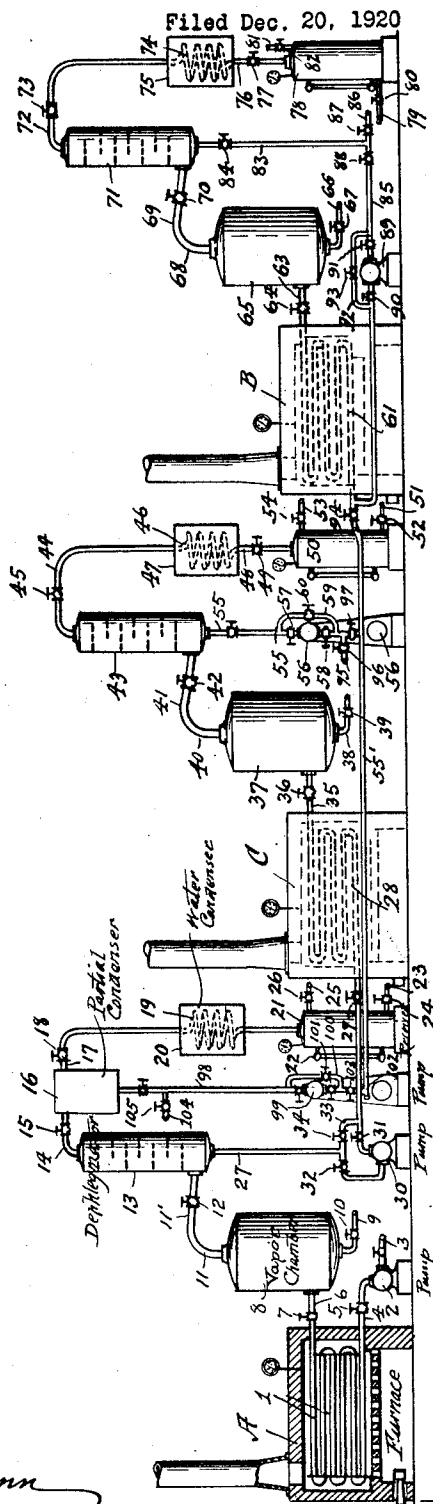


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PROCESS FOR CRACKING PETROLEUM OIL



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PROCESS FOR CRACKING PETROLEUM OIL.

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This invention relates to improvements in process and for cracking petroleum oil and refers more particularly to that type of process in which the generated vapors are subjected to reflux condensing action and the reflux condensate, i. e., the incompletely converted oil constituents subjected to further cracking reaction.

With certain types of petroleum oil, the reflux condensate produced in the cracking operation is more desirably subjected to further cracking reaction under different temperatures and pressures than is the original oil. By means of the present process, this reflux condensate can be separately cracked as part of a continuous process and under different conditions of temperature and pressure than the raw oil. As a further feature of the invention, the generated vapors are subjected to a double reflux condensing action in which the heaviest portions of the vapors are condensed and separately re-cracked while the intermediate portion of the vapors, i. e., those lighter than the heaviest but not yet sufficiently cracked and therefore heavier than the lightest, are separately condensed, subjected to further cracking under still different conditions of temperature and pressure.

In the drawing, the single figure shows a somewhat diagrammatic view partly in side elevation and partly in vertical section of improved apparatus for carrying out my process.

Referring in detail to the drawing, A, B and C designate three separate furnaces. In the furnace A is mounted a heating coil 1, as for example, a continuous coil of 2" to 6" pipe. This coil is fed from the charging pump 2, connected to the raw oil supply by inlet line 3 and delivering the raw oil to the heating element through the feed line 4 having throttle valve 5. The discharge side of the coil is connected by transfer line 6 having throttle valve 7 to vapor chamber 8. This vapor chamber 8 is provided with liquid residue drawoff pipe 9 controlled by throttle valve 10. It also has vapor outlet pipe 11 and downwardly inclined extension pipe 11' having throttle valve 12 and connected to the lower side of the dephlegmator 13. The upper end of the dephlegmator 13 is connected by vapor pipe 14 having throttle valve 15 to a partial condenser

or reflux condenser 16. The vapor space of this condenser is connected by a pipe 17 having throttle valve 18 to final condenser coil 19 seated in water condenser 20. The lower end of the coil 19 is connected to the upper part of receiver 21. This receiver 21 has liquid level gauge 22, liquid drawoff pipe 23, having throttle valve 24 and gas outlet pipe 25, having throttle valve 26.

