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(54) **FUEL FOR INTERNAL COMBUSTION ENGINE**

(57) A fuel for an internal combustion engine is provided which is environment friendly and arranged to minimize corrosion of the internal combustion engine. The fuel is characterized by 50 to 75 percent by weight of an alcohol component including isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol and 25 to 49.9 percent by weight of a hydrocarbon component, wherein the ignition point is not higher than -20 °C. Preferably, the alcohol component is 50 to 60 percent by weight while the hydrocarbon component is 40 to 49.9 percent by weight. Also, the alcohol component contains 15 to 30 percent by weight of isopropyl alcohol, 15 to 25 percent by weight of isobutyl alcohol, and 7 to 20 percent by weight of n-butyl alcohol.

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Description

Field of the Invention

[0001] The present invention relates to a fuel for an internal combustion engine and particularly, to a type of fuel for an internal combustion engine which is environment friendly and can produce a minimum of pollution.

Background of the Invention

[0002] Most common fuel for an internal combustion engine used, for example, in an automobile is gasoline. Gasoline or petroleum fuel when burned in the engine generates unwanted fumes including COx (carbon oxide), NOx (nitrogen oxide), and SOx (sulfur oxide) which are discharged together as exhaust gas into the air thus causing air pollution.

[0003] For replacement, a variety of alcohol based fuels for internal combustion engines have been proposed which contain large concentrations of alcohols. One of those alcohol based fuels is known as disclosed in Japanese Patent Laid-open Publication (Heisei) 9-227880. The known alcohol based fuel contains 48 to 58 percent by weight of alcohol such as methyl or isobutyl alcohol. The known alcohol based fuel containing a desired amount of alcohol thus has some advantages. Firstly, the alcohol based fuel includes a large number of oxygen molecules and when burned, generates less amounts of CO (carbon monoxide) and HC (hydrocarbon) . Accordingly, its combusted gas can release a minimum of CO and HC. Secondly, the alcohol based fuel contains a less amount of sulfur ingredients and its combusted gas includes a less amount of SOx. Accordingly, the fuel can be environment friendly. Thirdly, the alcohol based fuel is high in the octane rating and can thus be suited for use in a spark ignition type of the internal combustion engine.

[0004] However, the known alcohol based fuel is based on methyl alcohol and may contain as a greater amount as 40 percent by weight. Commonly as is desired for reduction of the overall weight, an internal combustion engine used in an automobile is made of aluminum. Aluminum is susceptible to the corrosion by methyl alcohol. It is hence probable that the internal combustion engine is corroded partially or namely at the cylinder head with the long-run use of the known fuel containing a high concentration of methyl alcohol.

[0005] It is thus an object of the present invention to provide a fuel for an internal combustion engine which is environment friendly and arranged to minimize corrosion of the internal combustion engine.

Summary of the Invention

[0006] A fuel for an internal combustion engine according to the present invention is characterized by 50 to 75 percent byweight of an alcohol component including isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol and 25 to 49. 9 percent by weight of a hydrocarbon component, wherein the ignition point is not higher than -20 °C.

[0007] The alcohol component at 50 to 75 percent by weight comprises isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol. As isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol are greater in the number of carbons (C) than methyl alcohol or ethyl alcohol, their corrosive effect on aluminum is lower thus minimizing corrosion of the internal combustion engine. When the alcohol component is lower than 50 percent by weight, it is overwhelmed by the hydrocarbon component. This will accelerate the generation of NOx and COx at the combustion thus increasing NOx and COx in the exhaust gas and polluting the environment. When the alcohol component exceeds 75 percent by weight, it disturbs the generation of thermal energy at the combustion hence declining the output power of the internal combustion engine and the performance of an automobile. Since the ignition point of the fuel is not higher than -20 °C, the low temperature startup can be ensured at a desired temperature.

[0008] Alternatively, the alcohol component including isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol may be 50 to 60 percent by weight while the hydrocarbon component is 40 to 49. 9 percent by weight. The hydrocarbon component may comprise aromatic substances including benzene and xylene and non-aromatic substances.

[0009] Preferably, the alcohol component contains 15 to 30 percent by weight of isopropyl alcohol, 15 to 25 percent by weight of isobutyl alcohol, and 7 to 20 percent by weight of n-butyl alcohol.

[0010] As its alcohol component contains 15 to 30 percent by weight of isopropyl alcohol, 15 to 25 percent by weight of isobutyl alcohol, and 7 to 20 percent by weight of n-butyl alcohol, the fuel according to the present invention can remain stable at the concentration of alcohols thus ensuring improved characteristics for the driving performance and the acceleration. Preferably, the weight ratio between isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol is expressed by (1.8-2.2) : (1.3-1.7) :1. This allows the fuel to be favorably used for energizing an automobile.

