

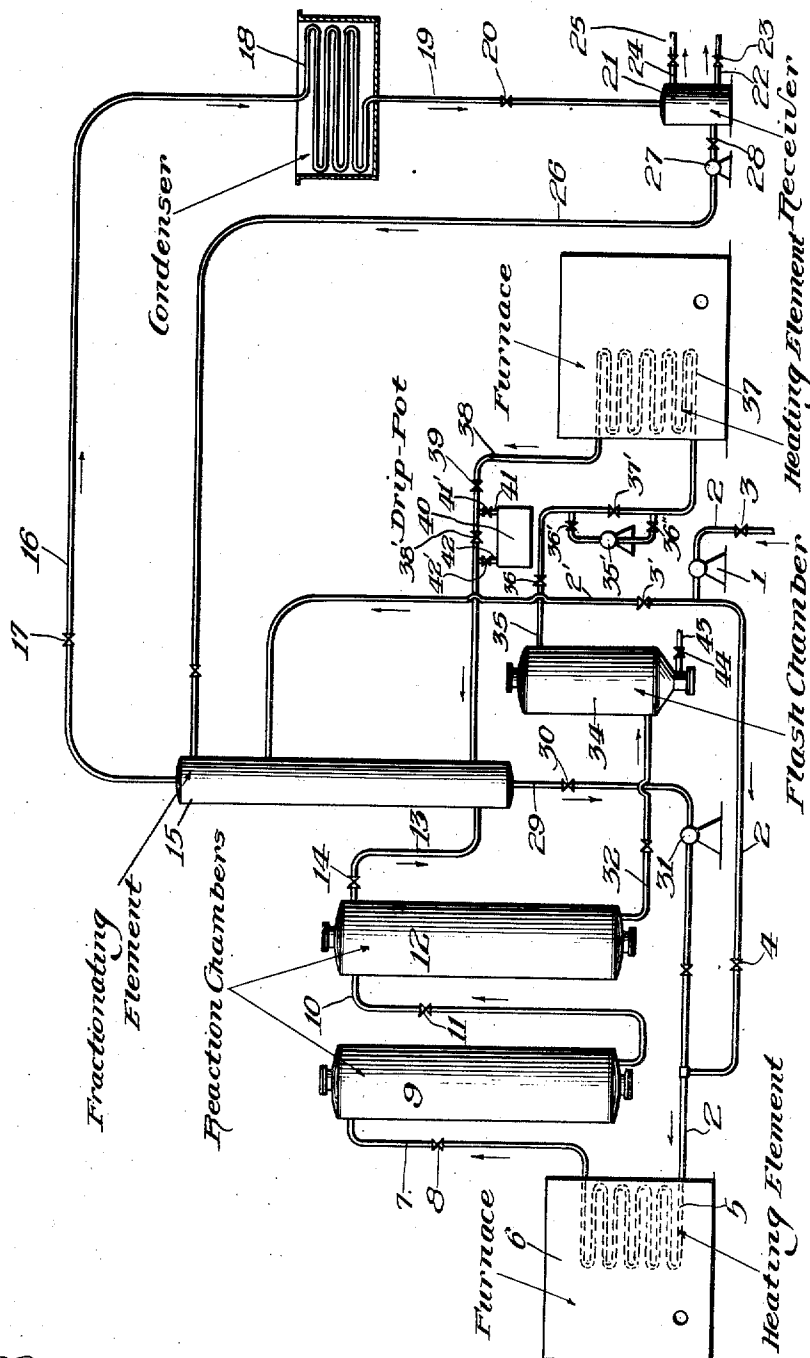
Dec. 21, 1937.

C. P. DUBBS

2,102,889

TREATMENT OF HYDROCARBON OILS

Original Filed July 19, 1930



Witness:

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UNITED STATES PATENT OFFICE

2,102,889

TREATMENT OF HYDROCARBON OIL

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mesne assignments, to Universal Oil Products
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ware

Application July 19, 1930, Serial No. 469,201
Renewed November 6, 1935

3 Claims. (Cl. 196—48)

This invention relates to the treatment of hydrocarbon oils, and refers more particularly to the conversion of higher boiling hydrocarbons into lower boiling hydrocarbons suitable for motor fuel. In one of the preferred embodiments of my invention, the oil to be treated is subjected in a heating zone to conditions which will induce cracking, the oil then being withdrawn and suitably reacted to separate vapors from unvaporized residue. The unvaporized residue is then flash distilled, the vapors resulting therefrom being further converted to produce additional low boiling hydrocarbons.

Further features and objects of invention will become evident in the following detailed description of an apparatus and process embodied within the concept of my invention.

Referring to the accompanying drawing which is a diagrammatic side elevation view, not to scale, and which illustrates one form of my invention:

Raw oil charging stock is pumped through pump 1, line 2 controlled by valves 3 and 4, and the heating element 5 located in furnace setting 6. A portion or all of the raw charging oil may be introduced into fractionating zone 15 through line 2' controlled by valve 3'.

