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PROCESS AND APPARATUS FOR CRACKING PETROLEUM OILS

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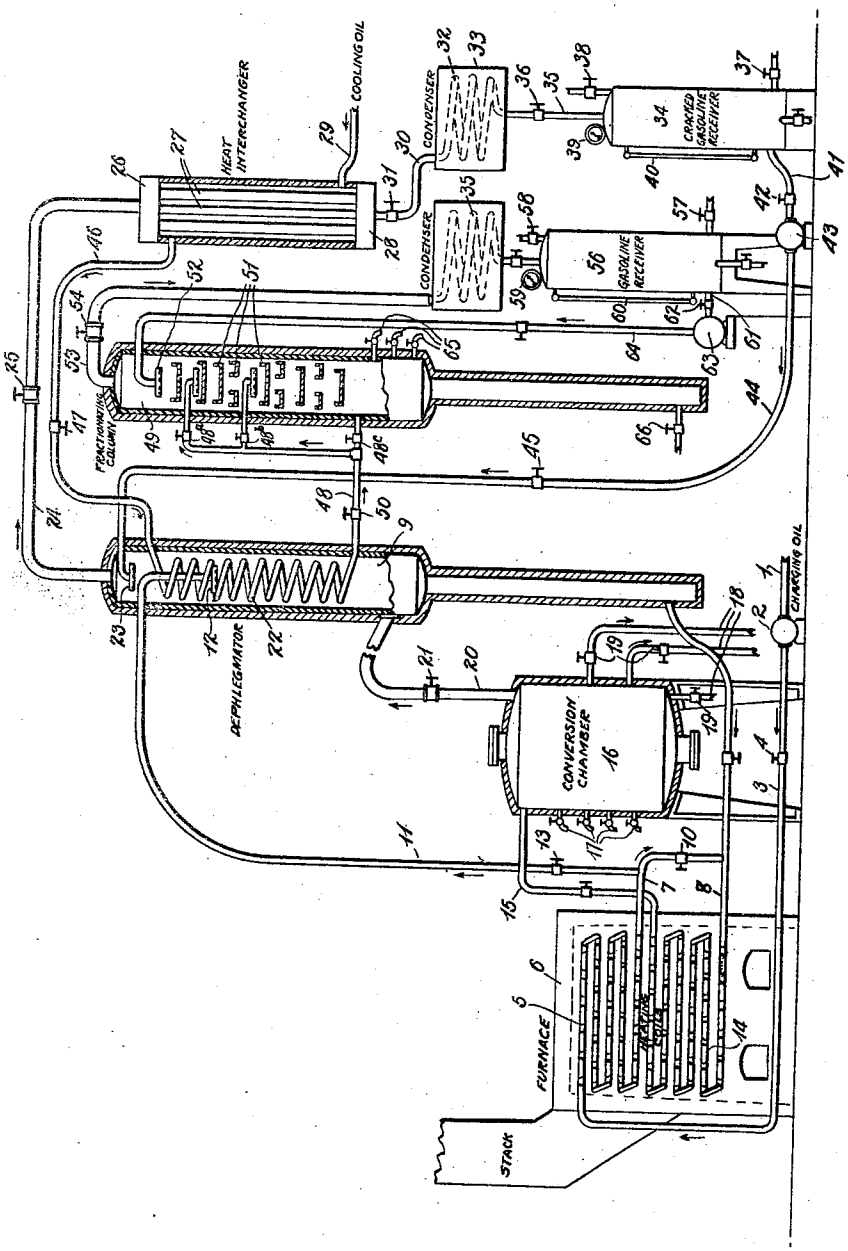

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PROCESS AND APPARATUS FOR CRACKING PETROLEUM OILS

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This application is a divisional application of my co-pending application Serial No. 603,401, filed Nov. 27, 1922, which has matured into Patent No. 1,592,560, dated July 13, 1926.

This invention relates to improvements in a process and apparatus for cracking petroleum oils and refers more particularly to a process of converting relatively high boiling point oils into oils of a lower boiling point such as gasolene and the like. Among the salient objects of the invention are to provide a process in which oils are separately charged to two distinct portions of the heating zone of a cracking apparatus and a process in which the heat given up in the dephlegmation of the oil vapors evolved in the cracking operation are used to volatilize an extraneous oil which is passed through the portion of the apparatus in which the vapors undergo dephlegmation and condensation.

The single figure is a diagrammatic side elevational view of the apparatus with parts broken away and parts in section.

