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HIGH ANTIKNOCK MOTOR FUEL

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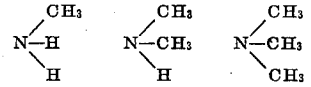
4 Claims. (Cl. 44—72)

This invention relates to improvements in spark-ignition engine motor fuels, and particularly to fuels enhanced in octane rating by selected aliphatic amines of adequate anti-knock blending value and lead susceptibility.

It is known that the addition of low boiling aliphatic amines in extremely small amounts to gasoline fuels as anti-oxidants has been suggested in the past. For this function, low concentrations, substantially less than 1%, should be sufficient, larger concentrations being undesirable in so far as the amines detract from the anti-knock value of the fuels. Now, it is found that although many of these amines tend to lower the anti-knock value for fuels for high compression ratio motors when incorporated into the fuels in substantial amounts, certain amines can be blended with these fuels to purposely obtain a marked useful improvement in this respect.

An object of this invention is to provide fuels of improved octane rating by additions of properly chosen aliphatic amines. The chief object of this invention is to provide fuels of improved octane rating for high-power spark-ignition engines from hydrocarbon base fuels, either alone or enhanced by lead alkyl anti-detonants with selected aliphatic amines having adequate anti-knock blending value and lead susceptibility to effect further improvement, particularly in the range of 80 to 100 octane number fuel compositions.

The aliphatic amines, in general, are all derivatives of ammonia (NH_3), in which one, two, or three hydrogen atoms are replaced by aliphatic hydrocarbon radicals. The large variety of compounds belonging to this class differ in the kinds of hydrocarbon radicals and number of hydrogen atoms replaced. For example, on replacing hydrogen atoms by methyl groups, the following derivatives are obtained:



Such derivatives and their higher alkyl homologues are subdivided into groups termed as follows:

Mono-alkyl derivatives—primary amines
Di-alkyl derivatives—secondary amines
Tri-alkyl derivatives—tertiary amines

To arrive at a proper evaluation of the anti-knock blending values for the various aliphatic amines, the amines were blended with commercial and aviation gasoline fuel stocks having clear octane ratings of 65 and 78.7, respectively, in concentrations of 1% by volume and higher, so as to obtain significant measurements of the anti-knock characteristics for the blends in a high compression C. F. R. engine. The octane rating tests were made in accordance with both the A. S. T. M. method and the Army method under standardized test conditions to obtain comparative data. The blends were tested with and without an added lead alkyl anti-detonant to ascertain which of the aliphatic amines have a desirable lead susceptibility.

Using the foregoing test methods, it was determined that there is a great diversity in the anti-knock blending values of the amines, indicating that although primary and secondary amines of 2 to 3 carbon atom alkyls have adequate octane blending values to make them beneficial in ordinary non-leaded fuels, only the primary and secondary isoalkyl amines, in which the isoalkyl radical is isobutyl or isoamyl, preferably isobutyl, are suitable in higher octane number and leaded fuels, which are highly essential in providing the needed supply of fuels for high compression and highly supercharged motors, such as are used principally in aircraft.

Therefore, the main embodiment of this invention resides in the addition of the primary and secondary isobutyl amines to leaded gasoline fuels, in which the hydrocarbon base fuel has a clear octane rating of at least about 65, said selected amines being blended in concentrations of 1% by volume or more to provide new high anti-knock motor fuel blends having octane ratings required for aviation fuels, i. e., of the order of 80 to 100 and higher.

Accordingly, aviation motor fuels of substantially improved anti-knock quality are provided by blending a gasoline base boiling substantially in the desired gasoline boiling range, e. g., from 100° F. to about 300° F. or about 400° F. and having a clear A. S. T. M. octane rating of at least 75 with from ½ to 3 cc. of tetraethyl lead per gallon of the fuel and with from about 5% to 20% by volume of a primary or secondary isobutyl amine in order to boost the octane rating of the blend to an octane number substantially above 80.

To specifically illustrate the invention, the following examples are given:

Examples

The isobutyl amines, both primary and secondary, were blended in concentrations ranging upwardly from 1% by volume in gasoline fuel bases having clear A. S. T. M. octane ratings of 65 and 78.7. Each of the blends were tested for octane rating in a C. F. R. engine, with and without added tetraethyl lead.

The aviation gasoline fuel base having a clear A. S. T. M. octane rating of 78.7 when blended with tetraethyl lead present in an amount restricted to 3 cc. per gallon, in conformance with the Army specifications, showed an octane rating of 94.5 by the Army method. The octane rating for this leaded fuel was further increased by ½ octane number per 1% by volume of added primary isobutyl amine thus making possible the formation of 100 octane number fuels by the addition of about 10% to 15% by volume of this amine, such fuels being necessary to meet stringent Army aviation specifications.

In using the secondary isobutyl amine (di-isobutyl amine) slightly larger amounts were found necessary to make the same improvement as made with primary isobutyl amine, however the secondary amine has an octane blending value well above 100 in both clear and leaded gasolines.