Referring back to the dephlegmator 13, to its lower end is connected a reflux condensate pipe 27, which leads to the inlet side of the heating coil 28 mounted in the furnace C. A throttle valve 29 is interposed in the line 27. There is likewise interposed in this line a pump 30 provided at either side with valves 31 and 32, whereby the reflux condensate may be pumped under increased pressure, if desired. A by-pass line 33 having throttle valve 34 is provided for bypassing the pump, if desired. The discharge side of the coil 28 is connected by transfer line 35 having throttle valve 36 to vapor chamber 37. This vapor chamber 37 is provided with liquid drawoff pipe 38 controlled by throttle valve 39. The upper end of the vapor chamber is connected by vapor pipe 40 and downwardly inclined pipe 41 having throttle valve 42, to the lower side of a dephlegmator 43. This dephlegmator 43 is provided with vapor outlet pipe 44 having throttle valve 45, which pipe 44 is connected to final condenser coil 46 seated in condenser box 47. The lower end of the coil is connected by pipe 48 having throttle valve 49 to the upper part of receiver 50. This receiver 50 has liquid drawoff pipe 51 controlled by throttle valve 52 and gas outlet pipe 53 controlled by throttle valve 54.

Referring back to the dephlegmator 43, to its lower end is connected reflux return pipe 55 in which is interposed a pump 56 having at either side valves 57 and 58. The pump may be by-passed by pipe 59 having valve 60. This line 55 connects to extension 55' leading to the heating coil 61 seated in furnace B. This coil may be of the same construction as the other two. The discharge side of this coil is connected by transfer line 63 having throttle valve 64 to an expansion or vapor chamber 65. This expansion chamber 65 has a liquid drawoff pipe 66 controlled by throttle valve 67. It is also provided with the vapor outlet pipe

68 and connecting downwardly inclined pipe 69 furnished with throttle valve 70 and leading to the lower side of a dephlegmator 71. The upper end of the dephlegmator is connected by vapor pipe 72 having throttle valve 73 to condenser coil 74 seated in condenser box 75. The lower end of the coil is connected by pipe 76 having throttle valve 77 to the top of receiver 78. This receiver 78 has liquid drawoff pipe 79 controlled by throttle valve 80 and gas outlet pipe 81 controlled by throttle valve 82.

The lower end of the dephlegmator 71 is connected by reflux condensate pipe 83 having throttle valve 84 to a second return pipe 85 leading back to the pipe 55', whereby it may be returned to the heating coil 61. The line 83 is also provided with the branch pipe 86 having throttle valve 87 connected to any suitable receptacle (not shown), whereby the reflux condensate may be led elsewhere than delivered to the coil 61. In this case a valve 88 in the line 85 can be closed and valves 84 and 87 regulated. In the pipe 85 is interposed a pump 89 having at either side, valves 90 and 91, whereby the reflux condensate may be returned to the pipe 55' under pressure. This pump may be by-passed by means of the pipe 92 having throttle valve 93. A throttle valve 94 is interposed in the pipe 55'.

I have heretofore stated that the reflux condensate from the pipe 55 may be delivered to the pipe 55'. It also may be delivered elsewhere, to-wit:—to a suitable receptacle, (not shown), by means of branch 95 having throttle valve 96. In this case the valve 97 interposed in the end of the pipe 55 will be closed.

Referring back to the partial condenser 16, to its lower side is connected condensate return pipe 98. In this pipe line 98 is interposed a pump 99 having suitable valves at either side thereof and also provided with the by-pass line 100 having valve 101. The lower end of the pipe 98 is connected as shown at 102 to the line 55', provided with control valve 103. The reflux condensate instead of being returned to the pipe 55' may be delivered to a suitable receptacle (not shown) by means of the branch 104 having throttle valve 105.

