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PROCESS FOR CONVERTING PETROLEUM OIL

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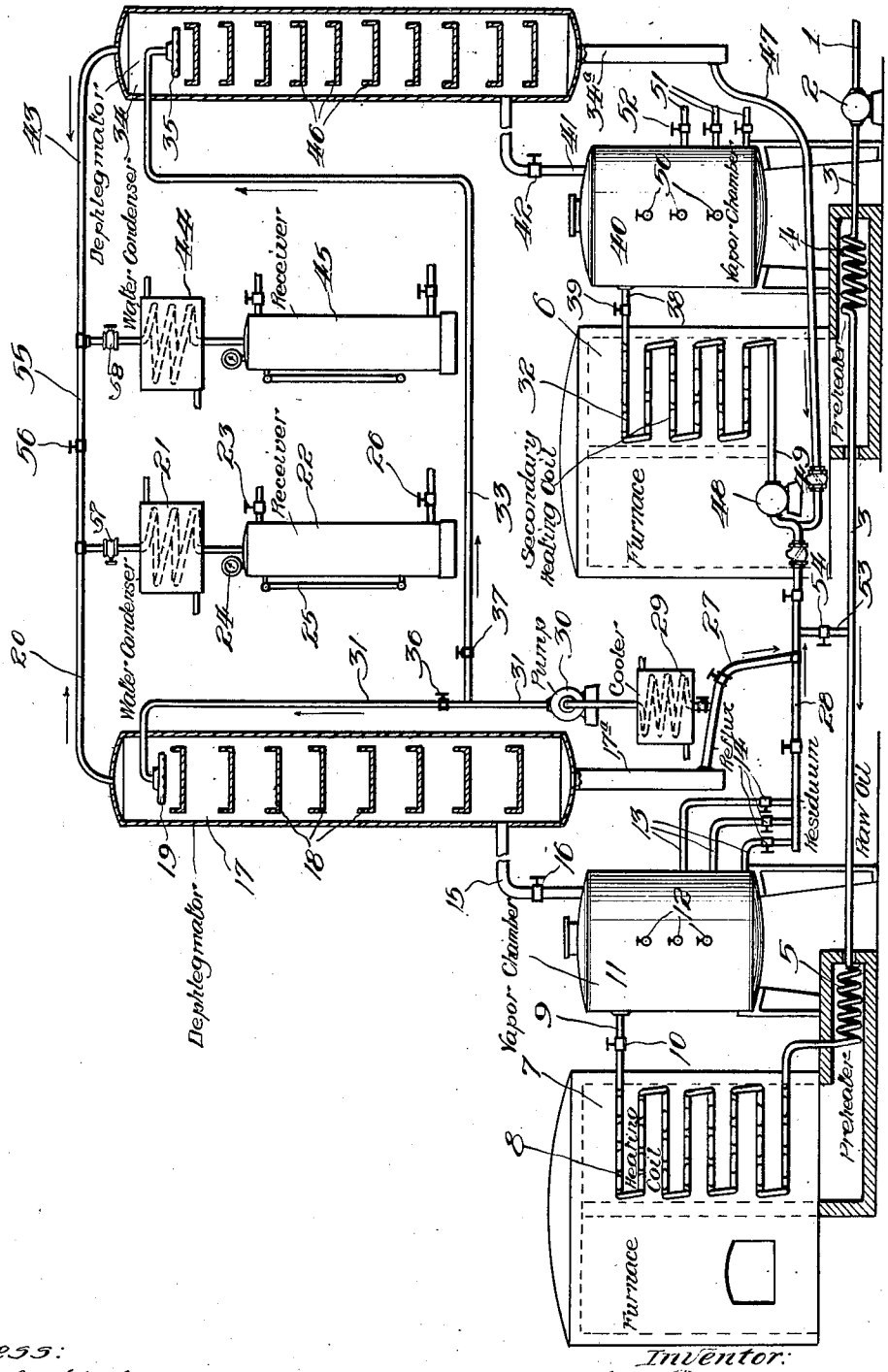

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UNITED STATES PATENT OFFICE

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PROCESS FOR CONVERTING PETROLEUM OIL

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This invention relates to improvements in a process for converting petroleum oil and refers more particularly to the destructive distillation of relatively high boiling point oils to produce oils of a lower boiling point having the characteristics of gasoline.

Among the objects of the invention are to provide a process in which the oil is treated, first, to remove the more easily cracked products by pressure distillation, and subsequently the unvaporized and reflux portions are directed to a second stage of treatment wherein a further conversion takes place.

The single figure is a diagrammatic side elevational view of the apparatus suitable for carrying out my process.

