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PETROLEUM REFINING

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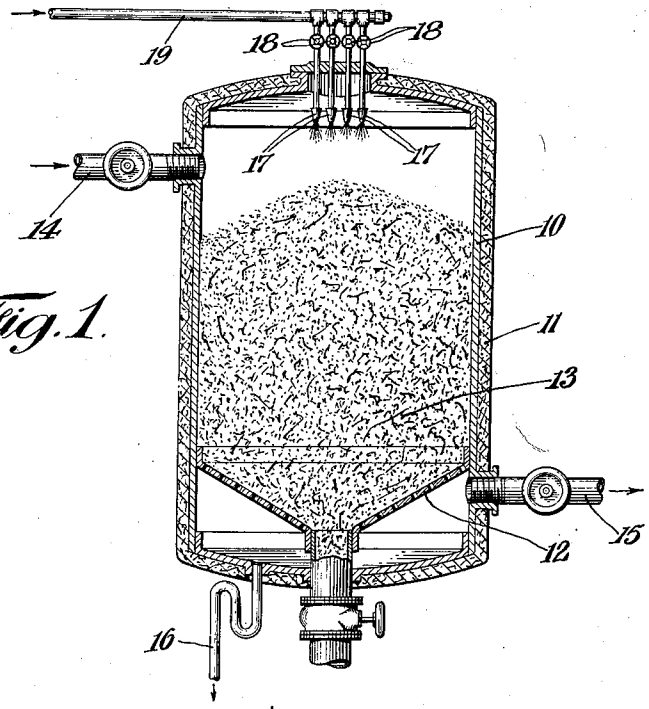

Fig. 1.

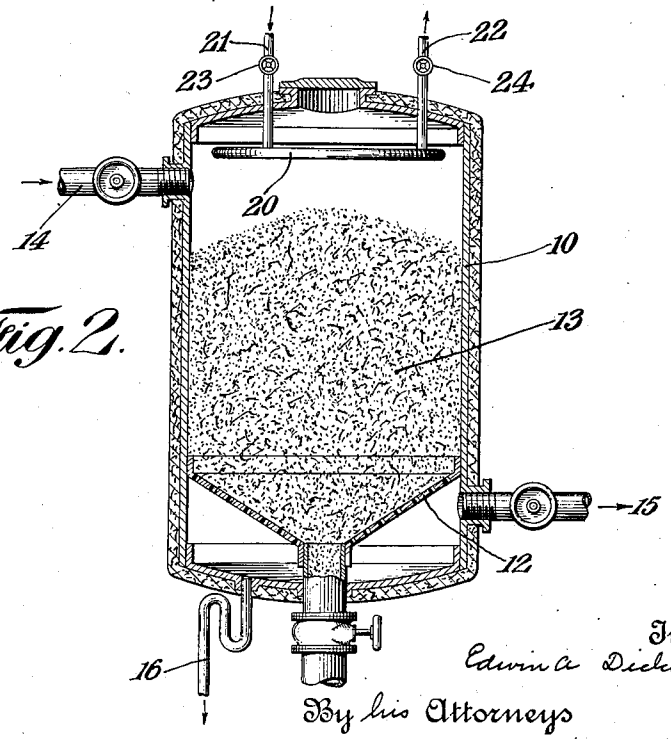

Fig. 2.

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UNITED STATES PATENT OFFICE

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PETROLEUM REFINING

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This invention relates to petroleum refining and particularly to the treatment of cracked petroleum products in vapor phase with solid adsorptive materials and has for an object an improvement in the method of refining cracked petroleum products by such treatment.

It is well known that cracked petroleum products intended for use as motor fuel must be treated or refined in order to eliminate certain deleterious constituents thereof before such cracked petroleum products are suited for use. One method of effecting this treatment is to pass the cracked petroleum products in vapor phase into contact with a solid adsorptive catalyst which has the property of selectively polymerizing the less stable hydrocarbons present. The polymers thus formed are separated from the remaining vapors by virtue of their higher boiling points and are removed as liquids while the refined vapor is collected and condensed in the conventional manner. The reaction of polymerization is exothermic and, as a result, the treated vapor often leaves the tower at a higher temperature than that of the entering vapor. The temperature rise is most marked when the catalyst is fresh and usually diminishes during the course of a run, although the refining of the vapor continues.

In some cases the rise in temperature of the vapor during treatment is accompanied by an increase in its final boiling point. Thus, in some cases, gasoline vapor having a final boiling point of 437° before treatment has been so modified during the treating process that its final boiling point is 460° or even higher during the period immediately following the introduction of fresh adsorptive material into the treating tower. The gasoline produced during this period which sometimes lasts for 48 hours, is difficult to market and is usually blended with gasoline of lower final boiling point which results in an obvious economic waste.

The improved method of refining which is the object of this invention eliminates the temperature rise above referred to and results in a product having its final boiling point substantially the same as that of the vapor prior to treatment.

There seems to be no entirely satisfactory explanation from the theoretical standpoint of the increase in the final boiling point of the treated product. It seems, however, in some way to be connected with the exothermic reaction and with the increased temperature of the treated vapor and may be due to the failure of the polymers produced to condense completely at the higher temperature. Whatever the cause may be, I have found that the rise in final boiling point can be prevented by introducing into the treating tower during the initial period referred to, a liquid, preferably previously treated distillate of approximately the same boiling range as the desired product. This may diminish the intensity of the exothermic reaction or it may simply reduce by heat transfer the amount of temperature increase without in any way effecting the intensity of the reaction itself. However, in whatever way it acts, it accomplishes the desired result.

Other objects, novel features, and advantages of this invention will be apparent from the following specification and accompanying drawings wherein:—

Figure 1 discloses one form of apparatus for carrying out the process and

Figure 2 discloses an apparatus for carrying out the process in a slightly modified manner.

