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PROCESS FOR CRACKING PETROLEUM OIL

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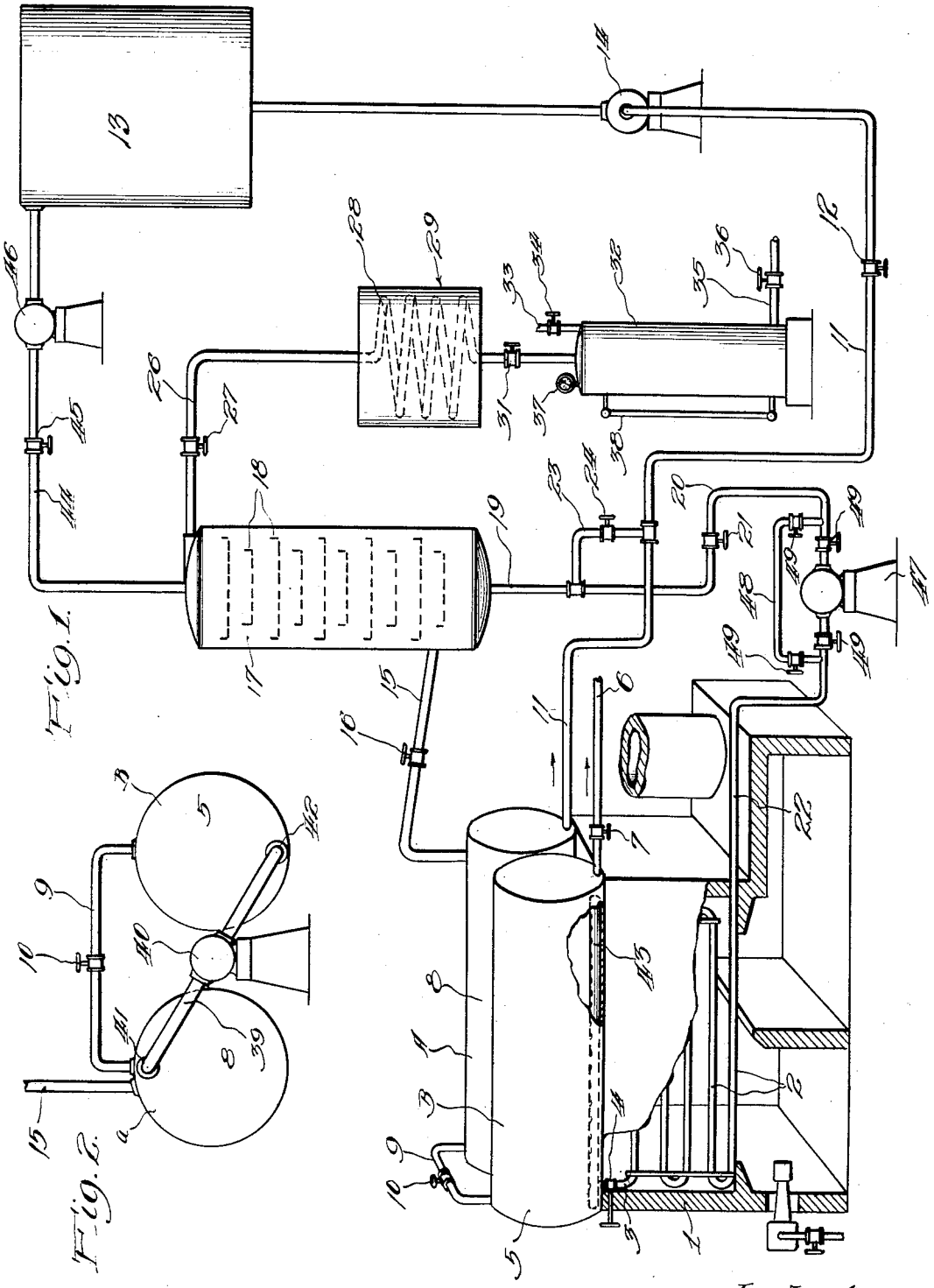

Fig. 1.

Fig. 2.

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PROCESS FOR CRACKING PETROLEUM OIL

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This invention relates to improvements in a process and apparatus for cracking petroleum oil and refers more particularly to the so-called continuous process in which the oil is heated to a cracking temperature, portions thereof vaporized and subjected to reflux condensation and the heavier or unsufficiently cracked condensate returned to the system for further treatment.

The advantages of the invention will appear from the following description and the accompanying drawing.

In the drawing:

Fig. 1 is a somewhat diagrammatic side elevation of the apparatus.

Fig. 2 is an end view of the expansion chambers.

Referring more particularly to the drawing, 1 designates a furnace in which is mounted a heating coil 2. The upper or delivery end of the heating coil 2 is connected by a transfer line 3 having a throttle valve 4, to the lower end of an expansion chamber 5, which expansion chamber may take the form of a large elongated shell. This expansion chamber 5 is provided with a residuum drawoff 6, having throttle valve 7 leading to a residuum tank. Vapors pass out of the upper end of the expansion chamber 5 into a second expansion chamber 8, which may be of the same character as the one first referred to, by means of a pipe 9 having a throttle valve 10. In this chamber 8 the heavier vapors as they pass along the length of the chamber will be condensed and may be drawn off as reflux condensate through the line 11, controlled by throttle valve 12 and led back to the raw oil tank 13. If desired, a pump 14 may be interposed in the line 11.