Referring to the drawing, the oil to be treated is introduced from any convenient extraneous source through the line 1 and is charged by means of the pump 2 through a line 3 which has interposed therein the preheating coils 4 and 5 positioned in the flues of the furnaces 6 and 7 respectively. The discharge end of the coil 5 connects with the heating coil 8 positioned in the furnace 7. This heating coil is connected by means of a transfer line 9 controlled by a valve 10 to a vaporizing or expansion chamber 11 which is equipped with try-cocks 12 for ascertaining the liquid level maintained therein, and residuum draw-off lines 13 controlled by valves 14.

To remove the vapors from the chamber a vapor line 15 controlled by a valve 16 is connected into the top of the chamber and communicates with the refluxing tower 17 in which are positioned baffling members or pans 18 for the purpose of causing the vapors to pass therethrough in a circuitous travel and at the same time offering the liquid refluxing agent, introduced into the top of the column through the spray pipe 19, the opportunity of intermingling more thoroughly with the vapors rising through the column.

The dephlegmated vapors pass from the top of the column through the line 20 and are subjected to a final condensing action in the condenser coil 21 after which they are collected as liquid distillate in the receiver 22, the latter being equipped with a gas relief pipe 23, pressure gauge 24, liquid level gauge 25, and a liquid draw-off valve 26. The condensate separated out in the dephlegmating column collects in the lower leg of the column designated as 17*a* and may be drawn off through the line 27 which is connected to the pipe 28 communicating with the residuum lines 13, or, it may be directed through the cooling coil 29 and charged by means of the pump 30 through the line 31 back into the top of the dephlegmator or portions recycled in this manner and the rest of the reflux permitted to continue to the pipe 28 through which it is introduced into the heating coil 32 positioned in the furnace 6.

A further disposition of the reflux condensate separated out in the column 17 is through the pipe 33 and into the top of the refluxing column 34 through the spray pipe 35. In order to do this it is necessary to close the valve 36 and open the valve 37, or by partially opening each of the valves regulated quantities of the reflux may be directed to the top of each of the dephlegmators for refluxing purposes. The cooling coil 29 is interposed in the return line to cool the refluxing medium in order that the pumping mechanism will not be subjected to excessive temperature and also for the purpose of supplying a cooler medium to the top of the dephlegmators.

This cooling coil may be cooled by water or by circulating the raw oil about the hot coil 29 containing the reflux condensate. In the drawing it is shown to be water-cooled, but by diverting the charging line to circulate the raw oil about this coil this heat could be conserved instead of being lost as it would be by water cooling.

The liquid oil drawn off from the vaporizing chamber through the residuum lines and also the reflux condensate not recycled to the top of the dephlegmating columns, are combined in the pipe 28 and directed to the heating coil 32 mounted in the furnace 6 where they are subjected to temperature and pressure conditions regulated to produce further conversion. This oil is of a relatively heavy nature, containing considerable carbonaceous material. It is therefore essential that the

oil be circulated during its heat treatment at a relatively high velocity and that the temperature and pressures maintained thereon be carefully regulated.

The oil after being heated is passed through transfer line 38 regulated by a valve 39 and is permitted to vaporize in the chamber 40 which is similar to the chamber 11.

The vaporized oil constituents separated out in the chamber 40 rise through the vapor line 41 regulated by a valve 42 and pass up through the column 34 where they are subjected to a dephlegmating action. Passing off from the top of the dephlegmator 34 the vapors are directed through the line 43 to the condenser 44, subsequent to which they are collected as distillate in the receiver 45 which is identical in construction to that shown at 22. The dephlegmation of the vapors in the column 34 is effected by recirculation of the condensate from the column 17 through the pump 30 and line 33. The vapors are also caused to follow a circuitous route through the tower due to the positioning of the pans 46 as obstructions or baffles.

The reflux products separated out in the column 34 are collected in the lower leg thereof designated as 34*a* and are drawn off through the line 47 and mixed with the liquid oil drawn off from the first stage through pipe 28. It being, of course, understood that suitable check valves are provided in pipe 28 and line 47 as shown. These combined products are pumped by means of the pressure pump 48 through the line 49 to the inlet end of the heating coil 32 where they are reheated. The chamber 40 is equipped with try-cocks 50 and residuum drawoff lines 51 controlled by valves 52.

A lead 53 regulated by a valve 54 is interposed between the line 28 and the pipe 3, by means of which the residual products may be recycled to the initial stage in place of introduction to the second stage of treatment or regulated quantities may be recycled to the initial stage, the remaining portions being retreated in the secondary stage as explained.

By means of a connecting lead 55 controlled by valve 56 and valves 57 and 58 in the lines 20 and 43 respectively, it is possible to combine portions of the vapors escaping from the separate refluxing columns.

