

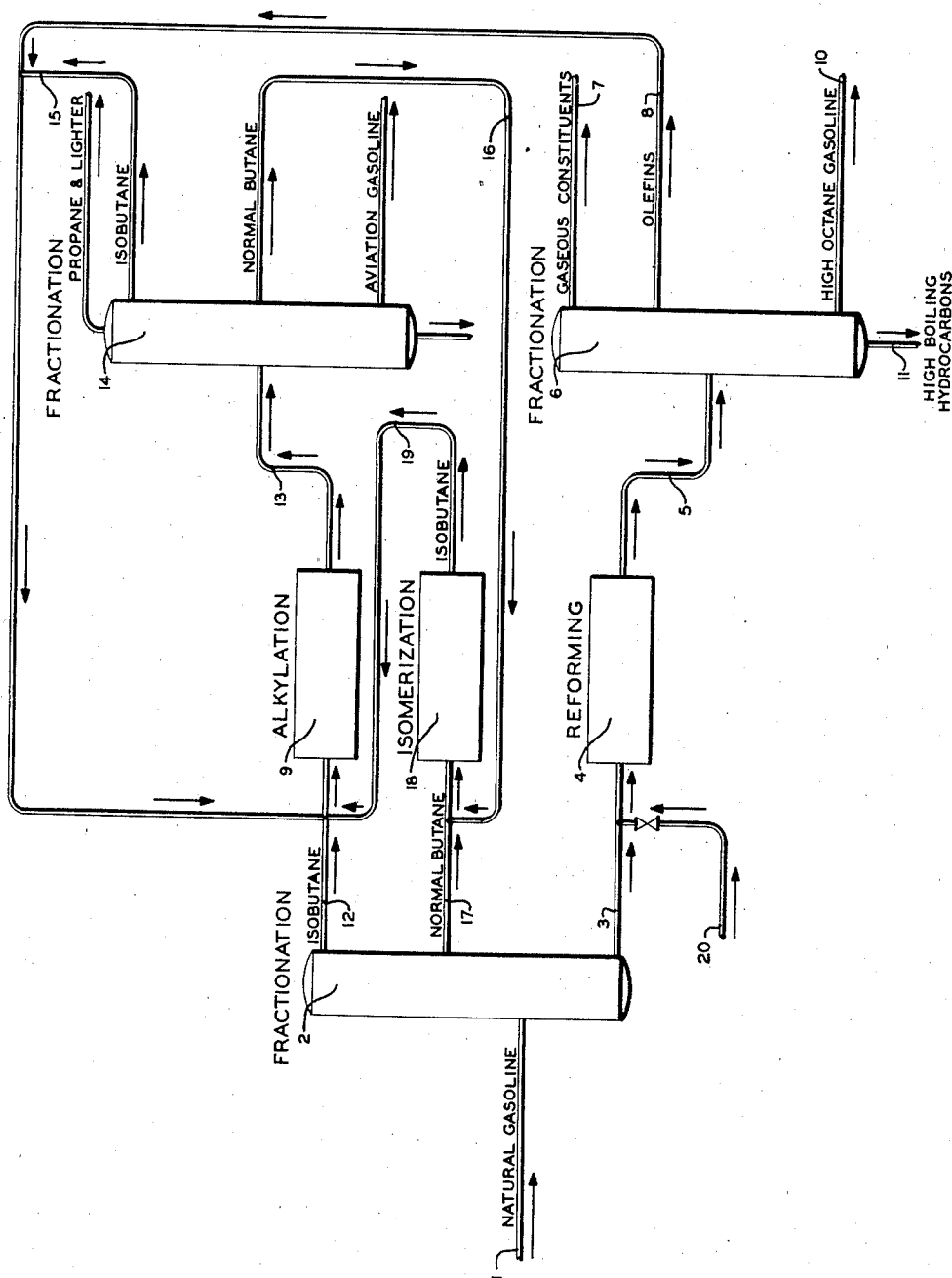
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L. C. KEMP

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MANUFACTURE OF MOTOR FUEL

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LEBBEUS C. KEMP
INVENTOR

BY *A. J. Dearborn*
Daniel Stuyker
HIS ATTORNEYS

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MANUFACTURE OF MOTOR FUEL

Lebbeus C. Kemp, Port Arthur, Tex., assignor to
The Texas Company, New York, N. Y., a corporation of Delaware

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This invention relates to the conversion of lower molecular weight hydrocarbons to higher molecular weight hydrocarbons and has to do particularly with a process for the simultaneous production of a relatively high octane motor fuel and a high octane aviation gasoline.

