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CRACKING PROCESS

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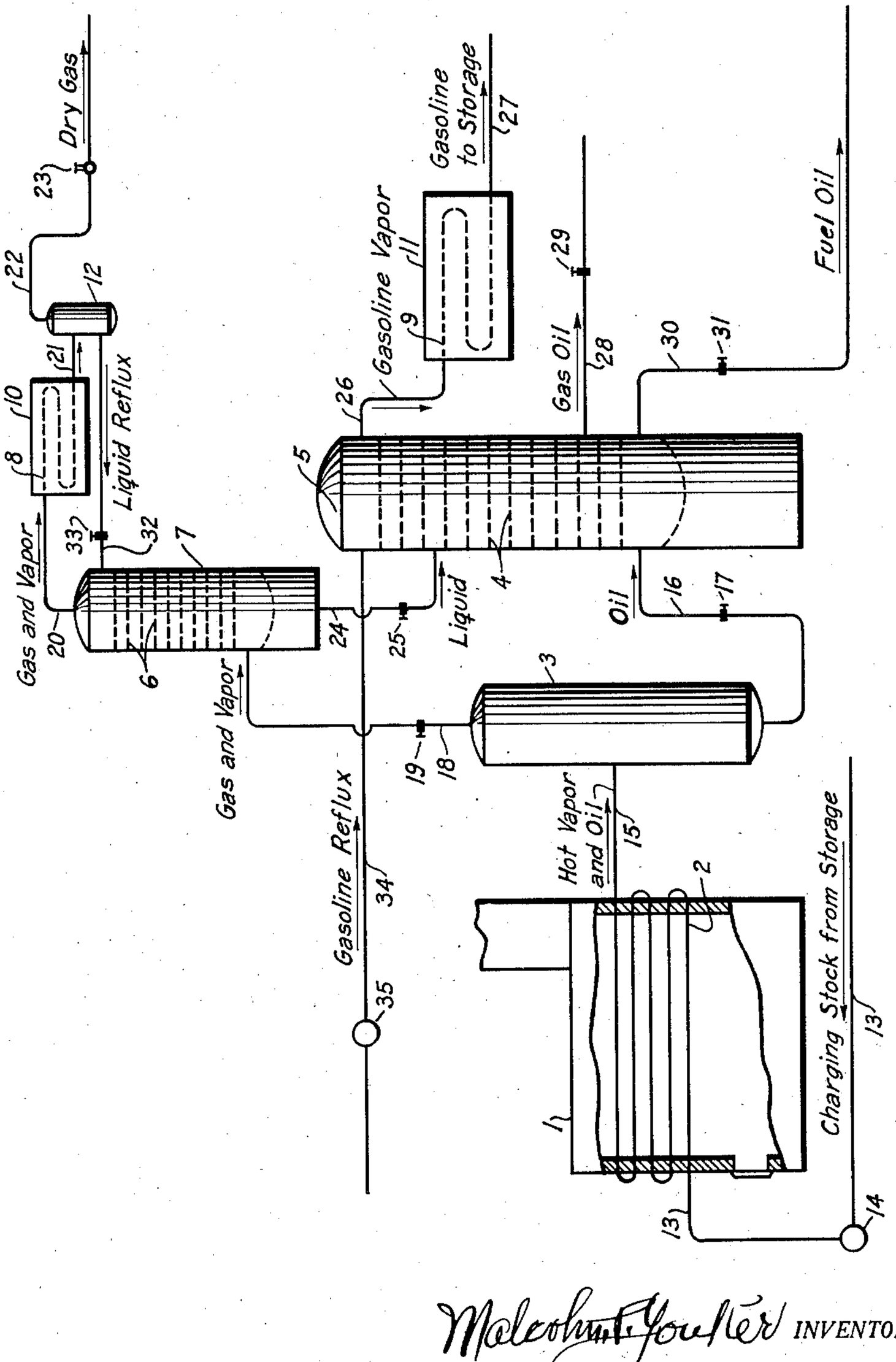

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CRACKING PROCESS

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7 Claims. (Cl. 196—94)

My invention relates to improvements in continuous cracking processes for cracking gas oil and fuel oil and the like to produce therefrom internal combustion motor fuels and has particular reference to an advantageous method of separating from the product of a continuous cracking still motor fuel which is sharply separated from both the permanent gas and less volatile than motor fuel liquids which are produced as a result of cracking. An advantage of my new improvement is that the product of a continuous pressure cracking still may be definitely and sharply separated into gas, motor fuel, and less volatile liquids through a second utilization of heat and pressure originally applied to obtain cracking. Other advantages which are obtained by my new improvement will be made apparent in the following description:

My new improvement will be understood from the following description taken in connection with the accompanying drawing in which one form of apparatus by which my new improvements may be carried out is illustrated diagrammatically in side elevation.