The oil at the conversion temperature is discharged through line 7 controlled by valve 8 into primary reaction chamber 9. The unvaporized residual liquid, together with vapors, is continuously discharged into secondary reaction chamber 12 through line 10 controlled by valve 11. The continuous withdrawal of liquid from the primary reaction zone 9, maintaining practically no liquid therein, permits a prolonged treatment of the hydrocarbons in substantially the vapor phase and prevents short-circuiting or bypassing of the vapors, causing them to traverse the entire length of the primary reaction zone.

The vapors containing the lower boiling products of conversion pass through line 13, controlled by valve 14 to the fractionating element 15. This element may be of any conventional type and serves to separate by dephlegmation or partial condensation the heavier intermediate reflux condensate from the lower boiling products of the process. The vapors leaving fractionating zone 15 pass through line 16 controlled by valve 17 into condenser 18 and the distillate is subsequently collected in receiver 21 after passing through line 19 controlled by valve 20. The liquid collected in receiver 21 is discharged to storage through line 22 controlled by valve 23. The uncondensable gas is passed

through line 24 controlled by valve 25. A portion of the product may be recirculated through line 26 by means of pump 27 controlling the same in addition by valve 28.

The reflux condensate leaving dephlegmator 15, together with such charging oil as may have been introduced thereto, passes through line 29 controlled by valve 30 and is picked up by hot oil pump 31 and sent to the heating element 5 through line 2 for reconversion. The unvaporized residue is withdrawn from secondary reaction chamber 12 through line 32 controlled by valve 33, and discharged into flash chamber 34. Pressure upon chamber 34 is substantially reduced with respect to secondary reaction chamber 12, causing a substantial proportion of the oil to vaporize or flash distill. Vaporized hydrocarbons are passed through line 35 controlled by valve 36 into secondary heating element 37. The temperatures within this secondary heating element are maintained sufficiently high to cause a substantial conversion of the hydrocarbon vapors entering therein into lower boiling products, and the operation is particularly directed towards high temperature or vapor phase conversion.

Where the production of gas is one of the primary objects of the process very high temperatures may be maintained in this heating element. For example, for the production of anti-knock gasoline, temperatures from 950 degrees to 1100 degrees F., more or less, may be maintained within this heating element. For maximum gas production temperatures from 1100 degrees to 1500 degrees F. are maintained.

The oil leaving heating element 37 is discharged through line 38 controlled by valve 39 into fractionating zone 15, separating the lighter from the heavier components of the vapors therein. During some high temperature operations tarry material may be formed and under these conditions it is preferable to bypass the vapors from the heating element 37 through a drip-pot or trap 40. This is accomplished by passing the vapors through line 41 into drip-pot 40 and through line 42 back into line 38. Control valves 41', 42', and 38' are manipulated accordingly.

The unvaporized residue from flashing zone 34 is withdrawn through line 43 controlled by valve 44. Depending upon the transfer of temperature and the reduction in pressure, that is, the temperature of the oil leaving the heating element 5, this residue may have characteristics which make it suitable for fuel oil or it may be reduced to asphalt or even to coke.

Equalized pressures may be used in the primary

heating element and the reaction chambers, or differential pressures may be employed between these elements. Temperatures of from 800 degrees to 950 degrees F., more or less, may be used in heating element 5 and from 950 degrees to 1500 degrees, more or less, in heating element 37. Preferably a reduced pressure is maintained upon the flashing zone 34 ranging from approximately atmospheric to 50 pounds per square inch. Likewise reduced pressure may be maintained upon the heating element 37 and the fractionating element 15. When it is desirable to carry the pressures upon heating element 37 and fractionating element 15 above that maintained in the flashing zone, pump 35 controlled by valves 37', 36' and 36'' may be used.

As specific examples of operating conditions and yields of production obtained by my process, with a Mid-Continent topped crude oil 26 A. P. I. gravity using a transfer temperature at the outlet of coil 5 of 930 degrees F., the temperatures within the primary and secondary reaction chambers being approximately 850 degrees and 810 degrees, respectively, and the pressures within these elements being approximately 170 pounds per square inch, with the reflux ratio, that is, the proportion of reflux condensate returning to the heating element 5 through line 30 relative to the raw oil charging stock being fed to the system of 2.5:1, a yield was produced of approximately 55 percent of gasoline having an anti-knock value of approximately 45 percent benzol equivalent, that is, equivalent to a mixture of Pennsylvania straight run gasoline containing 45 percent benzol. The transfer temperature at the outlet of heating element 37 during this operation was approximately 950 degrees F. A yield of 30 percent unvaporized residual oil of approximately 12 Baumé gravity was produced. This oil was suitable for fuel oil containing less than 2 percent so-called B. S. or suspended carbonaceous matter. About 12 percent by weight of the oil was converted into gas by this operation, amounting to approximately 500 cubic feet of gas per barrel of oil charged. The remainder of the production constituted several percent of pressure distillate bottoms and a very small percentage of coke.

