

UNITED STATES PATENT OFFICE

2,287,736

PRODUCTION OF MOTOR FUELS BY
SOLVENT EXTRACTIONArthur B. Hersberger, Lansdowne, Pa., assignor to
The Atlantic Refining Company, Philadelphia,
Pa., a corporation of PennsylvaniaNo Drawing. Application May 16, 1939,
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6 Claims. (Cl. 196—13)

The present invention relates to the production of motor fuels of improved combustion characteristics, and relates more particularly to the production of gasoline of improved anti-knock value and to the production of compression ignition fuel, such as Diesel fuel, of improved cetane value. In general, the fuels to be treated in accordance with this invention are distillate fuels such as cracked gasoline, kerosene, and gas oil, which fuels comprise mixtures of hydrocarbons of various types, including paraffins, olefines, aromatics, and naphthenes.

Fuels designed for use in spark-ignition engines, particularly engines having a high compression ratio, are characterized in having a relatively high anti-knock or octane value, and gasolines containing a relatively large proportion of aromatics, olefines, naphthenes or branched-chain paraffins exhibit this desirable property. On the other hand, fuels designed for use in compression engines, such as Diesel engines, are characterized in having a relatively high cetane value, and kerosenes or gas oils containing relatively large proportions of paraffin hydrocarbons, particularly straight-chain paraffin hydrocarbons, or naphthenes containing long hydrocarbon chains, exhibit this property. The cetane value of compression ignition fuels may be taken as indicative of the combustion characteristics of the fuel, i. e., the higher the cetane value, the lower the ignition temperature of the fuel and the shorter the delay period between the injection and ignition of the fuel. Paraffin hydrocarbons, in general, possess lower spontaneous ignition temperatures than the aromatic hydrocarbons, and it is therefore desirable to retain the paraffin hydrocarbons in compression ignition fuels, whereas the aromatic hydrocarbons are preferably retained in spark ignition fuels such as gasoline.

It is therefore an object of this invention to produce gasoline of improved anti-knock value from gasoline distillates comprising components having relatively higher and lower anti-knock values by separating from the distillate those components having relatively higher anti-knock value, and employing such components as motor fuel.

It is a further object of this invention to produce compression ignition fuels, such as Diesel fuel having improved ignition characteristics, by separating from the fuel oil stock comprising components having relatively higher and lower spontaneous ignition temperatures, those components having relatively lower spontaneous ig-

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niton temperatures, and employing such components as compression ignition fuel.

In accordance with the present invention, the separation of hydrocarbon oil distillate into fractions having different physical and chemical properties, and therefore different combustion characteristics, is accomplished by contacting the distillate with a solvent comprising morpholine, whereby the aromatic, olefinic, and naphthenic hydrocarbon components are dissolved in the solvent and may be separated from the undissolved, more paraffinic hydrocarbon components.

In the case of a gasoline distillate containing relatively higher and lower anti-knock components, i. e., aromatic components, and paraffinic components, respectively, the components removed from the distillate by extraction will constitute the fraction having the higher anti-knock value, and the components remaining undissolved will constitute the fraction having a lower anti-knock value.

However, in the case of a fuel oil distillate, such as gas oil containing relatively higher and lower spontaneous ignition temperature components, i. e., aromatic components, and paraffinic components, respectively, the components removed from the distillate by extraction will constitute the fraction having the higher spontaneous ignition temperature, and the components remaining undissolved will constitute the fraction having a lower spontaneous ignition temperature, which fraction is more desirable for use as a compression ignition fuel.

In carrying out the method of the present invention, the oil distillate is commingled or contacted with a solvent comprising morpholine, at a temperature below the miscibility temperature of the distillate and the solvent, whereby two liquid phases are formed, one phase comprising the major portion of the solvent containing the aromatic and/or naphthenic components dissolved therein, and the second phase comprising the undissolved, more paraffinic components containing a minor portion of the solvent. The two phases are separated from one another, for example, by decantation or centrifuging, and the solvent removed from each, for example, by water washing, or by distillation in the event that the boiling point of the solvent is sufficiently different from the boiling range of the oil components. The extraction process may be carried on in a batch system, a multiple-batch countercurrent system, or a continuous countercurrent system, the latter being preferred.

While morpholine, per se, may be employed as the selective solvent for the aromatic and/or naphthenic oil components, the extraction must usually be performed at relatively low temperatures, i. e., of the order of 0° F. or lower, since the morpholine is completely miscible with the oil distillate except at very low temperatures. In order to overcome this difficulty, it is preferable to employ morpholine admixed with an agent capable of increasing the miscibility temperature of the morpholine with the oil. Among the agents which may be suitably employed to this end are the water-soluble, lower aliphatic alcohols having less than 4 carbon atoms per molecule, i. e., methyl alcohol, ethyl alcohol, propyl alcohol, isopropyl alcohol, ethylene glycol, and glycerol. The volume ratio of alcohol to morpholine may vary within the range of from about 1:1 to 1:10, depending upon the temperature at which the extraction process is to be carried out and the character of the oil fractions it is desired to produce. The volume ratio of solvent to oil may vary within the range of from about 0.5:1 to 5:1, and is preferably of the order of 1:1. In lieu of, or in addition to morpholine, I may employ morpholine derivatives, such as methyl morpholine, ethyl morpholine, or the halogenated morpholines, e. g., chloromorpholine, in the selective extraction of hydrocarbon oils.

