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PROCESS OF CRACKING OIL

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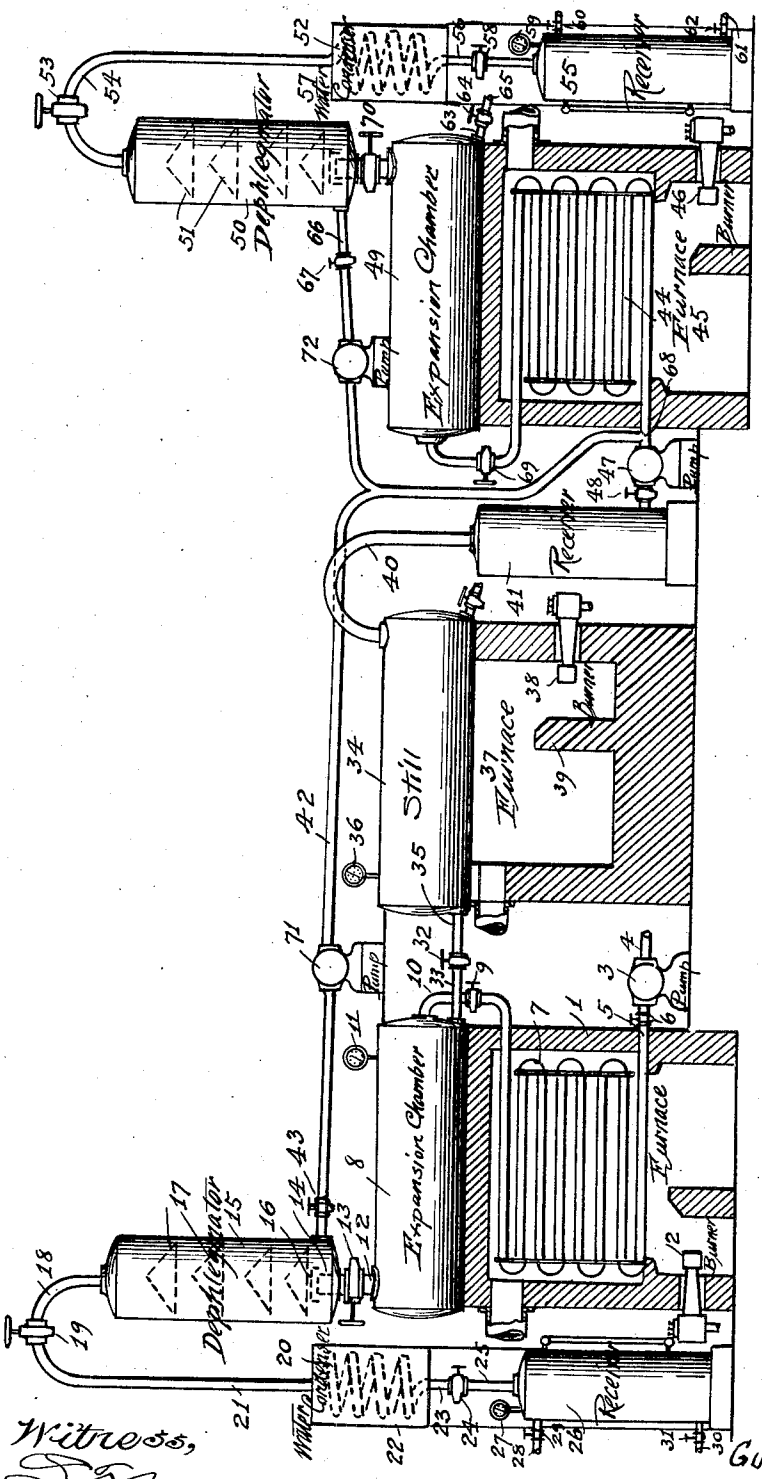

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UNITED STATES PATENT OFFICE

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PROCESS OF CRACKING OIL

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This invention relates to a process for cracking hydrocarbon oil in such a manner as to permit of a maximum charging capacity of oil to a heating coil, wherein the oil is subjected to a cracking temperature under pressure. The invention further contemplates the preventing of the return of any reflux condensate or residual oil formed in the process to said heating coil, in which the raw oil is initially treated. The residual oil formed in the initial part of the process is subjected to distillation in a secondary zone maintained under a lower pressure than the pressure maintained on the oil in the initial treatment. The reflux condensate resulting from the initial treatment of the oil and distillate obtained from the distillation of the residual oil in said secondary zone are combined and subjected to further treatment in an additional heating zone, from which the combined material is introduced into an enlarged chamber, the unvaporized oil being drawn from said enlarged chamber to be isolated from the system, while the vapors issuing therefrom are dephlegmated and reflux condensate returned to said additional heating zone for further treatment.