By treating the oil in its successive stages in this manner and by recycling the reflux condensate and utilizing the same as a refluxing medium, together with the conserving of heat in the system by the preheating methods described, it is possible to relieve a charging stock of considerably greater quantities of low boiling point oils than can be produced by a single stage cracking system in which the oil is circulated but once through the system and is treated but a single time for its lighter fractions. The recirculation of the reflux condensate also effects a more complete treatment and produces a more uniform and better quality distillate in the final collecting means.

By treating a Mid-Continent gas oil of approximately 32° Baumé at temperatures ranging from 700° to 900° F. and pressures from 200 to 500 pounds per square inch, and subsequently treating the unvaporized portions, such as the residuum, and reflux condensate in a separate zone of treatment wherein temperatures and pressures may be regulated to produce the most effective conversion, a good quality distillate may be relieved in the initial stage and also in the secondary stage, producing considerably in excess of what could be separated by the conversion in the single stage. Distillates ranging from 50% to 70% of the charging stock and having comparatively satisfactory ranges of boiling points and gravity may be produced.

The process is preferably operated continuously, it being necessary only to shut down when the carbon accumulation in the expansion chambers becomes objectionable.

I claim as my invention:

1. A process for converting hydrocarbon oil consisting in heating and vaporizing the oil in a primary stage under a substantial pressure, subjecting the evolved vapors to a dephlegmating action, condensing and collecting the dephlegmated vapors, directing the reflux condensate and unvaporized oil constituents resulting from the treatment in said primary stage to a secondary stage of treatment and there subjecting the combined products to heat and pressure conditions to produce further conversion, dephlegmating and condensing the vapors evolved in the secondary conversion stage in returning the reflux condensate produced in the secondary stage for retreatment in said secondary stage, and in employing reflux condensate produced in the primary stage as a refluxing medium in both stages.

2. A process for converting hydrocarbon oil consisting in heating and vaporizing the oil under a substantial pressure, subjecting the evolved vapors to a dephlegmating action, condensing and collecting the dephlegmated vapors, directing reflux condensate and unvaporized oil constituents to a secondary stage of treatment and there subjecting the combined products to heat and pressure conditions to produce further conversion, dephlegmating and condensing the vapors evolved in the secondary conversion stage, recycling selected portions of the reflux condensate removed from the initial dephlegmating stage to the top of the initial and secondary stages of dephlegmation and maintaining regulated pressure upon the system during treatment.

3. A process of treating hydrocarbon oil consisting in passing the oil through an initial heating zone wherein it is subjected to

a conversion temperature while maintained under a substantial pressure, in discharging the oil from the heating zone into an enlarged conversion chamber wherein substantial vaporization occurs, in passing the evolved vapors to a dephlegmator, in condensing the dephlegmated vapors and in collecting the resulting distillate, in combining portions of the reflux condensate formed in said dephlegmator with unvaporized oil withdrawn from said conversion chamber, in directing portions of said combined reflux condensate and unvaporized oil to said heating zone to be passed therethrough with the incoming raw oil, in passing the remaining portions of said combined reflux condensate and unvaporized oil to and through a secondary heating zone wherein said portions are subjected to further treatment under conditions of pressure and temperature to produce additional cracking thereof, in passing the oil from said secondary heating zone to an independent conversion chamber, in dephlegmating the vapors evolved in said independent conversion chamber, in condensing and collecting the dephlegmated vapors, in returning the reflux condensate resulting from such dephlegmation to said secondary heating zone to be passed therethrough together with said reflux condensate and unvaporized raw oil from the primary zone for retreatment.

4. A process of treating hydrocarbon oil consisting in continuously passing the oil through an initial heating zone wherein the oil is subjected to a conversion temperature while maintained under a substantial pressure, in discharging the oil from said zone into an enlarged conversion chamber, in dephlegmating the evolved vapors, in condensing the dephlegmated vapors, in collecting the resulting distillate, in passing reflux condensate resulting from such dephlegmation together with the unvaporized oil withdrawn from said conversion chamber under an applied pressure to a secondary heating zone wherein the oil is subjected to conditions of temperature and pressure to produce a further cracking thereof, in discharging the heated oil from said secondary heating zone, into an independent conversion chamber, in passing the vapors evolved in said second conversion chamber to a dephlegmator, in introducing into said dephlegmator reflux condensate produced from the dephlegmation of the vapors evolved in the initial conversion chamber, to act as a dephlegmating medium, in condensing the dephlegmated vapors, in collecting the resulting distillate and in returning the reflux condensate from said dephlegmator to said secondary heating zone.

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