

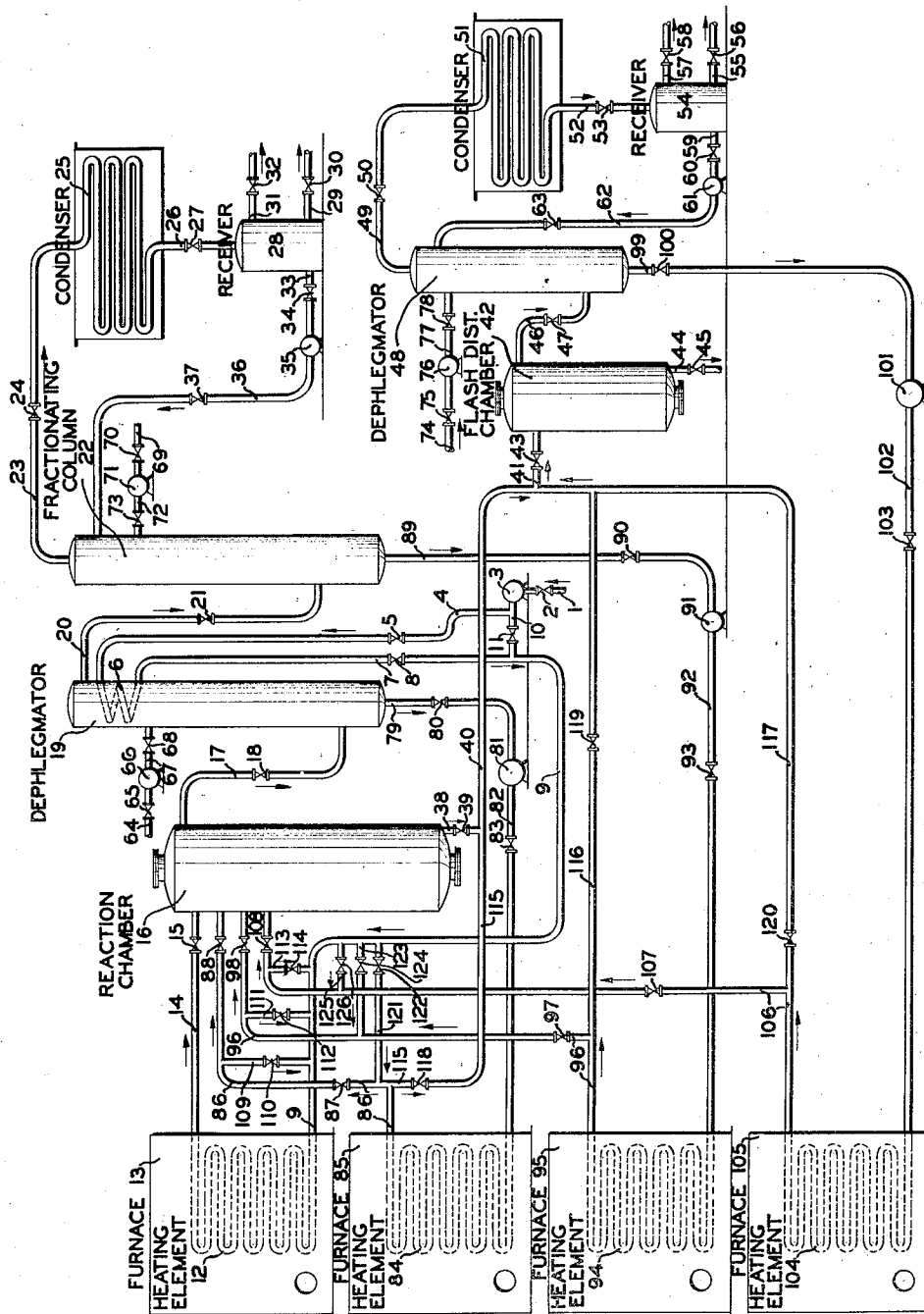
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J. D. SEGUY

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TREATMENT OF HYDROCARBON OIL

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INVENTOR

JEAN DELATTRE SEGUY

BY *Frank L. Belknap*
ATTORNEY

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TREATMENT OF HYDROCARBON OIL

Jean Delattre Seguy, Chicago, Ill., assignor, by
mesne assignments, to Universal Oil Products
Company, Chicago, Ill., a corporation of Dela-
ware

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This invention relates to the treatment of hydrocarbon oils, and refers more particularly to the conversion or thermal decomposition of relatively heavy oils to produce maximum quantities of anti-knock motor fuel.