The uncondensed vapors pass out of the tank 8 through the vapor pipe 15 controlled by a valve 16 to the side of a dephlegmator 17. This dephlegmator may be provided with the usual baffles 18 and reflux drawoff line 19. This line 19 has a branch 20, controlled by throttle valve 21, leading to the charging line 22, connected to the coil 2. Or if desired, the pipe 19 may be connected by branch 23 to the pipe 11, the pipe 23 having throttle valve 24. The reflux condensate may thus be returned either direct to the coil 2 or back to the tank 25 or if desired, may be led elsewhere. The uncondensed vapors and uncondensable gases pass out of the dephlegmator 17 through vapor pipe 26 having a throttle valve 27, to condenser coil 28, seated in condenser box 29. The lower end of the coil is connected by pipe 30 having throttle valve 31 to the receiver 32. This receiver is provided with gas outlet pipe 33, controlled by throttle valve 34, liquid drawoff pipe 35, controlled by valve 36. It also has pressure gauge 37 and liquid level gauge 38.

Means are provided whereby the liquid oil in the first expansion or vapor chamber 5 may be agitated, both to promote vaporization and prevent settling of carbon. This may be accomplished by means of a pipe 39 (see Figure 2), in which is interposed a pump 40, the pipe 39 connected at 41 to the upper part or vapor space of the chamber 8 and at 42 to a perforated pipe 43 extending along the lower or liquid containing portion of the first expansion chamber 5. The raw oil may be fed to the system from the tank 13 by pipe 44 having a throttle valve 45, to the top of the dephlegmator 17. A feed pump 46 may be interposed in the line 44 if desired. The feed line 22 may be provided with the pump 47, which pump may be by-passed by by-pass line 48, suitable valves 49 being provided for this purpose.

In the operation of the process, the raw oil is fed into the dephlegmator and thence to the line 22 to the heating coil 2. The oil in the coil 2 may be heated to a temperature of say, 860 degrees F., using mid-continent gas oil of about 34 degrees Baumé gravity. The oil in substantially liquid form, passes to the first expansion chamber 5, where vaporization takes place. A portion of the oil is vaporized and passes into the expansion chamber 8. The vapors travel through the expansion chamber 8 and the heavier portions will be condensed and may be drawn off and returned to the tank 13. The uncondensed portions pass into the dephlegmator, where a further reflux condensation takes place. The still uncondensed portions pass into the water condenser and receiver. The

raw oil is preheated by passing through the dephlegmator and also serves to assist in condensing the unsufficiently cracked vapors. A pressure of 150 pounds may be maintained on the entire system, or if desired, differential pressure may be maintained on different parts of the system by suitably controlling the various throttle valves, heretofore referred to. Thus, a higher pressure can be maintained on the coil than on the expansion chambers and a lower pressure on one expansion chamber than on the other, and a still lower pressure on the dephlegmator and so on to the receiver.

If desired, during the treatment, vapors may be pumped from the second expansion chamber back into the first one to facilitate vaporization and also to agitate the oil. It is to be understood in this art that certain very advantageous effects are obtained by slight differences in operation, the reason for many of which effects are still unknown to those skilled in the art and I, therefore, claim all the benefits incident to this method of operation.

I claim as my invention:

1. A process for cracking hydrocarbon oil, consisting in heating an advancing stream of oil to a cracking temperature, in passing heated oil from said stream to an enlarged reaction zone wherein conversion occurs and from which no unvaporized oil is permitted to return to said stream, in passing the vapors evolved from the oil to a second enlarged zone wherein heavier fractions of the vapors are condensed, in returning a portion of the vapors from said second enlarged zone to the first enlarged zone at a point below the liquid level of the oil therein to accelerate the conversion of the oil in said first enlarged zone and to prevent excessive carbon deposition therein, and in taking off the remaining vapors from said second enlarged zone for condensation and collection.

2. A process for cracking hydrocarbon oil consisting in heating an advancing stream of oil to a cracking temperature, in admitting heated oil from said stream to an enlarged reaction zone wherein conversion occurs and substantial vaporization takes place, in passing the vapors released from the oil to a second enlarged zone, in maintaining the vapors in said second enlarged zone under a lower superatmospheric pressure than is maintained in the first enlarged zone, in forcing portions of the vapors from said second enlarged zone into the body of the liquid oil in the first enlarged zone to agitate such oil, in dephlegmating the remaining vapors issuing from said enlarged zone and in passing the reflux condensate resulting from said dephlegmation together with charging oil to said stream.

3. A continuous process for cracking hydrocarbon oil, consisting in heating an advancing stream of oil to a conversion temperature, in transferring the highly heated oil from said stream to an enlarged reaction zone, wherein substantial vaporization occurs, in passing the evolved vapors to a second zone maintained under lower pressure than said enlarged reaction zone, in passing a portion of the vapors from said second enlarged zone to a dephlegmating zone maintained under a lower pressure than said second zone, and in returning the remaining portion of the vapors from said second enlarged zone to the first enlarged zone in withdrawing unvaporized residual oil from said enlarged reaction zone to be isolated from the system, and in withdrawing reflux condensate from the dephlegmating zone to be passed together with charging oil to said stream.

4. A hydrocarbon oil cracking process which comprises heating the oil to cracking temperature under pressure in a heating zone, discharging the heated oil into a vapor separating zone and separating the same therein into vapors and unvaporized oil, passing the vapors to a third zone and partially condensing the same therein, separately removing resultant condensate and uncondensed vapors from said third zone and passing the latter to a dephlegmating zone, mixing said condensate with charging oil for the process and introducing the resultant mixture into contact with the vapors in said dephlegmating zone, supplying unvaporized charging oil and reflux condensate from said dephlegmating zone to the heating zone, introducing into the unvaporized oil in said separating zone a portion of the uncondensed vapors removed from said third zone, and finally condensing the dephlegmated vapors.

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