My invention may be illustrated by the following example, which, however, is not to be construed as limiting the scope thereof:

A gasoline distillate produced by cracking hydrocarbon oil at elevated temperature and pressure, and having a distillation range of from 100° F. to 390° F., and A. P. I. gravity of 58.4°, an aniline number of 42.8, and an octane value of 66, was admixed with a solvent comprising 83% morpholine and 17% methyl alcohol, in the volume ratio of 1 part of solvent to 1.2 parts of distillate. The mixture of solvent and distillate was cooled to about 0° F., whereupon two liquid phases were formed, one comprising the major portion of the solvent and aromatic and/or naphthenic oil components, and the other comprising undissolved oil containing a minor portion of solvent. The two phases were separated from one another by decantation and the solvent was removed from each by washing with a small amount of water, the water thereafter being separated from the solvent by distillation. As a result of the extraction, there were produced two gasoline fractions having different physical properties and different anti-knock values. The dissolved fraction, in the amount of 37.8% by volume based on the initial distillate treated, had an A. P. I. gravity of 55.8°, an aniline number of 34.5, and an octane value of 70. The undissolved fraction, in the amount of 62.2% by volume based on the initial distillate treated, had an A. P. I. gravity of 19.4°, an aniline number of 46.2, and an octane value of 62.

It will be seen, from the above example, that in accordance with my process, there may be produced from a gasoline distillate containing relatively higher and lower anti-knock value components, a fraction having a higher anti-knock value and a second fraction having a lower anti-knock value than that of the initial gasoline distillate. In the same manner, heavier distillates, such as gas oil, may be separated into fractions having respectively higher and lower

spontaneous ignition temperatures, the latter of which may be suitably employed as an improved compression ignition fuel.

What I claim is:

1. In the solvent refining of mineral oils, the process which comprises separating an oil containing paraffinic and naphthenic hydrocarbons into fractions respectively more paraffinic and more naphthenic than the original oil by extracting said oil with a solvent comprising morpholine and a lower aliphatic alcohol.

2. The method of separating a motor fuel containing components having relatively high and lower spontaneous ignition temperatures into fractions respectively richer in higher and lower spontaneous ignition temperature components, which comprises commingling said motor fuel with a solvent comprising morpholine and a lower aliphatic alcohol to dissolve from said motor fuel the higher spontaneous ignition temperature components, separating the solvent containing said dissolved components from the undissolved lower spontaneous ignition temperature components and removing solvent from the higher spontaneous ignition temperature components.

3. The method of producing gasoline of improved anti-knock value from gasoline distillate containing components having relatively higher and lower anti-knock values, which comprises commingling said distillate with a solvent comprising morpholine and a lower aliphatic alcohol, forming a phase comprising morpholine, lower aliphatic alcohol, and the higher anti-knock value components, and a second phase comprising the lower anti-knock value components, separating the phases so formed and removing morpholine and lower aliphatic alcohol from the phase first mentioned.

4. The method of producing gasoline of improved anti-knock value from gasoline distillate containing components having relatively higher and lower anti-knock values, which comprises commingling said distillate with a solvent comprising morpholine and methyl alcohol, forming a phase comprising morpholine, methyl alcohol, and the higher anti-knock value components, and a second phase comprising the lower anti-knock value components, separating the phases so formed, and removing morpholine and methyl alcohol from the phase first mentioned.

5. The method of producing gasoline of improved anti-knock value from gasoline distillate containing components having relatively higher and lower anti-knock values, which comprises commingling said distillate with a solvent comprising morpholine and ethyl alcohol, forming a phase comprising morpholine, ethyl alcohol, and the higher anti-knock value components, and a second phase comprising the lower anti-knock value components, separating the phases so formed and removing morpholine and ethyl alcohol from the phase first mentioned.

6. In the solvent refining of mineral oils, the process which comprises separating an oil containing paraffinic and naphthenic hydrocarbons into fractions respectively more paraffinic and more naphthenic than the original oil by extracting said oil with a solvent comprising a lower aliphatic alcohol and a derivative of morpholine from the group consisting of methyl morpholine, ethyl morpholine, and a halogenated morpholine.

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CERTIFICATE OF CORRECTION.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 62, for "19.4°" read --59.4°--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of August, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)