The figure is a side elevational view with parts shown in section of the apparatus used in the process. Numeral 1 designates a furnace having burner 2 set therein and is also provided with a stack for the products of combustion to escape therefrom (not shown). A charging oil pump 3 for the raw stock to be treated, is provided with a pipe connection 4 attached to a storage tank (not shown). A pipe 5, having control valve 6, connects the pump 3 with the heating coil 7, the latter being connected with expansion chamber 8 through control valve 9, interposed in the transfer line 10. 11 is a high pressure gauge connected with expansion chamber 8. Pipe connection 12, connected with expansion chamber 8, is provided with a throttle valve 13 and extension pipe 14, set within dephlegmator 15, having cap 16 inserted therein and baffle plate material 17. To the top of dephlegmator 15 is connected a pipe 18, having control valve 19, connecting with water condenser coil 20 by means of pipe 21. 22 is a water condenser box. At the bottom of condenser coil 20 is a pipe connection 23, having control valve 24 therein and pipe connection 25 attached to the top of the receiver 26. To the receiver 26 is attached a high pressure gauge 27 and uncondensable gas pipe connection 28, with a control valve 29 for the escape of uncondensable gas generated in the cracking system. At the bottom of receiver 26 is pressure distillate pipe connection 30, having control valve 31 for the purpose of allowing the pressure distillate oil to be withdrawn. The residual oil formed during the cracking reaction is withdrawn through valve 32, located in pipe 33 leading from expansion chamber 8. The residual oil from expansion chamber 8 flows into still 34 by means of pipes 33 and 35. The still 34 has pressure gauge 36 set thereupon. The contents of still 34 may be heated by means of furnace 37 equipped with a burner 38, and a bridge wall 39. The products of the distillation from still 34 pass, by means of gooseneck 40, into receiver 41. The reflux condensate from dephlegmator 15 passes out of pipe 42, having control valve 43, into the heating coil 44 inserted in furnace 45, having burner 46 set therein. The reflux condensate from dephlegmator 15 is blended by means of pump 71 with the distillation products from the residual oil in still 34, passing through valve 48 into the suction side of pump 47, where it blends with reflux condensate coming from the discharge side of pump 71 as it passes into heating coil 44. The blended reflux condensate from dephlegmator 15 and the distillation products of the residual oil from still 34 are discharged, under heat and pressure from coil 44, into expansion chamber 49, and the vapors from said expansion chamber travel upward through dephlegmator 50, provided with baffling material 51; the uncondensed portion of said generated vapors, from expansion chamber 49, continue on to water condenser coil 52 via control valve 53 and pipe 54, thence to receiver 55 through pipe connection 56 leading from water condenser 52 set in condenser box 57. In pipe connection 56 is a control valve 58. To the top of receiver 55 the high

pressure gauge 59 is attached. The uncondensable gas generated in this part of the system is released by means of valve 60 and the condensed pressure distillate is allowed to flow out of the system by pipe 61, having control valve 62 inserted therein. The residue from the secondary cracking of the reflux condensate from the first portion of the process and the distillation products from the residual oil in still 34 is allowed to flow out of the expansion chamber 49 by means of pipe 63 and control valve 64, and pipe connection 65 connected with a rundown tank (not shown in the drawings). The reflux condensate from dephlegmator 50 is forced back by means of pumps 72 through pipe 66 and control valve 67 into pipe connections 42 and is retreated in the heating tubes 44.

A typical method of operation of this process is to charge the heating coil 7 with a heavy fuel oil, such as Wayside (Oklahoma) fuel oil, by means of pump 3, and then, starting with burner 2, heat the oil therein under a pressure of 175 lbs. to the square inch to a temperature such that the oil passing into the expansion chamber 8 is at 850°. The vaporized portion of the hot oil under pressure passes up through dephlegmator 15, where a portion of the vapors are fractionated out as a liquid. The uncondensed portion of the vapors continue their path of travel through the vapor lines 18 and 21 into water condenser coil 20 into receiver 26, where the liquid condensate is collected. The residual oil in expansion chamber 8 is allowed to pass through pipes 33 and 35, through control valve 32, into still 34, which is maintained at a pressure substantially below the pressure upon the coil 7, expansion chamber 8, dephlegmator 15, condenser coil 20 and receiver 26. As the residual oil is above the temperature of its boiling point at atmospheric or lower pressure, a substantial portion of said residual oil will distill over into receiver 41. If it is desired, burner 38 may be ignited and the products of combustion in furnace 37 may increase the rate of distillation in still 34, and the residue distilled to coke. The products of distillation from still 34 are pumped into the secondary heating coil 44, mixing with the reflux condensate from dephlegmator 15, travelling through pipe connections 42 and valve 43, mixing at the point 68, and also with reflux condensate from the dephlegmator 50 of the secondary portion of the process. The liquid from the secondary heating coil 44, passing into expansion chamber 49, through a control valve 69, is at a temperature of approximately 875° and a pressure of 175 lbs. The vapors generated in expansion chamber 49 travel through dephlegmator 50 and piping 54, having control valve 53 set therein and condenser coil 52 into receiver 55. The pressure distillate oil collected in receiver 55 is allowed to flow continuously to a rundown tank (not shown) via piping 61 and control valve 62.