In one embodiment of the present invention, it comprises subjecting raw oil charging stock to cracking conditions of elevated temperatures and pressures, separating the products of this reaction into various intermediate and final products, subjecting various intermediate products to reconversion under independently controlled cracking conditions and subjecting a portion or all of each of said reconverted intermediate products to further treatment.

In a more specific embodiment the invention comprises subjecting raw oil charging stock to cracking conditions of elevated temperatures and pressures in a heating element, discharging the heated materials into an enlarged reaction zone, wherein vaporous and non-vaporous products of the reaction are separated, subjecting vapors from the reaction zone to fractionation in a primary dephlegmator, subjecting the lighter uncondensed portion of the vapors from the primary dephlegmator to further fractionation in a secondary fractionating zone, subjecting the lighter uncondensed portion of the vapors from the secondary fractionating zone to condensation, cooling and collection, subjecting unvaporized residual oil from the reaction chamber to further vaporization in a zone of reduced pressure, subjecting the evolved vapors from said zone of reduced pressure to fractionation in a flash dephlegmator, uncondensed vapors from which are separately condensed, cooled and collected, subjecting reflux condensate from the primary dephlegmator, reflux condensate from the secondary dephlegmator and reflux condensate from the flash dephlegmator to reconversion, each under independently controlled temperature and pressure conditions, introducing a portion or all of each of said reconverted materials into the reaction chamber together with the converted raw oil charging stock.

As a feature of the present invention, I may introduce preheated or cold raw oil charging stock into any or all of the streams of reconverted intermediate products prior to the entrance of said streams into the reaction chamber.

Another feature of the present invention may provide for the introduction of a portion or all of any or all of the reconverted intermediate products into the stream of raw oil charging stock entering the raw oil heating element.

The invention further provides for the introduction of a portion or all of any or all of the reconverted intermediate products into the flash distilling chamber, if desired, together with the unvaporized residual oil from the reaction chamber to assist vaporization of the latter and, if so desired, to augment said vaporization to a point where only substantially dry coke will remain as a residual product in the flash distilling chamber.

Referring now to the accompanying diagrammatic drawing, which serves to illustrate one form of apparatus in which the process of the present invention may be practiced, raw oil charging stock supplied through line 1 and valve 2 may be fed by means of pump 3 through line 4 and valve 5, through preheating coil 6, located within dephlegmator 19, where it is preheated by indirect contact with the hot ascending vapors in this zone, and may thence flow through line 7 and valve 8 into line 9, where it may mingle with any portion of the raw charging stock fed directly from pump 3 through line 10 and valve 11 to line 9. The preheated or cold raw oil or a mixture of these, as the case may be, is fed through line 9 and valve 9a into heating element 12, where it is subjected to cracking under any desired temperature and pressure conditions.

Heating element 12 is located in any suitable form of furnace 13 and the heated oil leaving this heating element is discharged through line 14 and valve 15 into reaction chamber 16, from which unvaporized residual oil may be withdrawn to retreatment as hereafter more fully described and from which vapors, withdrawn through line 17 and valve 18, are subjected to fractionation in dephlegmator 19. Vapors from the top of the dephlegmator 19 are withdrawn through line 20 and valve 21 and introduced into fractionating column 22, where they are subjected to further fractionation, their lighter uncondensed portions being withdrawn through line 23 and valve 24, subjected to condensation and cooling in condenser 25, thence passing through line 26 and valve 27 to be collected in receiver 28, distillate from which is withdrawn through line 29 and valve 30 and vapors from which are released through line 31 controlled by valve 32. A portion of the condensed distillate from receiver 28 may be withdrawn through line 33 and valve 34 to pump 35 and returned through line 36 and valve 37 to fractionating column 22 to assist condensation and cooling in this zone and to maintain the desired outlet temperature of the vapors from the top of this column.

Unvaporized residual oil withdrawn from re-

action chamber 16 through line 38 controlled by valve 39 may be withdrawn all or in part, from the system by well known means not shown, or may be fed all or in part, through lines 40 and 41 to flash distilling chamber 42, the pressure being preferably reduced as the oil passes through valve 43 in line 41. Unvaporized residual oil from flash distilling chamber 42 may be withdrawn from the system to storage or elsewhere through line 44 controlled by valve 45. Vapors withdrawn from flash distilling chamber 42 through line 46 and valve 47 are subjected to fractionation in dephlegmator 48, from which the uncondensed light portion of the vapors is withdrawn through line 49 and valve 50, subjected to condensation and cooling in condenser 51, thereafter passing through line 52 and valve 53 into receiver 54, from which condensed distillate is withdrawn through line 55 and valve 56 and uncondensable gas is released through line 57 controlled by valve 58. A portion of condensed distillate from receiver 54 may be withdrawn through line 59 and valve 60 into pump 61 and returned through line 62 and valve 63 to dephlegmator 48 to assist condensation and cooling in this zone.