Referring to the drawing, the numeral 1 designates a furnace in which is disposed a heating coil 2. The numeral 3 designates a vertical cylindrical vapor liquid separator. Bubbling trays 4 are disposed in a bubbling type fractionating column 5. Bubbling trays 6 are disposed in a bubbling type fractionating column 7. Condensing coils 8 and 9 are disposed in condenser boxes 10 and 11 respectively. The numeral 12 designates a gas liquid separator. A pipe 13 in which is mounted a pump 14 leads to the inlet of heating coil 2. A pipe 15 leads from the outlet of heating coil 2 into separator 3. A pipe 16 in which is mounted a valve 17 leads from the bottom of separator 3 into fractionating column 5 at a point below bubble trays 4. A pipe 18 in which is mounted a valve 19 leads from the top of vapor liquid separator 3 into fractionating column 7 at a point below bubble trays 6. A pipe 20 leads from the top of fractionating column 7 into condensing coil 8. A pipe 21 leads from the outlet of condensing coil 8 into the gas liquid separator 12. A pipe 22 in which is mounted a loaded back pressure valve 23 leads from the top of gas liquid separator 12. A pipe 24 in which is mounted a valve 25 leads from the bottom of fractionating column 7 into fractionating column 5 at a point intermediate between bubbling trays 4. A pipe 26 leads from the top of fractionating column 5 into condensing coil 9. A pipe 27 leads from the outlet of condensing coil 9. A pipe 28 in which is mounted a valve 29 leads from one of bubbling trays 4 which is intermediate between the points of entry of pipes 24 and 16 into fractionating column 5. A pipe 30 in which is mounted a valve 31 leads from the bottom of fractionating column 5. A pipe 32 in which is mounted a valve 33 leads from the bottom of gas liquid separator 12 into the top of fractionating column 7. A pipe 34 in which is mounted a pump 35 leads into the top of fractionating column 5.

The apparatus outlined in the drawing will be used to carry out my new improvements in the following manner:

Comparatively non-volatile oil which is to be cracked to produce gasoline will be charged by pump 14 through pipe 13 and through heating coil 2 into separator 3. While passing through heating coil 2 this oil will be heated and partially cracked and partially vaporized. A mixture of liquid and vapor will emerge from heating coil 2 into vapor liquid separator 3 where a separation between vapor and liquid will be effected. Vapor will flow from the top of separator 3 through pipe 18 into the bottom of fractionating column 7 and thence upward through fractionating column 7 and pipe 20 into condensing coil 8. Condensate and gas will flow from condensing coil 8 through pipe 21 into vapor gas separator 12. Gas will flow from separator 12 through pipe 22 to be utilized as fuel or otherwise. Reflux liquid will flow from the bottom of separator 12 through pipe 32 into the top of fractionating column 7 thence downward through fractionating column 7 and through pipe 24 into fractionating column 5. Liquid will flow from the bottom of separator 3 through pipe 16 into the bottom of fractionating column 5. Fuel oil will be withdrawn from the bottom of fractionating column 5 through pipe 30 to storage tanks, which are not shown. Gas oil will be drawn from the fractionating column 5 through pipe 28 to storage tanks, which are not shown. Gasoline reflux will be delivered by pump 35 through pipe line 34 into the top of fractionating column 5 and will flow thence downward through fractionating column 5. Gasoline vapor will flow from the top of fractionating column 5 through pipe 26 into condensing coil 9. Gasoline condensate and gas will flow from condensing coil 9 through pipe 27 to storage. By manipulation of back pressure valve 23 and valves 25 and 17, a pressure preferably in the neighborhood of 375 pounds per square inch will be maintained in the heating coil 2, separator 3, fractionating column 7, condenser coil 8, separator 12,