The treating tower 10 is provided with a layer 11 of heat insulating material and with a fluid permeable shelf 12 which supports bed 13 of solid adsorptive catalytic material. Vapor to be treated is introduced into the tower 10 through the inlet 14 and treated vapor is removed through the outlet 15. Polymers and other liquid material produced in the tower are collected in the bottom thereof and are drawn off through the trapped outlet 16. In the top of the tower 10 there are provided a plurality of nozzles 17 connected through valves 18 with a pipe 19. By means of the pipe 19 liquid may be introduced into the tower through the nozzles 17, the flow being controlled by means of the valves 18.

After the tower has been charged with the solid adsorptive material 13, such for example as fuller's earth, the cracked vapor to be treated is introduced through the inlet 14 and caused to pass through the treating material. The action of the fuller's earth on such vapor is to polymerize unstable, unsaturated constituents into higher boiling substances which normally condense and are drawn out through the outlet 16. They may then be returned to a part of the cracking system or removed and handled separately.

The refined vapor leaves the treating tower through the outlet 15 and may be collected and condensed in the usual manner. When the catalytic material is fresh the presence of a considerable exothermic reaction may be noted by thermometers above and below the catalyst of which the latter will have the higher reading. During this period the condensed treated product has a higher final boiling point than the entering vapor. If, as soon as the issuing vapor is found to have a higher temperature than the entering vapor, sufficient liquid be introduced through the nozzles 17 to cause the bottom temperature to approach that of the entering vapor, the increase in final boiling point is checked. I prefer, for this purpose, to use a product refined in previous operations although other liquids, particularly other hydrocarbons, may be used with satisfactory results.

It is, of course, apparent that high boiling liquid so used will remain liquid whereas low boiling liquid will be vaporized, but in any event, the liquid introduced takes up heat from the vapor undergoing treatment. As an example, the following instance may be cited: In a treating tower directly connected with a cracking unit, a fresh charge of fuller's earth ordinarily results in a final boiling point of the treated vapors of 450°, while that of the incoming vapor is 410°. This condition customarily lasts approximately 58 hours in the particular apparatus referred to, and is accompanied by a temperature rise of 10° in the vapor during treatment. Vapor was introduced into the treating tower at a rate corresponding to 12 barrels of liquid per hour and to overcome the temperature increase during the first 48 hours of the run 80 gallons of condensed gasoline were sprayed per hour into the top of the treating tower. This cut down the temperature of the issuing vapor and also caused the final boiling point of the product to be reduced to that of the incoming vapor.

In Figure 2 there is disclosed a similar treating tower 10 having an insulating covering 11 and a fluid permeable shelf 12 upon which is supported a bed of catalytic material 13. The vapor inlet is designated 14 and the vapor outlet 15, while the liquid outlet is designated 16. In the top of the tower 11 there is provided a coil 20, having inlet and outlet pipes 21 and 22 respectively controlled by valves 23 and 24. By passing a coiling fluid or liquid through a coil 20, the portion of the vapor in the tower 10 may be condensed to provide a liquid for effecting the reduction in temperature of the treated vapor as described in connection with Fig. 1. The liquid thus provided acts in the same way as the liquid introduced through nozzles 17 and has the advantage that it is produced within the tower and to a certain extent simplifies the operation.

The cracked petroleum products may be supplied directly from the cracking operation while still in vapor phase to the refining operation or cracked petroleum products obtained from the cracking operation may first be condensed and then subsequently revaporized for the refining operation. The claims are intended to cover refining cracked petroleum products irrespective of whether the vapor of such products is passed directly from the cracking operation to the refining operation without condensation or whether the vapor is obtained by re-run distillation of cracked petroleum products after condensation.

It is of course understood that various modifications may be made in the process above described, without in any way departing from the spirit of the invention as defined in the appended claims.

I claim:—

1. In the process of refining cracked petroleum products by contact in vapor phase with solid adsorptive polymerizing material and wherein, during a period when the adsorptive polymerizing material is fresh, the issuing vapor normally is of higher boiling range than the entering vapor, the step which comprises passing liquid hydrocarbons with the vapor through said polymerizing material during such period and regulating the supply of liquid hydrocarbons to maintain the boiling range of the issuing vapor substantially the same as that of the entering vapor.

2. In the process of refined cracked petroleum products by contact in vapor phase with solid adsorptive polymerizing material and wherein, during a period when the adsorptive polymerizing material is fresh, the issuing vapor normally is of higher temperature than the entering vapor, the step which comprises mixing liquid hydrocarbons with the vapor to be treated, passing the mixture through the adsorptive polymerizing material during such period and regulating the supply of liquid hydrocarbons to maintain the issuing vapor at a temperature only slightly, if any, in excess of the entering vapor.

3. In the process of refined cracked petroleum products by contact in vapor phase with solid adsorptive polymerizing material and wherein the reaction is excessively exothermic

when the adsorptive polymerizing material is fresh, the step which comprises adding to the vapor under treatment liquid hydrocarbons during the period that the reaction is excessively exothermic and regulating the supply of liquid hydrocarbons to maintain the boiling range of the issuing vapor substantially the same as the entering vapor.

4. In the process of refining cracked petroleum products by contact in vapor phase with solid adsorptive polymerizing material and wherein the reaction is excessively exothermic when the adsorptive polymerizing material is fresh, the step which comprises passing condensate of the vapor through the adsorptive polymerizing material with the vapor during the period that the reaction is excessively exothermic and regulating the supply of condensate to maintain the issuing vapor at a temperature only slightly, if any, in excess of the entering vapor.

In testimony whereof, I have signed my name to this specification.

EDWIN A. DICKINSON.