As a feature of the present invention, I have provided for the introduction of an extraneous oil or oils, the composition of which corresponds substantially to that of the vapors entering the various fractionating zones or to that of the heavier portions of these vapors, that is, to that of the reflux condensates from the various fractionating zones, into any or all of the dephlegmating and fractionating columns 19, 22 and 48. In the case of dephlegmator 19 this extraneous oil, corresponding substantially to vapors introduced in dephlegmator 19 from line 17 or to reflux condensate from dephlegmator 19, may be supplied through line 64 and valve 65 to pump 66 and thence fed through line 67 and valve 68 to dephlegmator 19 in direct contact with the ascending vapors. In the case of fractionating column 22 the extraneous oil, corresponding substantially to vapors introduced into fractionating column 22 through line 20, or to reflux condensate from column 22, may be supplied through line 69 and valve 70 to pump 71 and thence fed through line 72 and valve 73 into direct contact with the ascending vapors in column 22. In the case of dephlegmator 48 the extraneous oil, corresponding substantially to vapors introduced into dephlegmator 48 from line 46, or to reflux condensate from dephlegmator 48, may be supplied through line 74 and valve 75 to pump 76 and thence fed through line 77 and valve 78 into direct contact with the ascending vapors in dephlegmator 48.

Reflux condensate from dephlegmator 19 withdrawn through line 79 and valve 80 to pump 81 is fed through line 82 and valve 83 into heating element 84, which is located in any suitable furnace 85 and from which reconverted materials are introduced through line 86 and valve 87 and valve 88 into reaction chamber 16.

Reflux condensate from fractionating column 22 withdrawn through line 89 and valve 90 to pump 91 is fed through line 92 and valve 93 into heating element 94, which is located in any suitable form of furnace 95, and from which the converted materials are introduced through line 96 and valves 97 and 98 into reaction chamber 16.

Reflux condensate from dephlegmator 48 withdrawn through line 99 and valve 100 to pump 101 is fed through line 102 and valve 103 to heat-

ing element 104, which is located in any suitable form of furnace 105 and from which the converted materials are introduced through line 106 and valves 107 and 108 into reaction chamber 16.

Raw oil charging stock, either preheated by passage through coil 6, or supplied cold to line 9 from pump 3, as the case may be, may be introduced in any proportion into any or all of the streams of reconverted materials from heating elements 84, 94 and 104. Raw oil may be introduced into line 86 by diverting it from line 9 through line 121 and valve 122. Raw oil may be introduced into line 96 by diverting it from line 9 through line 123 and valve 124. Raw oil may be introduced into line 106 by diverting it from line 9 through line 125 and valve 126.

Reconverted materials from any one, any combination, or all, of the heating elements 84, 94 and 104 may be introduced in any proportion into the stream of raw oil charging stock entering heating element 12 through line 9. Heated and reconverted materials from heating element 84 may be diverted all or in part, from line 86 and introduced into line 9 through line 109 controlled by valve 110. Heated and reconverted materials from heating element 94 may be diverted all or in part, from line 96 into line 9 through line 111 controlled by valve 112. Heated and reconverted materials from heating element 104 may be diverted all or in part, from line 107 into line 9 through line 113 controlled by valve 114.

Heated and reconverted materials from any one, any combination, or all of heating elements 84, 94 and 104 may be diverted, all or in part, from the transfer lines 86, 96 and 106, and fed respectively through lines 115, 116 and 117, controlled respectively by valves 118, 119 and 120 into line 41 to mingle with the unvaporized residual oil from reaction chamber 16, introduced into flash distilling chamber 42, to assist further vaporization of this residual product in chamber 42.

Pressures employed within the system may range from sub-atmospheric to high super-atmospheric pressures of 1500 pounds or more per square inch. Pressures may be substantially equalized throughout the entire system or differential pressures may be employed between various elements of the system.

Cracking temperatures employed may range from 750 to 1200° F. more or less. Preferably milder cracking conditions are employed in heating element 12 than in heating elements 84, 94 and 104, and the temperature and pressure conditions in each of these heating elements may be independently controlled.