and in pipe lines which connect these pieces of apparatus. The fractionating column 5 and condensing coil 9 will preferably be operated under atmospheric pressure except that in some cases a body of fuller's earth, or other treating agent, may be disposed in the pipe line 26 for the purpose of treating gasoline in the vapor phase in which case friction head set up by the treating agent may result in maintenance of 15 pounds or 25 pounds per square inch pressure in the fractionating column 5. The oil which is flowed through heating coil 2 will preferably be heated therein to approximately 900° F. However, in case highly unsaturated products are desired temperatures as high as 1200° or 1400° may be used. The quantity of reflux supplied to the top of fractionating column 7 will be regulated by valve 33 to obtain a temperature at the top of fractionating column 7 such that gases which are not desirable constituents of motor fuel will pass from the system through pipe 22 and valve 23. In case an excess quantity of reflux should accumulate in separator 12, a draw-off will be provided for removing such excess liquid from the system. Gasoline reflux will be supplied to the top of fractionating column 5 by pump 35 at a rate such that gasoline only will flow in a vapor phase from fractionating column 5 into condensing coil 9. The physical characteristics of the gas oil drawn from the fractionating column 5 through pipe 28 will be regulated by manipulation of valve 29. Increasing the quantity of gas oil so withdrawn through pipe 28 will increase the specific gravity of such gas oil and vice versa. The liquids which will flow through pipes 24 and 16 from a region of high pressure into a region of low pressure in the fractionating column 5 will largely vaporize upon entry into fractionating column 5 by reason of pressure reduction.

While I have described in detail one method of carrying out my improved process, it is to be understood that I do not limit myself to the exact procedure described but intend to claim broadly all of the advantages which are inherent in this improved process. I may, for instance, by means of manipulating valve 19 maintain a pressure in fractionating column 7 which will be lower than the pressure maintained in the heating coil and separator 3. Or I may elect to install a valve in the pipe 15 and maintain a maximum system pressure in heating coil 2. In some cases it may be desirable to add bubble trays at the bottom of fractionating columns 5 and 7 and to re-boil these columns. I will preferably operate the heating coil under a pressure such that heating, cracking, and substantial vaporization take place in this coil. I may install a heat exchanger in such a manner as to heat the incoming charging stock by means of the outgoing gas oil drawn from the fractionating column 5. I may draw no gas oil from the fractionating column 5. Gas oil drawn from the fractionating column 5 may be recharged to the system, and in case such oil is recharged to the system it will preferably not be mixed with fresh charging stock but will be preferably charged to the system separately in order that proper conditions of temperature may be maintained to handle this material in an efficient manner. Any of the conventional methods of refluxing the fractionating columns may be utilized.

I claim:

1. An improved process for treating comparatively non-volatile hydrocarbon oil to produce gas, gasoline and heavier hydrocarbons, comprising flowing said oil through a heating zone while heating the oil to a cracking temperature and maintaining the oil under super-atmospheric pressure, discharging the oil from said zone into a separating chamber, passing gas and vapor from said chamber into the lower portion of a rectifying zone, utilizing the rectifying zone under said pressure to separate dry gas from a liquid fraction containing gasoline, passing said liquid fraction from said rectifying zone into the upper portion of a second rectifying zone and reducing the pressure on the liquid fraction entering the second zone, passing hot oil heavier than gasoline from the separating chamber into the lower portion of the second rectifying zone while reducing the pressure on said hot oil, simultaneously rectifying the liquid fraction and last mentioned oil in the second rectifying zone, discharging gasoline vapor from the upper portion of the second rectifying zone, and discharging oil heavier than gasoline from the lower portion of the second rectifying zone.

2. An improved process for treating comparatively non-volatile hydrocarbon oil to produce gas, gasoline and heavier hydrocarbons, comprising flowing said oil through a heating zone while heating the oil to a cracking temperature, discharging the oil from said zone into a separating chamber, passing gas and vapor from said chamber into the lower portion of a rectifying chamber, utilizing the rectifying chamber to separate dry gas from a liquid fraction containing gasoline, maintaining the heating zone, separating chamber and rectifying chamber under a pressure of approximately 375 pounds per square inch, reducing the pressure on said liquid fraction and passing the same from said rectifying chamber into the upper portion of a second rectifying chamber, vaporizing the liquid fraction in the second rectifying chamber, passing hot oil heavier than gasoline from the separating chamber, after reducing the pressure of the hot oil, into the lower portion of the second rectifying chamber, simultaneously rectifying the vaporized liquid fraction and last mentioned oil in the second rectifying chamber, discharging gasoline vapor from the upper portion of the second rectifying chamber, and discharging oil heavier than gasoline from the lower portion of the second rectifying chamber.

