

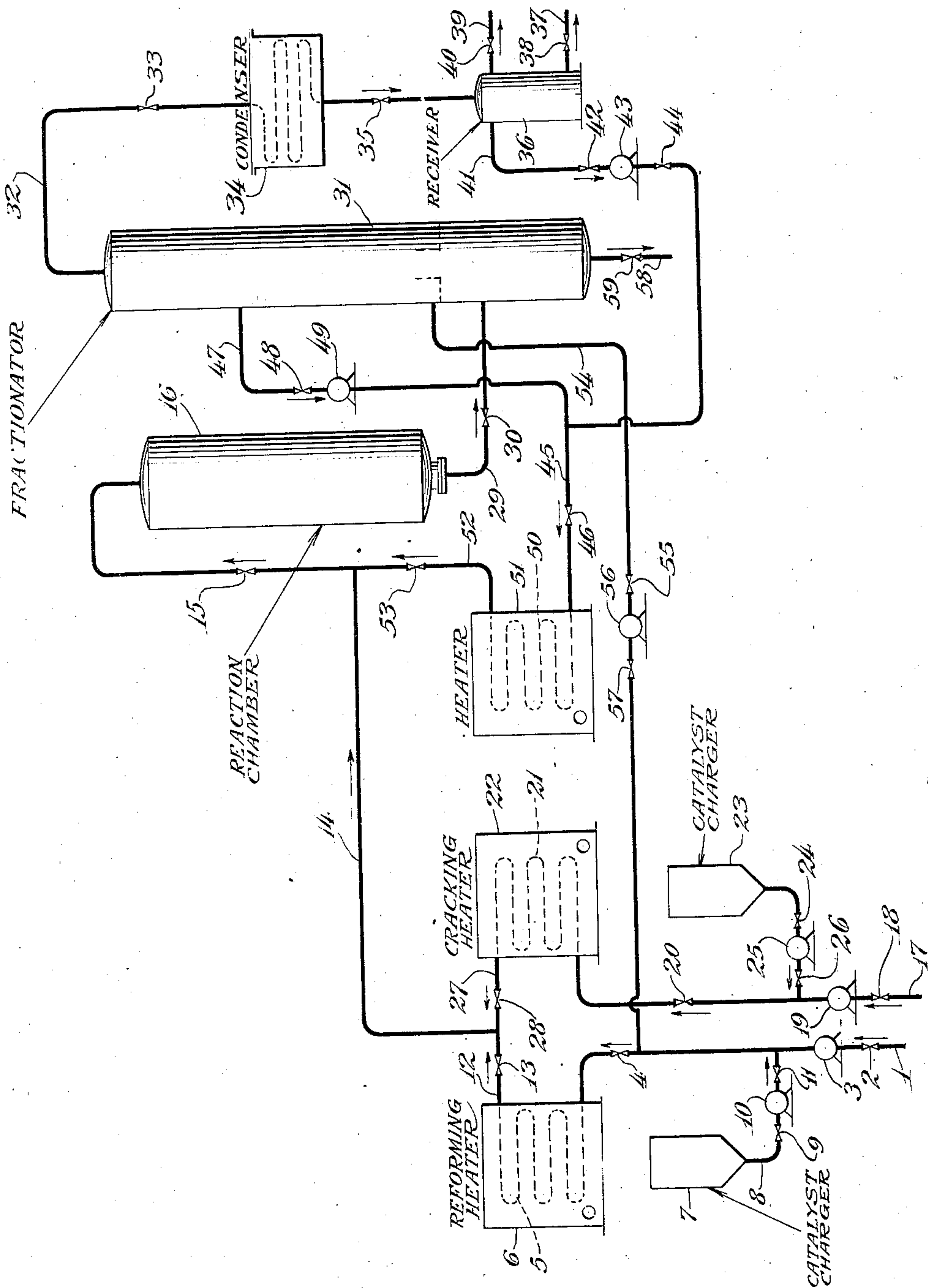
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CONVERSION OF HYDROCARBONS

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CONVERSION OF HYDROCARBONS

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4 Claims. (Cl. 196—52)

This invention relates to a process for converting hydrocarbon distillate into high yields of antiknock gasoline by subjecting them to the action of catalytic agents. More particularly it relates to a combination process for reforming naphthas and cracking higher boiling distillate fractions of petroleum to produce motor fuel. Although the charging stocks contemplated in the present invention are normally from petroleum sources, it is within the scope of the invention that similar stocks from other sources should be treated.

