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PROCESS FOR TREATING HYDROCARBON OIL

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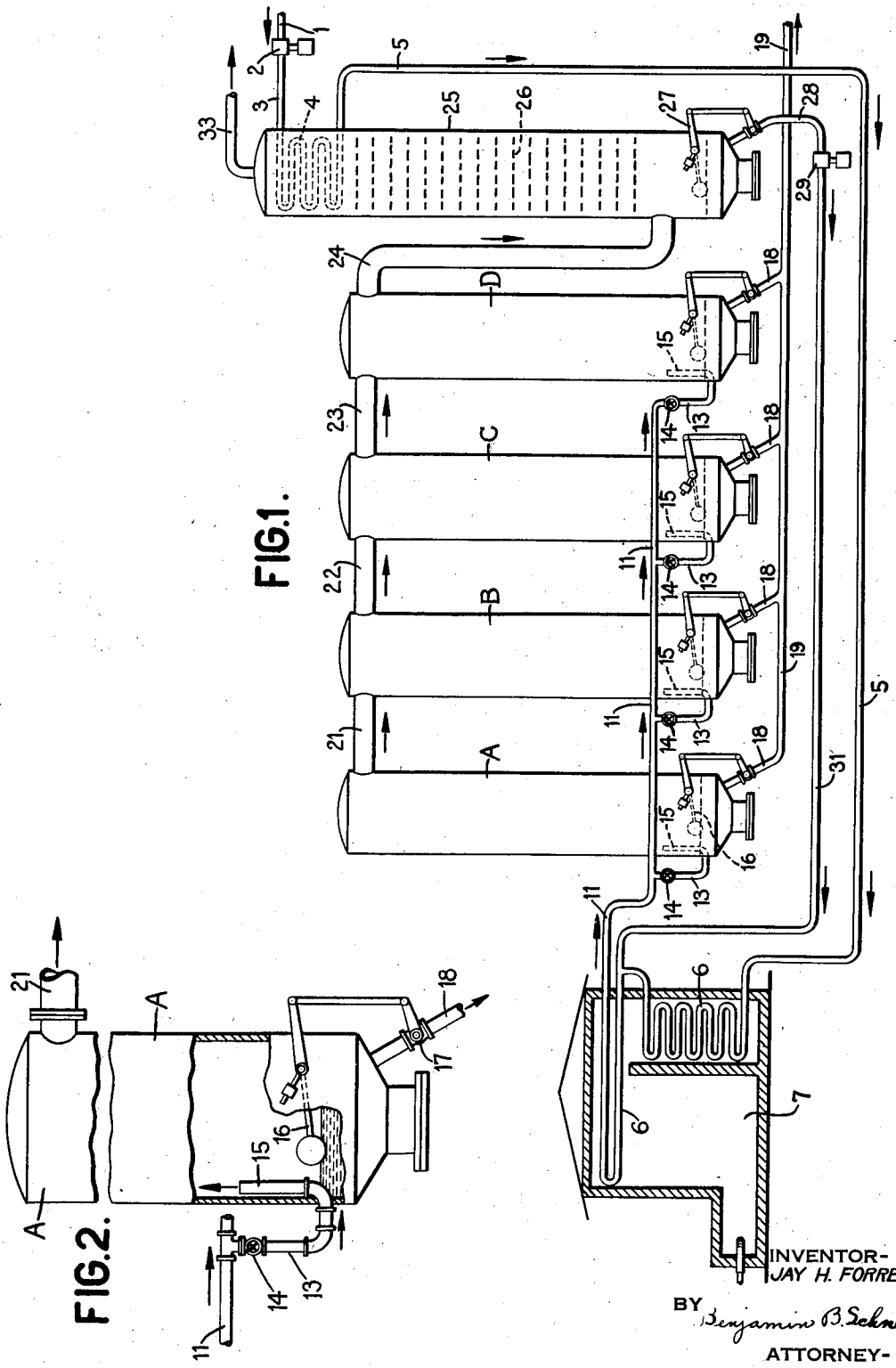


FIG.1.

FIG.2.