3. An improved process for treating comparatively non-volatile hydrocarbon oil to produce gas, gasoline and heavier hydrocarbons, comprising flowing said oil through a heating zone while heating the oil to a cracking temperature of about 900° F. and maintaining the oil at super-atmospheric pressure, discharging the oil from said zone into a separating chamber, passing gas and vapor from said chamber into the lower portion of a rectifying chamber, utilizing the rectifying chamber at said pressure to separate dry gas from a liquid fraction containing gasoline, passing said liquid fraction from said rectifying chamber after releasing said pressure, into the upper portion of a second rectifying chamber, passing oil heavier than gasoline from the separating chamber after releasing the first mentioned pressure, into the lower portion of the second rectifying chamber, simultaneously rectifying said liquid fraction and last mentioned oil in the second rectifying chamber at a pressure below that mantained in the heating zone, discharging gasoline vapor from the upper portion of the second rectifying chamber, and dis-

charging oil heavier than gasoline from the lower portion of the second rectifying chamber.

4. The process for separating products which are produced by the conversion of hydrocarbons under high pressure and high temperature, which comprises first rectifying under relatively high super-atmospheric pressure vapors produced by said conversion, thereby effecting a clean separation between the gases contained in said vapors and gasoline contained in said vapors, said gasoline contained in said vapors being liquefied in effecting said rectification as a part of a liquid fraction which contains hydrocarbons which are heavier than gasoline, releasing said liquid fraction from under said pressure and revaporizing substantially all of the gasoline contained in said liquid fraction, and rectifying said liquid fraction and said revaporized gasoline, thus effecting a clean separation between gasoline contained in said liquid fraction and the heavier than gasoline constituents of said liquid fraction.

5. An improved process for converting comparatively non-volatile hydrocarbon liquids to produce gasoline therefrom, which consists in passing hydrocarbon liquid which is less volatile than gasoline through a heating tube, heating and cracking and partially vaporizing said liquid in said heating tube, discharging the resulting mixture into a separating chamber, and separating from each other the vapor and unvaporized liquid thus produced, rectifying said vapor and thus making a sharp separation between gas and a liquid fraction containing gasoline produced as a result of the said cracking operations, discharging the gas from said process, and rectifying together in a single second zone at substantially atmospheric pressure, said unvaporized liquid and said liquid fraction containing gasoline, and thus making a sharp separation between the gasoline and less volatile than gasoline products which result from said cracking operations, said heating, cracking and vaporization and said rectification of said vapor being carried out under superatmospheric pressure.

6. The process for separating products which are produced by the conversion of hydrocarbons under high pressure and high temperature, which comprises first rectifying in a single rectifying zone under said pressure, vapors produced by said conversion, thereby effecting a clean separation between the gases contained in said vapors and gasoline contained in said vapors, said gasoline contained in said vapors being liquefied in effecting said rectification as part of a liquid fraction which contains hydrocarbons heavier than gasoline, releasing said liquid fraction from under said pressure and thereby revaporizing the gasoline contained in said liquid fraction, and rectifying in a second single rectification zone said liquid fraction, together with said vaporized gasoline, thus effecting a clean separation between gasoline contained in said liquid fraction and the heavier than gasoline constituents of said liquid fraction.

7. A process for separating products consisting of gasoline, permanent gases and less volatile than gasoline liquids which are produced by the conversion of hydrocarbons under high superatmospheric pressure and high temperature, comprising first separating said products under substantially the same pressure into a vapor fraction containing gasoline and said permanent gases and a liquid fraction containing said less volatile than gasoline liquids, rectifying said vaporous fraction under said last mentioned pressure and thereby effecting a clean separation between the permanent gases and the gasoline contained in said vaporous fraction, discharging said separated permanent gases from the process, said gasoline contained in said vaporous fraction being liquefied in effecting said rectification, releasing said gasoline and said liquid fraction from under said last mentioned pressure and thereby revaporizing the gasoline contained therein, and rectifying said gasoline and said liquid fraction after releasing the same from under said pressure and thus effecting a clean separation between the gasoline and the heavier than gasoline constituents of the liquid fraction.

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