Broadly, the invention contemplates a process for the conversion of natural gasoline hydrocarbons to high octane motor fuel hydrocarbons, which involves separating a fraction comprising butanes from natural gasoline and subjecting the higher boiling constituents of the gasoline to thermal conversion for the production of olefin hydrocarbons. The olefin hydrocarbons comprising C₃ and C₄ hydrocarbons are removed from the products of conversion, leaving a fraction comprising hydrocarbons suitable as motor fuel of relatively high anti-knock value. The olefin hydrocarbons are subjected to alkylation with isobutane derived from the butane fraction of the natural gasoline to produce aviation gasoline of high anti-knock value.

The butane fraction of natural gasoline comprises both normal butane and isobutane and, therefore, the invention contemplates subjecting the normal butane to isomerization for the production of isobutane, which is subsequently alkylated with the olefin hydrocarbons produced in the thermal conversion step.

In order to describe the invention more fully reference will now be made to the accompanying drawing comprising a flow diagram illustrating a general method of flow for the process of this invention.

Referring to the drawing, natural gasoline is conducted from a source, not shown, through a pipe 1 communicating with a fractionating unit 2. The natural gasoline may be comparatively free from propane and lighter hydrocarbons and may contain around 20-40% of normal and isobutanes.

This gasoline is subjected to fractionation so as to separate therefrom separate fractions respectively rich in normal butane and isobutane. In the event that the feed gasoline contains propane and lighter hydrocarbons provision may be made for removing all or a portion of these lighter hydrocarbons as a separate fraction in the fractionation unit 2.

The fraction comprising hydrocarbons of higher molecular weight than butane is removed from the lower portion of the fractionation unit 2 through a pipe 3 leading to a reforming unit 4, which may be of either the thermal or catalytic type. In the unit 4 the hydrocarbons are sub-

jected to cracking temperatures which may range from around 950° to 1050° F., for example, and while under pressure which may range from around 50 to 1000 pounds per square inch gauge.

The conditions of temperature and pressure, as well as duration of temperature treatment in the unit 4, are regulated so as to realize the desired degree of conversion of saturated hydrocarbons to olefin hydrocarbons and particularly C₃ and C₄ olefins.

Additional saturated hydrocarbon feed may be drawn from an extraneous source, if necessary, through a pipe 20 communicating with the inlet to the reforming unit 4.

The products of conversion are passed from the unit 4 through a pipe 5 to a fractionation unit 6. The products are there subjected to fractionation to remove gaseous constituents, including fixed gases, propane and the like, which are drawn off through a pipe 7. If desired, the low-boiling hydrocarbons drawn off at this point may be subjected to further treatment, such as catalytic polymerization for the production of polymer gasoline.

A further fraction is produced from the unit 6 comprising C₃ and C₄ hydrocarbons, a large proportion of which are olefin hydrocarbons. This fraction is drawn off through a pipe 8 leading to an alkylation unit 9 to which reference will be made below.

The high boiling constituents of the products of conversion from the unit 4 may be withdrawn from the fractionation unit 6 through a pipe 10 and will comprise gasoline hydrocarbons of relatively high anti-knock value; for example, having an octane value of around 75-85 (C. F. R. M.). The fractionation is advantageously controlled so as to produce a fraction having a boiling point not in excess of around 395 or 400° F. If, as a result of the reforming step, higher boiling hydrocarbons are present, these may be removed as a separate fraction through a pipe 11.

The isobutane fraction produced from the fractionation unit 2 is conducted through a pipe 12 to the alkylation unit 9 already referred to and to which the olefin hydrocarbons from the pipe 8 are introduced. During alkylation these hydrocarbons are subjected to contact with an alkylation catalyst such as concentrated sulfuric acid or a liquid prepared by completely saturating water at about room temperature with boron trifluoride.

The alkylation unit may comprise a single reaction stage or a plurality of such stages such as described, for example, in my pending appli-

cation, Serial No. 238,715, relating to a method for manufacture of anti-knock hydrocarbons. It is to be understood, however, that the specific manner in which the reaction is effected, as well as the operating conditions employed, may be varied so as to produce the results particularly desired.