In another operation utilizing the same charging stock, by increasing the temperature in heating element 37 to approximately 1050 degrees F., approximately 50 per cent of gasoline was made; approximately 25 per cent of fuel oil was produced of higher viscosity and somewhat lower gravity than in the previous operation due to change brought about by the modified fractionation in column 15. The gas yield in this operation was approximately 1000 cubic feet per barrel, amounting to approximately 24 per cent by weight of the oil charged, a small percentage of pressure distillate bottoms and a somewhat larger percentage of coke than in the former operation was produced. The anti-knock value of the gasoline in this second operation was increased.

Using a gas, oil charging stock of approximately 36 A. P. I. gravity with corresponding conditions to the above produced higher yields of gasoline and fuel oil, the latter being of better quality than in the former operation, the gas produced being somewhat lower in quantity than the above.

Increasing temperatures in heating element 37 causes a greater conversion of the hydrocarbons into gas. This is also true of increased temperatures in heating element 5. For example, by maintaining temperatures at approximately 950

degrees F. in heating element 5 and 1050 degrees F. in heating element 37, I may make as much as 1500 to 2000 cubic feet of gas per barrel of oil charged, thus permitting the process to be utilized as a gas making operation in conjunction with gasoline production.

When the formation of gas is undesirable it may to a large extent be reduced by employing relatively high pressure particularly in coil 37, say from 400 to 600 pounds per square inch.

The process above specifically described is capable of various modifications, and the apparatus described for use in the process can be changed in various ways without departing from the concept of my invention. For example, although I have described the use of a preliminary and secondary reaction chamber, a single reaction chamber may be used. This and other likely changes are included within the scope of the invention as outlined in the appended claims.

What I claim as my invention is:

1. A hydrocarbon oil cracking process which comprises passing the oil in a restricted stream through a heating zone and heating the same therein to a cracking temperature under sufficient pressure to maintain a substantial portion thereof in the liquid phase, discharging the heated oil into the upper portion of an enlarged reaction zone maintained under cracking conditions of temperature and pressure and passing the commingled vapors and liquid oil downwardly there-through, withdrawing the vapors and liquid unvaporized oil as a mixture from the lower portion of the reaction zone and maintaining practically no liquid level in the reaction zone, separating the mixture withdrawn from the reaction zone into vapors and unvaporized oil and flash distilling the unvaporized oil by pressure reduction, subjecting vapors formed by the flashing of the unvaporized oil to a gasoline-producing vapor phase cracking operation at vapor phase cracking temperature, dephlegmating the vapor phase cracked vapors in admixture with the vapors removed from the reaction zone to condense insufficiently cracked fractions of the commingled vapors and returning resultant reflux condensate to the heating zone, and finally condensing the dephlegmated vapors.

2. A hydrocarbon oil cracking process which comprises passing the oil in a restricted stream through a heating zone and heating the same therein to a cracking temperature under sufficient pressure to maintain a substantial portion thereof in the liquid phase, discharging the heated oil into the upper portion of an enlarged reaction zone maintained under cracking conditions of temperature and pressure and passing the commingled vapors and liquid oil downwardly there-through, withdrawing the vapors and liquid oil as a mixture from the lower portion of the reaction zone and maintaining practically no liquid level in the reaction zone, introducing said mixture into a separating zone and separating the same therein into vapors and unvaporized oil, separately removing the vapors and unvaporized oil from the separating zone and flash distilling the latter by pressure reduction, subjecting the resultant flashed vapors to a gasoline-producing vapor phase cracking operation and combining the cracked vapors thus formed with the vapors removed from the separating zone, deplegmatizing the resultant vaporous mixture to condense insufficiently cracked fractions thereof and returning resultant reflux condensate to the heating

zone, and finally condensing the deplegated vapors.

zone and maintaining practically no liquid level in the reaction zone, separating the vapors from the unvaporized oil under pressure and flash distilling the latter by pressure reduction, cracking resultant flashed fractions in a second heating zone under independently controlled cracking conditions of temperature and pressure and combining resultant cracked vapors with the first-named vapors, dephlegmating the commingled vapors and supplying reflux condensate thus formed to the first-named heating zone, and finally condensing the deplegated vapors.

CARBON P. DUBBS.

CERTIFICATE OF CORRECTION.

Patent No. 2,102,889.

December 21, 1937.

CARBON P. DUBBS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 32, claim 1, strike out the word "liquid"; line 39, same claim, for "flushing" read flashing; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of March, A. D. 1938.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

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