In one specific embodiment the present invention comprises a process for converting hydrocarbon oil into high antiknock gasoline which comprises converting a naphtha fraction of said hydrocarbon oil in a primary step with or without the addition of a catalytic agent, converting higher boiling hydrocarbon oil into gasoline in the presence of a cracking catalyst powder in a secondary cracking step, non-catalytically converting light reflux and process gas produced as hereinafter described in a tertiary step, combining the reaction products in a reaction zone, fractionating said reaction products, recovering gasoline, supplying light reflux and gas to the tertiary cracking step as described, and returning a portion of higher boiling reflux for further conversion in said primary step.

The invention is further understood by reference to the accompanying drawing which is diagrammatic and should not be interpreted as limiting the process unduly.

A naphtha charging stock is introduced through line 1, valve 2, pump 3 and valve 4 to coil 5 which is disposed in reforming heater 6. The temperature in the coil is within the range of 900–1200° F. and at a pressure of substantially atmospheric to 1000 pounds per square inch or higher. The conditions used depend to a certain extent upon the charging stock undergoing conversion and as to whether thermal non-catalytic or catalytic reforming is being used. If a catalyst is to be employed, somewhat lower temperature conditions can be maintained in the reforming coil if desired. When using a catalyst, it is introduced from catalyst charger 7 through line 8, valve 9, pump 10 and valve 11, passing through line 1 to coil 5. The character and composition of the catalyst may vary considerably. Suitable catalysts will be described in more detail in a later section. The reaction products pass through line 12 and valve 13 to line 14 and thence through valve 15 to reaction chamber 16. Higher boiling hydrocarbon oil charging stock such as gas oil,

kerosene distillate, wax distillate and the like is introduced through line 17, valve 18, pump 19 and valve 20 to coil 21 which is disposed in heater 22. The oil is mixed with catalyst from charger 23, passing through valve 24, pump 25 and valve 26 to line 17. The catalyst may be in the form of a slurry in a portion of a charging stock or other suitable medium. Considerable cracking occurs in coil 21 which is maintained at temperatures within the range of approximately 500–1200° F. and pressures of substantially atmospheric to 1000 pounds per square inch. The reaction products pass through line 27 and valve 28, joining with the reaction products from coil 6 in line 14. The temperature conditions in reactor 16 are within the range of approximately 500–1000° F., although somewhat higher temperatures may also be employed. The reaction products containing catalyst in suspension pass through line 29 and valve 30 to fractionator 31. Gas and gasoline pass through line 32, valve 33, condenser 34, valve 35 to receiver 36. The gasoline is recovered through line 37 containing valve 38 and may be withdrawn to storage or such additional treatment as may be necessary to produce finished product. A portion of the gas may be passed through line 39 and valve 40 to a suitable gas recovery system not shown. A portion of the gas is passed through line 41, valve 42, pump 43 and valve 44 to line 45 and valve 46. It is mingled with a light reflux boiling substantially above the gasoline range, entering from line 47 through valve 48 and pump 49. The mixture is passed to coil 50 which is disposed in heater 51. The mixture passes through line 52 and valve 53 to line 14 and is thus returned to reactor 16. The temperature and pressure conditions maintained in coil 50 are adequate to obtain substantial conversion of the hydrocarbon oil being within the range of approximately 900–1200° F. and a pressure of 100–1000 pounds per square inch or higher. A heavy reflux is removed through line 54, valve 55, pump 56 and valve 57, passing to line 1 and thus being recycled for further conversion. A residual fraction is withdrawn from fractionator 31 through line 58 and valve 59. This fraction contains spent catalyst in suspension and the catalyst may be recovered therefrom and reactivated by treatment with an oxygen-containing gas under conditions adequate to remove carbonaceous and hydrocarbonaceous deposits.

