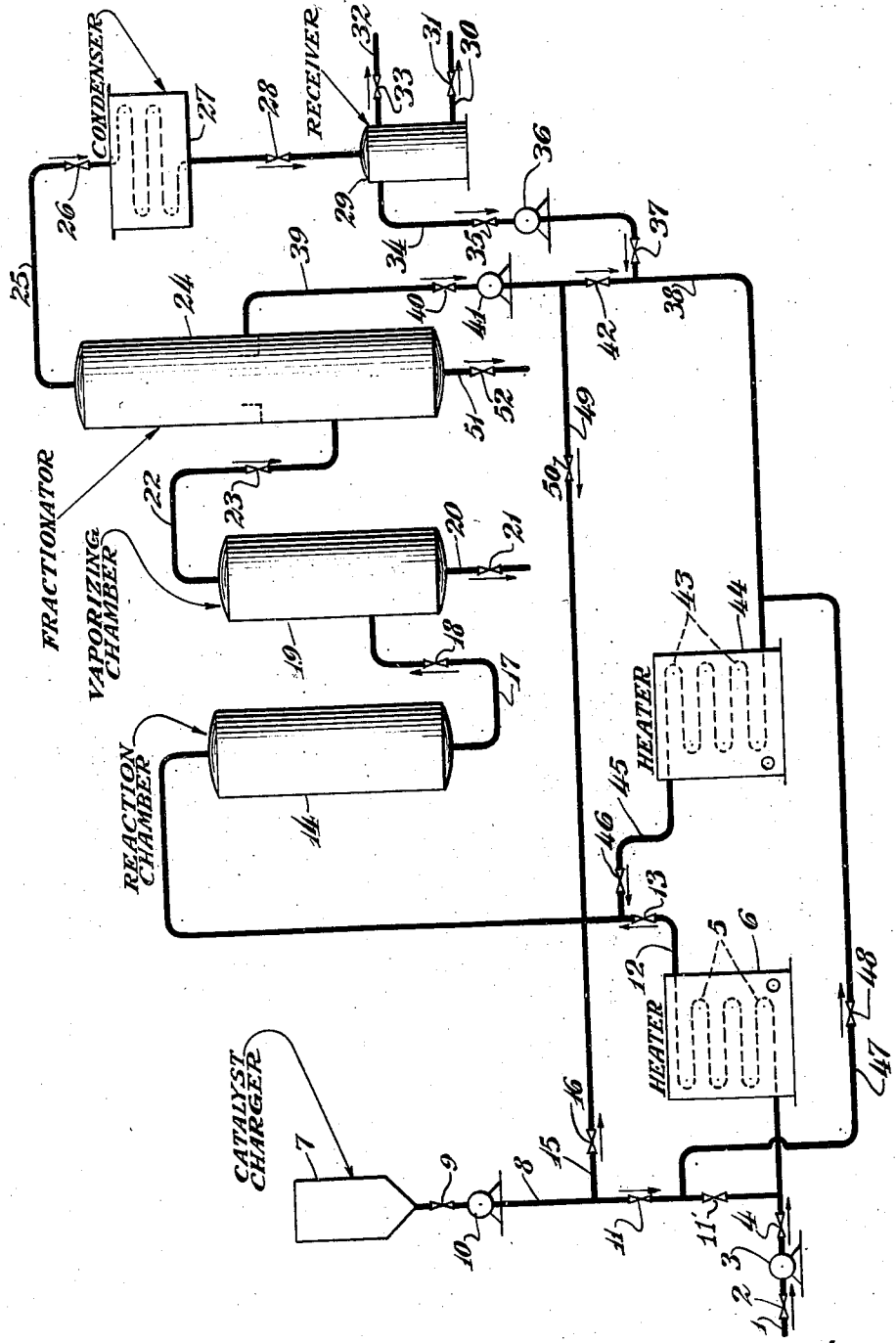
Oct. 26, 1943. G. EGLOFF 2,332,562

CONVERSION OF HYDROCARBONS

Filed May 27, 1940



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Patented Oct. 26, 1943

2,332,562

UNITED STATES PATENT OFFICE

2,332,562

CONVERSION OF HYDROCARBONS

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Application May 27, 1940, Serial No. 337,359

2 Claims. (Cl. 196—52)

This invention relates to a process for converting hydrocarbon oil into substantial yields of high antiknock gasoline. More particularly it relates to cracking hydrocarbon distillates in the presence of a powdered cracking catalyst under conditions adequate to produce high antiknock gasoline for use in motor fuels or as aviation gasoline.