Isoamyl amine was found capable of making an improvement in leaded fuels having octane ratings between about +65 and +90.

Low boiling aliphatic amines other than the primary and secondary isoalkyl amines, in which the isoalkyl groups contain 4 to 5 carbon atoms, have been found too deficient in their octane blending values for improvement of high anti-knock quality fuels, particularly aviation fuels containing lead-alkyl anti-knock agents and requiring octane ratings above 80.

It is understood by those skilled in the art that it is desirable to minimize the amount of lead alkyl anti-detonating agent added to a fuel and that a fuel is not upgraded in octane rating in direct proportion to increased increments of the added lead alkyl compound, but that instead each succeeding increment of the lead compound is less effective. It will also be appreciated by those skilled in the art that fuel components and various organic compounds greatly differ in their behavior for increasing or lowering the effectiveness of the lead alkyl compounds, this behavior being termed lead susceptibility.

With respect to the primary and secondary isobutyl amines which are the preferred blending agents, tests show that these agents have somewhat higher octane blending values in a gasoline base of 65 A. S. T. M. octane number with 1 cc. of tetraethyl lead added per gallon than they have in a gasoline base of 78.7 A. S. T. M. octane number with 3 cc. of the tetraethyl lead added per gallon. For example, by adding a 5% concentration of isobutyl amine to a 65 O. N. gasoline base containing 1 cc. of tetraethyl lead per gallon, the Army octane rating is increased to the extent of nearly 2 octane numbers for each increment of 1% of the isobutyl amine, making the octane blending value of the amine amount to +154, while in 78.7 O. N. gasoline with 3 cc. of tetraethyl lead added per gallon the octane blending value of this amine is lowered to +140.

The unexpectedly high blending values of the isobutyl amines stand out remarkably in contrast to the blending values of other alkyl amines and even to the blending value of one of the best known anti-knock blending agents, namely, di-isopropyl ether. These facts are demonstrated in the following table:

Blending agent		Octane blending value (Army method) with 3 cc. T. E. L. added per gallon
Name	Formula	
Trimethylamine	$(CH_3)_3N$	−178
Diethylamine	$(C_2H_5)_2NH$	0
Di-isopropylamine	$(C_3H_7)_2NH$	0
Isopropylamine	$(C_3H_7)NH_2$	+70
Di-isopropyl ether	$(C_3H_7)_2O$	+105
Isobutylamine	$(C_4H_9)NH_2$	+140
Di-isobutylamine	$(C_4H_9)_2NH$	+110
Di-isoamylamine	$(C_5H_{11})_2NH$	+90

Differently from the alkyl ethers, the most pronounced superiority in blending value is obtained in the case of the aliphatic amines when the alkyl radical in the amines is an isobutyl radical, and the isobutyl amine has shown a marked superiority in blending value over the best of the aliphatic ethers. Although isopropyl amine has a blending value which approaches the blending value of the preferred isoalkyl amines having 4 to 5 carbon atoms in the alkyl groups, it does not have an adequately high blending value for improving leaded aviation fuels to octane ratings of the order of 80 to 100, because its blending value is below this octane number range.

In addition to the isoalkyl amines of ascertained suitable blending values for use in the high quality aviation fuels and the metallo-organic anti-knock agents, such as tetraethyl lead or other lead-alkyl compounds, other additives may be incorporated into the fuels, as desired, such as, a lubricant, a gum-fluxing agent, a thickening agent, dye, corrosion inhibitor, and stabilizer or gum inhibitor. The gasoline fuel base may comprise largely hydrocarbons having particularly good anti-knock properties, such as alkylated benzene or isoparaffins.

While this invention has been illustrated by a number of specific examples, there are a number of modifications which are intended to come within the scope of the invention as defined in the appended claims.

I claim:

1. High anti-knock motor fuel having an A. S. T. M. octane rating above 80 and comprising a major proportion of a hydrocarbon gasoline base stock having an octane rating of at least 65, about 3 cc. of tetraethyl lead per gallon, and about 5–20% of an iso-alkyl amine having 1 to 2 alkyl groups and having about 4 to 5 carbon atoms per alkyl group.

2. Motor fuel according to claim 1 in which the amine is primary isobutyl amine.

3. High anti-knock motor fuel having an A. S. T. M. octane rating of at least 100, comprising a major proportion of a hydrocarbon gasoline base stock having an octane rating of at least 75, about 3 cc. of tetraethyl lead per gallon, and about 5–20% of primary isobutyl amine.

4. High anti-knock aviation fuel having an A. S. T. M. octane rating above 80 comprising a major proportion of an aviation gasoline hydrocarbon base stock boiling within the approximate limits of 100–300° F. and having an octane rating of at least 65, about 3 cc. of tetraethyl lead per gallon and about 5–20% of primary isobutyl amine.

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