As a specific example of a typical operation of the process of my invention, a 24° A. P. I. gravity Mid-Continent topped crude forms the raw oil charging stock for the system and is subjected in heating element 12 to a temperature of approximately 850° F. under super-atmospheric pressure of some 500 pounds per square inch. Pressure upon reaction chamber 16 is reduced to approximately 150 pounds per square inch, and is substantially equalized with the pressure in dephlegmator 19. Secondary fractionating column 22 and subsequent condensing and receiving equipment, as well as the flash distilling system, are maintained under a pressure of approximately 30 pounds per square inch. Three additional streams of hydrocarbon oil undergoing conversion, corresponding respectively to the reflux condensate from dephlegmator 19, fractionating

column 22 and flash dephlegmator 48, form about 80% of the total oil undergoing conversion.

The oil passing through heating element 84 is maintained at an outlet temperature of approximately 925° F. and the pressure of approximately 275 pounds per square inch, maintained upon heating element 84, is equalized with the reduced pressure upon reaction chamber 16 before the oil is introduced thereto. The outlet temperature upon heating element 94 is maintained at approximately 1100° F., and the pressure in this heating element is substantially equalized with the pressure in reaction chamber 16. The outlet temperature for heating element 104 is approximately 950° F., and the pressure upon this heating element is maintained at about 200 pounds to the square inch. A small portion of the reconverted material from heating element 94 is introduced into flash distilling chamber 42 to assist vaporization of the residual oil. Sufficient raw oil is introduced into the three streams of reconverted materials entering reaction chamber 16 to insure a temperature of the combined materials in chamber 16 of approximately 850° F.

In an operation such as above outlined, a yield based on the total charge to the system of approximately 68% of motor fuel having an antiknock value of about 50% equivalent to a blend of about 50% straight run Pennsylvania gasoline and about 50% benzol is obtained. About 4% pressure distillate bottoms are recovered from the redistillation of the distillate collected in receiver 54, the remainder of the products from the system being gas and dry coke formed in the flash distilling chamber 42.

During another operation portions of the heated hydrocarbon streams from heating elements 84, 94 and 104 may be diverted into the flash distillation chamber 46 while the remainder may be directed to the reaction chamber 16. In another operation wherein unvaporized liquid residue only is diverted into the flash distillation chamber, a yield of approximately 55% motor fuel with a 50% benzol equivalent may be obtained making at the same time approximately 25% of flashed residual fuel oil and the remainder gas with some coke. The examples given are illustrative and are not to be construed as limitations upon the broad scope of the invention.

I claim as my invention:

1. A hydrocarbon oil cracking process which

comprises passing the charging oil in a restricted stream through a heating zone and heating the same therein to cracking temperature under pressure, discharging the heated oil into a vapor separating zone and separating the same therein into vapors and unvaporized oil, removing the vapors and subjecting the same to dephlegmation thereby forming reflux condensate, separately removing the unvaporized oil and flash distilling the same in a flashing zone by pressure reduction, dephlegmating the resultant flashed vapors thereby forming flash reflux, subjecting said reflux condensate and said flash reflux independently of the charging oil and independently of each other to independently controlled cracking conditions of temperature and pressure best suited for the cracking thereof, then introducing said reflux condensate and said flash reflux to said separating zone to be commingled therein with the heated charging oil and with each other, and finally condensing the dephlegmated vapors.

2. The method as defined in claim 1 further characterized in that there is introduced into contact with the vapors in the first-mentioned dephlegmating step an oil corresponding in character to said reflux condensate and in that there is introduced into contact with the vapors in the second-mentioned dephlegmation step an oil corresponding in character to said flash reflux.

3. A hydrocarbon oil cracking process which comprises passing the charging oil in a restricted stream through a heating zone and heating the same therein to cracking temperature under pressure, discharging the heated oil into a vapor separating zone and separating the same therein into vapors and unvaporized oil, removing the vapors and subjecting the same to dephlegmation thereby forming reflux condensate, separately removing the unvaporized oil and flash distilling the same in a flashing zone by pressure reduction, dephlegmating the resultant flashed vapors thereby forming flash reflux, subjecting said reflux condensate and said flash reflux independently of the charging oil and independently of each other to independently controlled cracking conditions of temperature and pressure best suited for the cracking thereof, then introducing at least a portion of such reheated condensates to said flashing zone, and finally condensing the dephlegmated vapors.

JEAN DELATTRE SEGUY.