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PROCESS FOR TREATING HYDROCARBON OIL

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1 Claim. (Cl. 196—58)

My invention relates to the art of pyrolytic conversion or cracking of petroleum oils and the like and has for an object the provision of a process of and apparatus for cracking relatively high boiling oils, such as gas oil, into lower boiling products, the process and apparatus being particularly adapted to produce a satisfactory yield of gasoline products having a high anti-knock value when used as motor fuel, and being capable of employment for extended periods of time with high operating efficiencies and a minimum of operating difficulties.

My invention has for further objects such additional improvements in operative advantages and results as may hereinafter be found to obtain.

My invention is particularly adapted to be employed in conjunction with a method of cracking hydrocarbon oil, designated generally as "low-liquid-level" operation, in which an oil is heated to cracking temperature under pressure, as, for example, while in transit through a pipe coil, and the resultant cracked products are delivered to one or more enlarged stills or reaction chambers from which vapors and liquids are separately removed, the latter at a rate sufficient to maintain the bulk of the material within the chamber or chambers in the form of vapors and to prevent the accumulation of more than small amounts of liquid in the bottom of the chamber or chambers. The vapors thus withdrawn are fractionated to recover a heavy fraction and a lighter fraction therefrom, the heavy fraction being recycled through the cracking zone if desired, while the liquid products, or tar, removed from the reaction vessel or vessels may be withdrawn from the system.

By means of my present invention, prior operating difficulties are overcome. Cracking is successfully carried out principally in the vapor phase to give cracked distillate having an improved anti-knock value, while avoiding excessive coke formation in the reaction chambers and maintaining high yields and high operating efficiency.

According to my invention the stills or vapor chambers are substantially unobstructed internally and are as free as possible from intruding surfaces upon which carbon or coke is likely to accumulate. The stills or chambers are operated either under such conditions that the liquid levels therein are located at very low points or in such a manner that there is substantially no liquid level in any of the stills or chambers, materials in the liquid phase either being removed as fast as formed or evaporated in the course of the process.

The heated partially cracked products from the pipe coil are discharged into the interior or interiors of the still or stills in an upward direction, preferably by means of a vertically disposed conduit terminating a short distance above the liquid level within the still or a little above the bottom of the still, but in any event discharging upwardly into that portion of the still which is occupied by materials in the vapor phase.

Provision is made for withdrawing vapors from the upper portion of the still or stills and for removing tar or other liquid products from the bottom of the same. The vapors are subjected to fractional condensation in the usual manner and all or a portion of the heavier condensate may be recycled for further treatment.

In order that my invention may be clearly set forth and understood, I now describe, with reference to the drawing accompanying and forming a part of this specification, a preferred form and manner in which my invention may be embodied and practiced. In this drawing,

Figure 1 is a somewhat diagrammatic elevational view of apparatus for cracking petroleum oil constructed in accordance with my present invention; and

Figure 2 is a view, partly in elevation and partly in vertical section, of a portion of the apparatus shown in Figure 1, on an enlarged scale.

Similar reference numerals designate similar parts in each of the views of the drawing.

Referring now to the drawing, the oil to be cracked, for example, a gas oil, is introduced from a suitable source (not shown) through a conduit 1, and is forced by a pump 2 through a conduit 3, a heat-exchange coil 4 and a conduit 5 into a pipe coil 6 located within a suitable heating furnace 7, where the oil is heated to a cracking temperature, for example, a temperature of 895° F. The heated oil then passes through a transfer line 11 to a plurality of insulated reaction chambers or stills A, B, C, and D, being introduced into the bottoms of the stills A, B, C, and D through branch conduits 13 having valves 14 and terminating in vertically disposed conduits 15 located within the interiors of the stills A, B, C, and D.

In the preferred instance, each of the stills A, B, C and D is provided with a device 16 associated with a valve 17 in an outlet pipe 18 for maintaining a predetermined liquid level in the bottom of the corresponding still and the upper ends of the conduit 15 terminate a short

distance above the liquid levels determined by the devices 16. I have found that a distance of three feet in a still forty feet high gives satisfactory results insofar as the specific operating instance set forth herein is concerned.