Referring to the apparatus and the manner in which oil is coursed therethrough, there is supplied an oil charge from any convenient source through the line 1 which is pumped by means of a charging pump 2 through the line 3 controlled by a valve 4 to the preheating tubes 5. These preheating tubes are positioned in the upper or cooler portion of the furnace and utilize the heat of the waste combustion gases, relieving them of heat which would normally be lost. The oil after passing downwardly through this continuous coil which runs longitudinally of the furnace 6, is directed from the discharge end of the coil through the line 7 which is connected to a line 8 which returns the reflux condensate from the lower leg of the dephlegmator 9. In this line 7 is positioned a valve 10 by means of which the oil may be permitted to pass to the line 8 or be directed into the pipe 11 which terminates in the form of a spray 12 in the upper portion of the dephlegmator 9, thus the preheated oil may be supplied directly to the second section of the heating tubes through the line 8 or utilized as a refluxing medium in the dephlegmating column. If the oil is directed through the line 7 to the line 8 by closing the valve 13 and opening the valve 10 the preheated oil will be coursed through the second section 14 of the heating coils positioned in the lower or hotter portion of the furnace 6 and there be raised to a conversion temperature. This heated oil in a conversion state passes thence through the transfer line 15 to the expansion or conversion chamber 16 which is fitted with trycocks 17 by means of which may be ascertained the liquid level in the chamber at all times. The chamber is heavily insulated to prevent loss of heat through radiation and is provided with the liquid residuum draw-off lines 18 controlled by valves 19. These lines may be successively used as the carbon collects in the bottom of the chamber for drawing off the unvaporized relatively heavy residual substances from the chamber. The vapors evolved from the body of oil in the expansion chamber pass off through the vapor line 20 regulated by a valve 21 and rise through the dephlegmating column 9 where they are subjected to the refluxing action of the relatively cool oil passing through the coil 22 and also by coming in intimate contact with cooler oil introduced by the spray pipes 12 and 23, the spray pipe 12 may be employed for introducing the preheated oil from the upper tubes of the furnace and the spray 23 for returning portions of the liquid distillate from the final collecting tank as will hereinafter be explained. The uncondensed vapors passing off from the top of the dephlegmating column are directed through the line 24 controlled by valve 25 to the upper drum 26 of a heat interchanger. In this heat interchanger the vapors are passed first from the upper drum through connecting tubes 27 to the lower drum 28 while there is circulated about the connecting tubes 27 relatively cool oil introduced through a line 29. From the lower header 28 the condensed and uncondensed oil constituents pass down through the pipe 30 controlled by a valve 31 and circulate through the condensing coil 32 positioned in the water condenser box 33.

After passing through this final stage of condensation the liquid distillate is collected in the receiving tank 34 which communicates

with the discharge end of the condenser coil by means of a pipe 35 regulated by a valve 36. The receiving tank 34 is equipped with a liquid draw-off valve 37, a pressure relief valve 38, pressure gauge 39 and a liquid level gauge 40. A second liquid drawoff line 41 in which is interposed a valve 42 communicates with the suction side of the pump 43 by means of which the liquid distillate collecting in the receiving tank may be returned through the line 44 controlled by a valve 45 and introduced by means of the spray 23 into the top of the dephlegmating column.

The oil introduced through the line 29 may be a separate or extraneous oil from that undergoing treatment in the process above described. This extraneous oil is preheated by circulation about the tubes 27. This oil is then drawn off from the upper part of the preheater through the line 46 regulated by a valve 47 and is circulated through the closed coil 22 positioned in the dephlegmating column 9. In this portion of the apparatus this extraneous oil serves as a dephlegmating medium and absorbs the heat given up by the vapors passed to the dephlegmating column 9 from the chamber 16. This heat is normally sufficient to raise the extraneous oil to a volatilizing temperature, the character of such oil and the amount introduced through the line 29 being regulated to effect these results to the extent desired. This heated fluid oil is passed through the transfer line 48 conected to the discharge end of the coil 22 and is introduced into the fractionating column 49 through either of the secondary connections 48*a*, 48*b* or 48*c*. The passage of the oil constituents through the fractionating column 49 is interrupted by a series of perforated pans 51, causing an increased dispersion of the oil and there may be also introduced to the column and brought in intimate contact with these vapors a liquid distillate introduced by the spray pipe 52. Thus the vaporous constituents evolved from such extraneous oil are subjected to a refluxing action and subsequent thereto pass off through the vapor line 53 in which is interposed a valve 54 to the condensing coil 55. After being condensed therein they are collected as liquid distillate in the receiving tank 56. This tank similarly to the tank 34 is equipped with a liquid draw-off valve 57, a pressure relief valve 58, pressure gauge 59, and liquid level gauge 60. The distillate may be returned from this tank by means of a pipe 61 controlled by a valve 62 and recharged into the top of the fractionating column 49 through the pump 63 and return line 64. Try-cocks 65 are positioned in the lower portion of the fractionating column 49 for determining the liquid level therein. A lower draw-off valve 66 connected to any convenient storage is utilized to control this liquid level. If desired, this liquid collected in the fractionating column may be returned and charged with the oil to the heating tubes 5 or 14.