In one specific embodiment the present invention comprises mixing a hydrocarbon oil with a powdered cracking catalyst, heating the mixture at cracking conditions of temperature and pressure, separately heating recycle oil and/or process gases in the presence of an additional portion of said cracking catalyst, mixing the reactants with those from the first step, adding thereto an additional quantity of powdered cracking catalyst, passing the mixture to a reaction zone followed by a vaporizing zone, recovering gasoline, gas and recycle oil, and returning a portion of the recycle oil and gas as previously described.

The invention is further understood by reference to the accompanying drawing which is diagrammatic and should not be construed as limiting it to the exact conditions described therein.

Hydrocarbon oil which is suitably a distillate fraction such as gas oil, kerosene distillate and the like is introduced through line 1, valve 2, pump 3 and valve 4, passing to coil 5 which is disposed in heater 6. The temperature maintained in this coil is within the range of 500–1200° F. at pressures of substantially atmospheric to 1000 pounds per square inch. Catalyst powder as such or in the form of a slurry in a part of the charge or a fraction of reaction products or other suitable carrier, is introduced from catalyst charger 7 through line 8 containing valve 9, pump 10, valve 11 and valve 11', mixing with the charging stock in line 1. The mixture passes from coil 5 through line 12 and valve 13 to reaction chamber 14. An additional quantity of the catalytic agent is introduced through line 15 containing valve 16. The reaction products in line 12 are commingled with recycle oil and/or process gases from coil 43 whereby the temperature may be increased if desired by heating the incoming hydrocarbons to a higher temperature than is used in coil 5. Alternatively, colder oil from line 49 may be introduced to regulate the temperature of the combined reactants, when, for example, it is desired to continue the conversion in reactor 14 at a lower temperature than in the cracking coils. This permits great flexibility to the process from an operating standpoint. The reaction mixture from chamber 14 passes through line 17 and valve 18 to vaporizing chamber 19. Residual oil containing catalyst in suspension is removed through line 20 and valve 21. A vaporous fraction is passed through line 22 and valve 23 to fractionator 24 from which gasoline and gas are removed through line 25, valve 26, condenser 27 and valve 28 to receiver 29. Gasoline is recovered through line 30 and valve 31, being passed to a suitable stabilizer not shown. A portion of the process gases may be withdrawn through line 32 and valve 33. The process gases may be further treated by polymerization and/or alkylation processes to produce additional yields of gasoline. A part of the receiver gases may be passed through line 34 containing valve 35, pump 36 and valve 37 to line 38 wherein they may be commingled with a light recycle oil from line 39 containing valve 40, pump 41 and valve 42. The mixture passes through line 38 to coil 43 which is disposed in heater 44. The mixture may be heated to cracking conditions of temperature and pressure of the order of approximately 800–1200° F. and passed through line 45 and valve 46, joining with line 12 and mixing with the reactants therein as previously described. Alternatively, an additional quantity of catalyst may be introduced through line 47 and valve 48.

As a further alternative, the gas alone may be passed through coil 43 as described and part or all of the reflux may be passed through line 49 and valve 50 to line 12 where it acts as a quench and thus serves as a means of decreasing the temperature of the reaction products to a desired point. This may be done when it is desired to bring the temperature within the range of approximately 500–850° F. under which conditions the fresh catalyst added from line 15 serves to bring about the conversion of olefin hydrocarbons in the gasoline so that the finished gasoline may be substantially olefin-free. When operating in this way, the temperatures maintained in coils 5 and 43 are normally in excess of approximately 900° F. whereby an olefin-containing gasoline of high antiknock value is produced. Higher boiling fractionator bottoms may be withdrawn from fractionator 24 through line 51 and valve 52 to be further cracked or to be used as a fuel oil.