It will be observed from the drawing that the connections between the pipes 13 and the transfer line 11 are such that the material flowing from the coil 10 enters the stills A, B, C, and D in parallel, the valves 14 being operated in such a manner as to secure satisfactory distribution of the preheated material to the several stills, and preferably in such manner as to maintain the temperatures in the several stills A, B, C, and D substantially the same. Tar or other residual liquid is removed from the bottom of the stills A, B, C, and D through the outlets 18 which may lead, as shown, to a manifold line 19, while vapors are removed from the tops of the stills A, B, C and D. In the specific instance illustrated, the means for removing the vapors comprises vapor conduits 21, 22 and 23 connecting the tops of the several stills in series and a vapor conduit 24 leading to a bubble tower or fractionating tower 25 in the upper portion of which is located the heat-exchange coil 4. The interior of the tower 25 is provided with suitable fractionating means such as bubble-cap plates or trays 26, screen plates, "disk-and-doughnut" trays or the like.

As the vapors pass up through the tower 25, fractionation takes place under the influence of cooled reflux oil condensed by contact of the hot vapors with the coil 4 and limited fractional condensation of the vapors is effected. A float device 27 may be provided in the bottom of the tower 25 for maintaining a suitable liquid level, and condensate or backtrap from the bottom of the tower 25 may be recycled through a conduit 28, a pump 29 and a conduit 31 to the coil 6 or a portion thereof for further cracking treatment.

Uncondensed cracked distillate vapors reaching the top of the tower 25 are removed through the vapor line 33 and pass to whatever condensing equipment may be provided for them.

In one instance extremely successful results were obtained in the treatment of gas oil derived from a Mid-Continent crude, which gas oil had a specific gravity of 26° A. P. I. This gas oil was brought to a temperature of 895° F. at the outlet of the coil 10. The coils 6 and 10, the stills A, B, C, and D and the tower 26 were maintained under a pressure of about 310 pounds per square inch. Temperatures of 860° F. and 840° F. were maintained in the bottoms and tops, respectively, of the stills A, B, C, and D, while temperatures of 800° F. and 550° F. were maintained in the bottom and top outlet, respectively, of the tower 25.

Operating under these specific conditions, it was found that the naphtha or gasoline produced was considerably improved in anti-knock quality with respect to previous operations in which the treatment of materials in the stills A, B, C, and D was carried out largely in the liquid phase. Thus, naphtha having an octane number 71 was produced as compared with naphtha having an octane number of 63 produced in previous "high-liquid-level" operations. Naphtha produced according to the process of my invention contained as much as 50% of unsaturates and aromatics as compared with naphtha containing 40% of such constituents obtained in previous operations. No appreciable effect upon the treating characteristics of the naphtha was observed.

It was also found that, in comparison to previous "high-liquid-level" operations, the amount of gasoline produced was substantially unchanged although a smaller quantity of tar was produced by my process.

All of these advantageous results were obtained without substantial decrease in efficiency of operating time and without excessive coke formation or high maintenance cost.

It will be obvious to those skilled in the art that while I have described my invention hereinabove with respect to a particular operation and embodiment, it is susceptible of considerable variation. Thus, my invention is adapted to be used in conjunction with various types of cracking equipment other than that specifically shown and described hereinabove. Moreover, while the specific arrangement of the soaking vessels or stills illustrated is preferred, it is not absolutely essential that a plurality of stills be employed nor that the stills be arranged in parallel with respect to the flow of the products from the heating coil or other preheating apparatus.

Furthermore, as has been indicated hereinabove, the still or stills may be so operated that there is substantially no liquid level therein, liquid oil being removed as fast as it separates, without permitting any accumulation thereof in the still vessel or vessels.

My invention is, therefore, not limited to all the specific details of the illustrative example or examples set forth hereinabove, but may variously be embodied and practiced within the scope of the claim hereinafter made.

I claim:

The method of converting hydrocarbon oil into lower-boiling products which comprises heating a hydrocarbon oil to cracking temperature under superatmospheric pressure while in transit through a heated pipe coil, discharging the stream of highly heated products therefrom into the lower portion of an elongated interiorly unobstructed vertically disposed reaction space wherein said products undergo cracking under said pressure by their contained heat, separately removing vapors from the upper portion of said space and passing them to a suitable condensing operation, and withdrawing liquid products from the lower portion of said reaction space at a rate sufficient to prevent the accumulation of liquid therewithin above a predetermined level in the lower portion thereof, the said stream of highly heated products from said coil being discharged vertically upwardly into said reaction space at a point substantially immediately above the point of maximum liquid level therein.

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