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METHOD OF PROCESSING HYDROCARBONS TO PRODUCE MOTOR FUEL

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This invention relates to an improved method of processing hydrocarbons such as methane, ethane, propane, butane, pentane, hexane, or other saturated aliphatic hydrocarbons, to produce motor fuel with high anti-detonating characteristics, and one which may be mixed or blended with the various grades of gasoline stock to improve the anti-detonating characteristics thereof.

Briefly stated, my invention comprises converting saturated hydrocarbons into olefines by reacting on saturated hydrocarbons with acetylene gas, polymerizing the olefines formed and hydrogenating the polymerized product to produce motor fuel consisting principally of hydrocarbons with branched chain molecular structures, and/or reacting on branched chain hydrocarbons, such as isobutane, isopentane, isohexane, isoheptane, or other isomeric saturated hydrocarbons, with acetylene to produce olefinic hydrocarbons with an increased number of branched chains, and then hydrogenating the olefinic hydrocarbons to produce saturated hydrocarbons with an increased number of branched chains suitable as a fuel for high compression internal combustion engines.

Processes of producing branched chain hydrocarbon motor fuels, such as iso-octane by the catalytic polymerization of butylene and hydrogenation of the polymerized product is known in the art, however commercial processes employing mixtures of olefinic gases derived from cracking butane or other petroleum oils, to produce iso-octane by known polymerization and hydrogenating methods usually produces a motor fuel ranging from 90 to 95 octane number, while by my improved method a motor fuel may be produced of any desired number ranging from 90 to 100 or somewhat higher by increasing the number of branch chains of the hydrocarbon molecules constituting the fuel.

The following represents graphically the reactions which take place in processing methane and ethane with acetylene for the production of iso-octane.

For methane—

$Ch_4+C_2H_2=C_3H_6$ propylene

2 C_3H_6 polymerized$=C_6H_{12}$ isohexylene

$C_6H_{12}+H_2=C_6H_{14}$ isohexane

$C_6H_{14}+C_2H_2=C_8H_{16}$ iso-octylene

$C_8H_{16}+H_2=C_8H_{18}$ iso-octane

For ethane—

$C_2H_6+C_2H_2=C_4H_8$ butylene

2 C_4H_8 polymerized$=C_8H_{16}$ iso-octylene

$C_8H_{16}+H_2=C_8H_{18}$ iso-octane

In processing hydrocarbons such as isoheptane the following represents the reaction which takes place to produce isononane which may be regulated so that the resultant motor fuel may have an octane number greater than 100 in case the isoheptane reacted upon by the acetylene gas contains 2 or more branched chains.

$C_7H_{16}+C_2H_2=C_9H_{18}$ isononylene

$C_9H_{18}+H_2=C_9H_{20}$ isononane

Isoheptane having two branched chains may be produced by reacting on propane with acetylene and hydrogenating the resultant product as follows:

$C_3H_8+C_2H_2=C_5H_{10}$ isopentylene

$C_5H_{10}+H_2=C_5H_{12}$ isopentane

$C_5H_{12}+C_2H_2=C_7H_{14}$ isoheptylene

$C_7H_{14}+H_2=C_7H_{16}$ isoheptane

An object of the invention is to produce motor fuel from saturated straight chain hydrocarbons, suitable for use in high compression internal combustion engines without the use of anti-knock compounds, such as tetraethyl lead.

Another object of the invention is to produce a motor fuel which may be blended with gasoline stock derived from crude petroleum oil by distillation or cracking operations, either with or without the use of tetraethyl lead, to produce a motor fuel which will conform to all aircraft fuel specifications as required by the trade.

Another object of the invention is to produce a hydrocarbon motor fuel having an octane number of at least 100 by the synthetic production of hydrocarbons having more than two branched chains in the molecular construction.

Another object of the invention is to add hydrocarbon radicals to straight chain hydrocarbons to form hydrocarbons with branched chains.

Various other objects and advantages of the present invention will be apparent from the description of the preferred method or examples of the process embodying the present invention.

Example 1

One volume of ethane derived from any available source is mixed with two volumes of a 50% mixture of acetylene and nitrogen gas. This mixture maintained at atmospheric or less than atmospheric pressure is heated to 350–400° F. by any suitable heating means, such as a pipe coil heater, and passed therefrom in a continuous stream flow through a contact mass coated with a catalytic agent such as titanium oxide, vanadium oxide (V_2O_3) or silica. The contact

mass may be any of the known substances which present large surface exposures for the space employed, such as asbestos, diatomaceous earth, special constructed porcelain balls or cones, fused magnesium sulphate, slag sand, silica quartz or brick work, and the like.

In the reaction chamber approximately 80 to 95% of the ethane and acetylene combine with the formation of isobutylene by the reaction heretofore given.

From the reaction chamber the isobutylene and other gases are conducted to a polymerizing unit of any well known type such as those employing a phosphoric acid catalyst and are therein polymerized to form iso-octylene which is thereafter hydrogenated by known processes to produce iso-octane motor fuel with an octane ranging from 90 to 100.

Example 2

Isohexane, derived from any source, such as by the known method of polymerizing propylene to form dimers and thereafter hydrogenating the polymerized product to form the isohexane, is processed with acetylene in accordance with the method described in Example 1, using the same proportional mixture at the same temperature, and thereafter hydrogenated by known methods to form iso-octane with two side chains. The motor fuel thus produced will have an octane number of 90 to 100.

By this invention and by the method described in Example 1 methane may be processed with acetylene to produce propylene, the propylene polymerized and then hydrogenated to form isohexane, which may be again treated with acetylene in accordance with Example 2 to produce iso-octane with two side chain radicals or groups and an octane value of 98 to 100.

While the process herein described is well adapted for carrying out the objects of the present invention various forms and modifications may be made, such for example as the use of various forms of reaction chambers employing various forms of heat exchangers to extract the exothermic heat of the acetylization reaction, and the invention includes all such modifications and changes as appear in the scope of the appended claims.

I claim:

1. In a process of producing a branched chain high anti-knock paraffinic motor fuel hydrocarbon, the step which comprises reacting acetylene with an isohexane.

2. Process of producing iso-paraffinic hydrocarbons boiling in the usual range of motor fuels, which comprises reacting a paraffinic hydrocarbon containing at least three carbon atoms per molecule with acetylene in the presence of a metal oxide catalyst at a temperature of about 350° to 400° F. and hydrogenating the resulting product.

3. Process of producing branched chain high antiknock paraffinic motor fuel hydrocarbons, which comprises reacting a paraffinic hydrocarbon containing more than two, but less than eight carbon atoms per molecule with acetylene, in the presence of a metal oxide catalyst, at a temperature of about 350° to 400° F., and hydrogenating the resulting product.

4. Process of increasing the number of branched chains in iso-paraffinic hydrocarbons, and thereby increasing their antiknock value, which comprises reacting iso-paraffins containing less than eight carbon atoms per molecule, with acetylene, in the presence of a metal oxide catalyst, and hydrogenating the resulting product.

5. Process of increasing the number of branched chains in iso-paraffinic hydrocarbons, and thereby increasing their antiknock value, which comprises reacting iso-paraffins, containing less than eight carbon atoms per molecule with acetylene in the presence of a vanadium oxide catalyst, and hydrogenating the resulting product.

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