The catalytic agents employed in the present process are varied in composition and include such materials as naturally-occurring earths which have been activated by treatment with acids.

Another type of catalyst, which is preferred in the cracking step, is the so-called silica-alumina, silica-zirconia, silica-alumina-zirconia, etc., type of catalyst which may be used alone or may have promoting oxides of metals such as chromium, molybdenum, tungsten, vanadium, uranium, thorium, titanium, etc., deposited thereon. These composites are made by the separate or simultaneous precipitation of the components under such conditions that a substantially sodium ion-free composite is prepared. The catalyst particles are preferably of colloidal dimensions. Another type of catalyst comprises a relatively inactive carrier having supported thereon promoting oxides of the elements appearing in the left-hand columns of groups IV, V and VI of the Periodic Table. These materials are also prepared in an extreme state of subdivision. These catalysts may be used alone or in admixture, but all of the possible catalysts among those mentioned are not necessarily equivalent and identical results may not be obtained by the substitution of one for another. Moreover, certain of the catalysts are more active for the cracking step and certain others for the reforming step, and it is within the scope of the invention that different catalysts should be used in each of these steps.

The following example is given to illustrate the usefulness and practicability of the process, but should not be construed as limiting it to the exact conditions or catalysts given therein.

A Mid-Continent gas oil and naphtha are cracked according to the present process, using a sodium ion-free silica-alumina catalyst having deposited thereon a minor amount of chromium oxide; the same type of catalyst being used in both the cracking and the reforming steps. The reforming step may be carried out at 1100° F. and the cracking step at 1000° F., both being at approximately 2500 pounds per square inch pressure. The thermal cracking step in which gas and light reflux is cracked is carried out at 1050° F. and 500 pounds per square inch pressure. The pressure maintained in the reaction chamber is approximately 20 pounds per square inch. A total yield of approximately 70% of 400° F. end-point gasoline having an octane number of 78 may be obtained in this way. Additional quantities of gasoline are obtainable by polymerizing a portion of the gases withdrawn from the process.

I claim as my invention:

1. A process for the conversion of hydrocarbon oil which comprises subjecting a naphtha to catalytic reforming in the presence of a powdered dehydrogenating catalyst suspended therein, subjecting a gas oil to catalytic cracking in the presence of a powdered cracking catalyst suspended therein, combining conversion products containing the catalysts from both steps, subjecting the mixture to continued conversion in a reaction chamber, separating the resulting conversion products into liquid residue containing the catalysts and cracked vapors, fractionating said cracked vapors to form light and heavy reflux condensates, recovering the fractionated vapors, returning the heavy reflux condensate to the reforming step, thermally cracking said light reflux condensate, and supplying cracked products from the thermal cracking step to said reaction chamber.

2. The process of claim 1 further characterized in that the fractionated vapors are subjected to cooling and condensation, the resulting distillate and undissolved and uncondensed gases collected and separated, and said undissolved and uncondensed gases supplied to the thermal cracking step.

3. A conversion process which comprises subjecting a relatively light hydrocarbon oil containing naphtha fractions to catalytic reforming in the presence of a dehydrogenating catalyst suspended therein, independently subjecting a heavier hydrocarbon oil to catalytic cracking in the presence of a cracking catalyst suspended therein, combining conversion products and catalysts from the conversion steps, subjecting the mixture of hydrocarbon conversion products to continued conversion in the presence of the mixed catalysts, fractionating resultant vaporous conversion products to separate a gasoline boiling range fraction and to condense as reflux condensate fractions higher boiling than said gasoline fraction, and supplying at least a portion of said reflux condensate to the catalytic reforming step.

4. The process of claim 3 further characterized in that the fractions higher boiling than gasoline are condensed as light and heavy reflux condensate fractions and the heavy reflux condensate fraction is supplied to the catalytic reforming step.

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