The catalytic agents employed in the present process are preferably those known as silica-alumina, silica-zirconia and silica-alumina-zirconia. This type of catalytic agent is prepared

by the separate or simultaneous precipitation of the components under conditions such that a powdered material of particle size approaching colloidal dimensions is produced. The material is washed until substantially free of alkali metal ions and may be dried prior to introduction into the system. The catalyst may be introduced as a dry powder or as a slurry in a part of the oil undergoing conversion, or in a part of the reaction products or any other suitable carrying medium. The quantity of catalyst used may vary from approximately 0.1–20% by weight of the oil and is normally within the range of approximately 0.5–10% of the oil. The catalyst may be recovered and reactivated by treatment with an oxygen-containing gas under conditions such that the carbonaceous and hydrocarbonaceous deposits are burned. The temperature of reactivation should be kept at a point below 1500° F. and preferably below 1200° F.

The following examples are given to illustrate the practicability of the invention but should not be construed as limiting it to the exact conditions given therein.

Example I

A Mid-Continent gas oil may be converted in the manner described using a silica-alumina powder employing a temperature in the gas oil conversion step of approximately 1000° F. and a temperature of 1100° F. in the gas conversion coil 43. No recycle oil or catalyst is employed in coil 43. Sufficient side cut may be added to the combined feed line 12 so that a temperature of approximately 750° F. is maintained in the reaction chamber. Approximately 1% of catalyst by weight of the charging stock is used, half of this being introduced into the combined feed line by way of line 15. A total yield of approximately 68% of 78 octane number gasoline substantially free of olefin hydrocarbons may be obtained in this manner.

Example II

The Mid-Continent gas oil of Example I may be treated at 1025° F., the side cut and gas being heated to 1100° F. and the reactor maintained at 975° F., temperature being controlled by adding a small amount of quench oil from line 49 to the combined feed line. When a total of 2% of catalyst is used, being introduced to both coils and the combined feed line, a yield of 71% of 79.5 octane number gasoline, olefinic in character, is obtainable. By stabilizing the gasoline to 7 pounds Reid vapor pressure and polymerizing the olefins in the stabilizer gases, an additional quantity of gasoline of 83 octane number may be obtained.

I claim as my invention:

1. A process for the conversion of hydrocarbon oil which comprises adding fresh powdered siliceous cracking catalyst to said oil, passing the mixture in a confined stream through a heating zone and therein heating the same to a cracking temperature, commingling additional fresh powdered siliceous cracking catalyst with the stream of reaction products leaving said heating zone, supplying the resulting mixture to a reaction zone and therein continuing the conversion, separating cracked vaporous and non-vaporous residue containing the powdered catalyst from the resultant conversion products, fractionating said cracked vapors to separate therefrom as reflux condensate fractions higher boiling than gasoline, cooling and condensing the fractionated vapors, separating normally gaseous materials from the resulting distillate, adding additional fresh powdered catalyst to at least a portion of the normally gaseous materials, heating the mixture of gases and catalyst to conversion temperature and introducing the heated mixture into said reaction zone.

2. A process for the conversion of hydrocarbon oil, which comprises adding a fresh powdered siliceous cracking catalyst to said hydrocarbon oil, passing the mixture in a confined stream through a heating zone and therein heating the same to a cracking temperature, commingling additional fresh powdered siliceous cracking catalyst with the stream of reaction products leaving said heating zone, supplying the resulting mixture to a reaction chamber and therein maintaining the same at cracking temperature, separating non-vaporous liquid residue containing the powdered catalyst from cracked vapors, fractionating the cracked vapors to separate as reflux condensate fractions higher boiling than gasoline, separately heating said reflux condensate to a conversion temperature and subjecting the same to further conversion in said reaction chamber, cooling and condensing the fractionated vapors, separating normally gaseous hydrocarbons from distillate, combining fresh catalyst with said normally gaseous hydrocarbons and subjecting the mixture to heating with said reflux condensate.

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