrough above its critical temperature, and maintaining the oil constituents in the second zone for a sufficient length of time to obtain substantial conversion to lower boiling point products.

11. The process of cracking residual oils in vapor or dispersed phase, which comprises injecting the residual oil to be cracked into a high temperature stream of hydrocarbon vapor passing through a long tube of restricted cross section mounted in a heating zone, intimately spraying and distributing the residual oil into said stream at an intermediate point in said tube in such a ratio to the vapor stream that the residual oil is instantly vaporized and intimately dispersed in the vapor stream, controlling the heating of said stream in said zone to maintain the temperature of the same above the dew-point of the resulting mixture thereby preventing separation of any liquid, continuing the heating of the mixture in said tube for a sufficient period of time to convert a substantial proportion of said residual oil and the hydrocarbon of said vapor stream into constituents boiling in the gasoline range and a small proportion of free carbon, separating the free carbon from the resulting vapors in the form of a dry finely divided carbon, suddenly chilling the resulting vapors following said separation to a temperature below that of further decomposition by in-

timately mixing therewith a fluid cooling medium, fractionating the resulting cooled products to recover a gasoline fraction comprising the gasoline constituents produced in said cracking operation and a plurality of fractions of higher boiling point than said gasoline, and injecting the highest boiling of said higher boiling point fractions into the vapor stream at an inter-

mediate point in said tube to supply at least in part said residual oil for cracking therein.

12. The process of cracking an oil residuum as defined by claim 8 in which the oil residuum injected into the vapor stream is obtained as a product in the cracking operation.

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