It is to be clearly understood that the pressure and temperature cited are purely illustrative, as they may vary with the raw oil to be treated. I may crack the crude oil itself, such as the heavy asphaltic oils from Texas, California or Mexico, and I may maintain a different pressure upon the process at pressure control valves, 9, 13, 19, 24, 29, 69, 70, 53, 58 and 60. I may find it desirable to maintain a pressure on the heating coil 7 of 750 lbs. and a temperature of 900° and a pressure of 500 lbs. upon the expansion chamber 8, and reduce the pressure from 500 to 350 on the dephlegmator while subjecting the vapors, passing control valve 19, to a pressure of 175 lbs. and a pressure of 90 lbs. upon the receiver 26. These conditions are favorable for highly refractory oils, such as certain gas oils distilled from a Pine Island crude oil, certain Mexican oils and Texas oils. The reflux condensate and the distillation products from the residual oil from expansion chamber 8, passing into still 34, require more drastic pressure and temperature conditions for their conversion into commercial yields of gasoline and other oils, hence the pressure upon the secondary heating coil 44 may be 900 lbs., 700 upon the expansion chamber 49, 500 upon the dephlegmator 50, 300 upon the water condenser coil 52 and 200 lbs. pressure upon the receiver 55, while cracking said refractory gas oils, such as from Pine Island, Texas and Mexican crudes.

In the primary portion of the process I have converted a Wayside fuel oil into 22 per cent of 58° Baumé gravity gasoline and 25 per cent of 41° Baumé gravity gasoline, while the reflux condensate from the primary portion of the process and the distillation products from the residual oil were further converted in the secondary portion of the process into 20 per cent of 58° Baumé gravity gasoline and 21 per cent of 41° Baumé gravity gasoline.

I claim as my invention:

1. A process of cracking oil, consisting in continuously passing the oil through a coil of restricted cross-sectional area, wherein it is subjected to cracking conditions of temperature and pressure, in discharging the oil from said coil into an expansion chamber where vaporization occurs, in passing the vapors from said expansion chamber to a dephlegmator wherein the heavier fractions are condensed, in condensing the vapors issuing from said dephlegmator and collecting the resulting distillate, in continuously withdrawing hot residuum from said expansion chamber and passing it to a residuum still wherein it is treated under a lower pressure than that maintained in the heating coil, in collecting the distillate resulting from such treatment of the residuum; in withdrawing re-

flux condensate from said dephlegmator and commingling it with the distillate resulting from the treatment of the residuum and in retreating the resulting mixure in a second coil, wherein, higher conditions of heat and pressure are maintained than in said first coil; in passing the heated mixture from said second coil into an expansion chamber, in dephlegmating vapors issuing from said last mentioned expansion chamber, in returning the re-flux condensate resulting from such last mentioned dephlegmation to said second heating coil, in condensing the vapors resulting from such dephlegmation and in collecting the resulting distillate.

2. A process of treating hydrocarbon oil, consisting in continuously passing oil through a heating coil wherein it is subjected to cracking conditions of heat and pressure, in discharging the oil from said coil into an expansion chamber, in dephlegmating the vapors issuing from said expansion chamber, in continuously withdrawing hot residuum from said expansion chamber and passing it directly into a residuum still wherein it is treated under lower pressure than that maintained in said coil; in collecting the distillate resulting from such treatment of the residuum, in forcing this distillate under an applied pressure through a second heating coil wherein it is subjected to higher conditions of heat and pressure than those maintained in said first coil; in delivering the heated oil from said second heating coil into a second expansion chamber, in passing reflux condensate resulting from the dephlegmating of the vapors issuing from said first mentioned expansion chamber under an applied pressure to the advancing stream of said distillate to be retreated in said second coil, in dephlegmating the vapors produced by the retreatment of said distillate and reflux condensate in said second coil; in condensing the vapors resulting from said dephlegmation and in collecting the resulting distillate.

3. A process of treating hydrocarbon oil, consisting in initially subjecting the oil to cracking conditions of heat and pressure to cause the oil to separate into vapors and a liquid residue, in dephlegmating the vapors, in distilling the liquid residue in an independent zone under a lower pressure than that to which the oil is initially subjected, in uniting the distillate obtained by the distillation of said residue with reflux condensate resulting from the dephlegmation of said vapors and in passing the commingled reflux condensate and distillate through a separate heating zone wherein the mixture is subjected to a higher temperature and a greater pressure than that to which the oil was initially subjected.

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