Where sulfuric acid is the alkylation catalyst it is desirable to use an acid having a concentration of around 90-100% and, preferably, about 94-98% H_2SO_4 . The temperature of the alkylation reaction may range from around 0-120° F., but advantageously is about 60-90° F.

Sufficient pressure is employed to maintain the reacting liquids in the liquid phase. The ratio of isobutane to olefins in the mixture entering the alkylation unit is at least about 1:1 and preferably about 3:1 to 5:1. The ratio of acid to total hydrocarbons in the reactor may be around 0.5 to 2.0 parts by volume of acid to one hydrocarbon.

The products of the alkylation reaction, after having been neutralized, are conducted through a pipe 13 to a fractionation unit 14. This fractionation is for the purpose of removing propane and lighter constituents which may be present, as well as for the removal of unreacted isobutane and normal butane. The fractionation may be regulated so as to produce a gasoline fraction suitable as aviation motor fuel as, for example, having an end boiling point of around 311° F. with an octane rating of around 90 or above.

The unreacted isobutane is recycled through a pipe 15 to the alkylation unit 9. The normal butane fraction produced from the unit 14 is conducted through pipe 16 communicating with a pipe 17 through which the normal butane fraction produced from the fractionation unit 2 passes to an isomerization unit 18.

In the unit 18 the normal butane is subjected to contact with an isomerization catalyst, such as anhydrous aluminum chloride, in the presence of a small amount of hydrogen halide, so as to convert the butane to isobutane. For example, the reaction may be carried out in the vapor phase at temperatures of about 190-220° F. and under pressures of about 175-250 pounds per square inch. The off-gases from this reaction may be either recycled in toto, with washing to remove hydrogen halide, or subjected to fractionation.

The isobutane so produced is withdrawn and conducted through a pipe 19 communicating with the inlet to the alkylation unit 9, previously referred to.

While certain conditions and other details of operation have been mentioned, it is contemplated that these may be varied as desired, depending upon the character of the gasoline hydrocarbons undergoing treatment, as well as upon the particular nature of the final products desired.

Obviously many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. In a process for the conversion of natural gasoline hydrocarbons to high octane motor fuel hydrocarbons the steps which comprise fractionating natural gasoline to separate therefrom fractions respectively rich in normal butane and isobutane and to produce a fraction comprising mainly hydrocarbons of higher molecular weight than butane, subjecting the normal butane fraction to isomerization to produce isobutane, subjecting the fraction comprising hydrocarbons of higher molecular weight than butane to thermal conversion to form olefin hydrocarbons including normally gaseous olefins, fractionating the products of conversion to separate therefrom a fraction comprising C_3 and C_4 hydrocarbons, including olefins, and a high boiling fraction comprising motor fuel hydrocarbons of relatively high octane rating, subjecting said C_3 and C_4 fraction to alkylation with said isobutane, and subjecting the products of alkylation to fractionation to separate therefrom a fraction comprising hydrocarbons suitable as aviation motor fuel of high octane value.

2. In a process for the conversion of natural gasoline hydrocarbons to high octane motor fuel hydrocarbons, the steps which comprise fractionating natural gasoline to separate therefrom fractions respectively rich in normal butane and isobutane and to produce a fraction comprising mainly hydrocarbons of higher molecular weight than butane, subjecting the normal butane fraction to isomerization to produce isobutane, subjecting the fraction comprising hydrocarbons of higher molecular weight than butane to thermal conversion to form olefin hydrocarbons, including normally gaseous olefins, subjecting the products of conversion to fractionation, separating therefrom a normally gaseous fraction comprising C_3 and C_4 olefins, separating another fraction comprising motor fuel of relatively high anti-knock value, subjecting the C_3 and C_4 hydrocarbon fraction to alkylation with said isobutane derived from the lower boiling portion of the feed, subjecting the products of alkylation to fractionation, separately removing isobutane and normal butane from the alkylated hydrocarbons, forming from the alkylated hydrocarbons another fraction comprising aviation motor fuel of high octane value, recycling at least a portion of the isobutane removed from the alkylated hydrocarbons to the alkylation operation and recycling at least a portion of the normal butane separated from the alkylated hydrocarbons to the isomerization operation.

LEBBEUS C. KEMP.