As explained the partially expended gases in the furnace are used to preheat the incoming charging oil which is then united with the reflux condensate and subjected to a conversion temperature while flowing through the hottest portion of the furnace or a further preheating of the charging oil may be effected by diverting this preheated oil into the top of the dephlegmating column and there bringing it into intimate contact with the heated oil vapors. In this latter operation oil subsequent to being introduced to the dephlegmating column will flow back with what reflux condensate it may collect and be charged to the section 14 of the heating coil in the furnace. Further utilization of the heat given up by the vapors in the dephlegmating column 9 is effected by supplying this heat to the extraneous oil charged first to the heat interchanger through line 29 and then circulated through a closed coil 22 in the dephlegmating column 9. In the heat interchanger the temperature of the oil is substantially raised so that its circulation through the dephlegmating column will serve to raise the temperature of the oil to its evaporating temperature. This evaporation may or may not be accompanied by more or less conversion or cracking.

The secondary system may be utilized in topping crude petroleum, redistillation, or for the treatment of different types of oils with provision subsequent to treatment for collecting separately the distillates of unlike character produced in the separate system.

The process is therefore economical to operate and oils of different characters may be treated in the same apparatus without mixing. Further, the control which may be had by manipulation of the valves in the connecting lines between the different stages serves to materially improve the character of the reaction and the quality of the distillate obtained.

Having thus described my invention, what I claim is:

1. An apparatus for cracking hydrocarbon oil comprising an enlarged chamber within which a body of oil is adapted to be maintained under cracking conditions of temperature and pressure, a reflux condenser, means for conveying vapors evolved from the oil from said enlarged chamber to said reflux condenser, a heating coil disposed within a furnace, means for introducing incoming charging oil to a section of the heating coil disposed in the coolest portion of the furnace, means for conveying reflux condensate from said reflux condenser to a section of the heating coil disposed in the hottest portion of the furnace, and means for uniting the charging oil subsequent to its flow through the section

of the coil positioned in the coolest portion of the furnace with the reflux condensate entering the section of the coil positioned in the hottest portion of the furnace, and means for conveying the heated charging oil and reflux to said enlarged chamber.

2. An apparatus for cracking oil comprising a heating zone, a conversion zone, and a dephlegmator serially connected, a heat interchanger, means for conveying vapors from said dephlegmator through said heat interchanger, a final condenser for vapors passing through said heat interchanger, means for conveying cool oil through said heat interchanger out of contact with the vapors therein, means for conveying such oil subsequent to its passage through said heat interchanger through a closed conduit disposed within said dephlegmator where the oil absorbs heat from the vapors undergoing dephlegmation, an independent fractionating column, means for conveying the oil subsequent to its passage through said closed conduit into said fractionating column wherein the lighter constituents of the oil vaporize, and means for maintaining independently regulated pressures in said dephlegmator and said fractionating column.

3. A process for treating hydrocarbon oils consisting in charging one oil to a heating zone of a cracking process wherein said oil is raised to a conversion temperature, in thence delivering such oil to a conversion zone wherein substantial vaporization occurs, in thence passing the vapors to a dephlegmator wherein the insufficiently cracked vapors are condensed forming reflux condensate, in passing the dephlegmated vapors from said dephlegmator through a heat interchanger and in thereafter condensing the dephlegmated vapors and collecting the resulting distillate, in simultaneously flowing a second oil through but out of contact with the vapors in said heat interchanger, in then passing such second oil in heat interchange relation to but out of physical contact with the vapors undergoing dephlegmation in said dephlegmator, in thereafter delivering said second oil to a separate fractionating column, and in maintaining a superatmospheric pressure on the oil undergoing conversion while maintaining a lower pressure in said fractionating column.

4. A process for heat treating hydrocarbons comprising initially introducing the hydrocarbons to that portion of a heating coil positioned in the coolest part of a furnace, causing the oil to pass through the coil in a direction countercurrent to the flow of the heating gases in the furnace during a substantial portion of the heat treatment, thereafter causing the oil to flow through said heating coil in the same direction of flow as the heating gases through a hotter portion of the furnace wherein it is heated to a cracking temperature, delivering the heated oil constituents to an enlarged reaction chamber, subjecting vapors evolved from the oil to reflux condensation, uniting reflux condensate separated from the vapors with the oil flowing only in the same direction as the heating gases in the furnace, and maintaining a superatmospheric pressure on the oil undergoing treatment in the process.

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