The process may be operated as follows: Raw oil, as for example, petroleum fuel oil, may be fed continuously to the heating tubes 1 where it is heated to a temperature of say, 750 degrees F. and while in substantially liquid phase passed to the vapor chamber 8 and thence to the first reflux condenser. The uncondensed portions will pass to the partial condenser 16 and the still uncondensed portions will pass to the condenser 19 and thence to the receiver 21. All of the elements so far referred to may be maintained under a pressure of say, 150 pounds. The reflux condensate from the dephlegmator 13 may be

pumped by means of the pump 30 to the second heating coil 28 and there subjected to a temperature of say, 800 degrees F., passing thence to the vapor chamber and thence to the dephlegmator 43. The uncondensed portions will pass out of the top of the dephlegmator 43 into the coil 46 and thence to the top of receiver 50. This part of the system from the coil 28 to receiver 50 may be maintained under a pressure of say, 200 pounds. The reflux condensate formed in the dephlegmator 43 may be pumped back by means of the pump 56 to the lines 55 and 55' and thence to the heating coils 61 seated in the furnace B. Here the reflux condensate will be heated to a temperature of say, 850 degrees F. The reflux condensate will thence pass into the chamber 65 and the vapors therefrom into the dephlegmator 71. The uncondensed portions will pass out of the dephlegmator into the condenser 74 and thence to the receiver 78. The heating tubes 61 and associated mechanism may be maintained under a pressure of say, 250 pounds. The reflux condensate from the dephlegmator 71 may be returned by pump 89 to the pipe 55' and thence through the tubes 61.

The reflux condensate from the second reflux or partial condenser 16 may be pumped back by the pump 99 to the pipe 55' and thence to the tubes 61. From the foregoing it will be seen that the raw oil and the different cuts of reflux condensate are all treated under different pressures and temperatures.

The process may be carried out exactly in the manner above described except that the reflux condensate from the partial condenser 16 may be by-passed through the line 104 or the reflux condensate from the dephlegmator 71 may be by-passed through the line 86 and may be re-cracked in a system separate if desired, or the partial condenser may be left in the system in the manner as described and only the reflux condensate from the dephlegmator 71 drawn off through the line 86.

The process may be operated in the manner first above described, except that the oil in the first heating coil may be heated to a temperature of say, 650 degrees F. and subjected to a pressure of 100 pounds; the oil in the second heating coil, to-wit, in the furnace C heated to a temperature of 750 degrees F. and subjected to a pressure of 150 pounds while the reflux condensate passed through the furnace B may be heated to a temperature of 750 degrees F. and subjected to a pressure of 200 pounds.

The process may also be operated by maintaining a pressure of say, 150 pounds on the heating coil 1; a reduced pressure, as for example, 75 pounds, on its associated condenser and dephlegmator and partial condenser, and 50 pounds on the final condenser 19 and receiver 21, the oil being heated to a temperature of say, 680 degrees F. The pressure

on the oil in the heating coil in the furnace C may be 200 pounds, at a temperature of 720 degrees F.; the pressure on the associated vapor chamber and final condenser and receiver reduced say, to 75 pounds. The oil in the heating coil 61 may be heated to a temperature of 780 degrees F., subjected to a pressure of 250 pounds, while the associated vapor chamber and dephlegmator may be maintained under a pressure of say, 100 pounds and the associated final condenser and receiver at 50 pounds.

The process may also be carried out in the manner last described except that the vapor chamber may be maintained under the same pressure as the oil in the heating tubes while the dephlegmator may be maintained at atmospheric pressure.

I claim as my invention:

20 1. A process of cracking oil, which consists in passing the oil through a heating coil wherein it is subjected to cracking conditions of heat and pressure, in discharging the oil from said coil into a vapor chamber, 25 in passing the vapors from said vapor chamber through successive dephlegmators, in passing the reflux condensate from each of said dephlegmators under applied pressure to independent heating zones and in subjecting the reflux condensate passed to each of said 30 independent heating zones to higher temper-

atures than the temperatures to which the oil is subjected in said heating coil.

2. A process of cracking oil, which consists in passing the oil through a heating zone wherein it is subjected to cracking conditions of heat and pressure, in dephlegmating the vapors produced from said heating zone in successive dephlegmators, in passing the reflux condensate from each of said dephlegmators under an applied pressure to independent heating zones in subjecting the reflux condensate in each of said independent heating zones to a higher temperature than that to which the oil is subjected in said first named heating zone, in condensing the vapors issuing from the last of said dephlegmators, and in collecting the resulting distillate.

3. A continuous process for cracking hydrocarbon oil, consisting in initially subjecting the oil to cracking conditions of heat and pressure to cause substantial conversion thereof, in subjecting the vapors evolved from the oil to primary and secondary dephlegmating actions, in separately subjecting the reflux condensates resulting from said primary and secondary dephlegmating actions to independent cracking reactions at temperatures substantially above the temperature to which the oil was initially subjected.

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