[0011] The fuel may further contain not higher than 6. 0 percent by weight of MTBE.

[0012] As the fuel contains not higher than 6.0 percent by weight of MTBE (methyl tertiary butyl ether), it can produce less amounts of hazardous matters thus being environment friendly. The smaller the amount of MTBE, the more the fuel will be environment friendly. Preferably, MTBE may be 0.3 percent by weight or lower.

[0013] The hydrocarbon component in the fuel of the present inventionmay contain 0.2 to 1. 0 percent by weight of

aromatic substances and 48. 9 to 49.7 percent by weight of non-aromatic substances. With its hydrocarbon component doped at the above-mentioned percentage, the fuel can provide characteristics essential as an automobile fuel even when the amount of its alcohol component is higher.

Best Modes for embodying the Invention

[0014] Embodiments of a fuel for an internal combustion engine according to the present invention will be described in more detail.

[0015] The fuel for an internal combustion engine contains high concentrations of an alcohol component and a hydrocarbon component. The alcohol component is a mixture of isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol. As the alcohol component contains isopropyl alcohol which is greater in the number of carbon atoms than methyl alcohol, it is less corrosive to aluminum thus contributing to minimum corrosion of the internal combustion engine. The alcohol component is included 50 to 75 percent by weight in the fuel. When the alcohol component is lower than 50 percent byweight, the hydrocarbon component will increase. This leads to the generation of NOx and COx during the combustion and causes the exhaust gas to contain more amounts of NOx and COx. When the alcohol component is higher than 75 percent by weight or oversupplied, it will hardly increase the thermal energy during the combustion but decline the output power of the internal combustion engine. In particular, when its internal combustion engine burns the fuel, the automobile fails to improve the running performance or particularly the accelerating rate. It is hence desirable that the fuel contains 50 to 60 percent by weight of the alcohol component.

[0016] More specifically, the alcohol component contains 15 to 30 percent by weight of isopropyl alcohol, 15 to 25 percent by weight of isobutyl alcohol, and 7 to 20 percent by weight of n-butyl alcohol. As the alcohol component contains 15 to 30 persent by weight of isopropyl alcohol, 15 to 25 percent by weight of isobutyl alcohol, and 7 to 20 percent by weight of n-butyl alcohol, the fuel allows the alcohol component to be stable and can have the properties essential for an automobile fuel, and it can remain stable to replace gasoline as the fuel for the internal combustion engine of an automobile without improving the internal combustion engine. It is further desirable that the weight ratio between the three alcohols, isopropyl alcohol (X), isobutyl alcohol (Y), and n-butyl alcohol (Z), is expressed by X:Y:Z= (1.8-2.2):(1.3-1.7):1.

[0017] The hydrocarbon component of the fuel contains aromatic substances (aromatic compounds) and non-aromatic substances (non-aromatic compounds). The aromatic compounds include benzene, toluene, xylene, and other aromatic groups having eight carbons and nine or more carbons. The fuel contains 25 to 49.9 percent by weight of the hydrocarbon component. As the fuel contains such a desired percentage of the hydrocarbon component, it can have the properties essential for an automobile fuel while including a higher concentration of the alcohol component and favorably replace the gasoline. Preferably, the fuel contains 40 to 49.9 percent by weight of the hydrocarbon component in relation to the alcohol component.

[0018] It is desired that the hydrocarbon component contains 0. 2 to 1.0 percent by weight of the aromatic substances and 48 . 9 to 49. 7 percent by weight of the non-aromatic substances. The hydrocarbon component can thus have the properties essential for an automobile fuel.

[0019] Moreover, the fuel contains not higher than 6.0 percent by weight of methyl tertiary butyl ether (MTBE). MTBE functions to increase the octane rating in the fuel but produces SOx when burned thus being hostile to the environmental protection. Since MTBE is not higher than 6. 0 percent by weight, it will give less environmental impact while increasing the octane rating. The octane rating may further be increased by modifying the percentage of each ingredient. This allows the amount of MTBE to stay not higher than 0.1 percent by weight and if desired, be decreased substantially to zero.

[0020] The fuel having a higher concentration of the alcohol component is thus as low as -20 °C at the ignition point. As its ignition point is low, the fuel remains ignitable at a low temperature hence contributing to the low temperature startup of an internal combustion engine. Also, as the fuel has an octane rating of 94.0 or higher, its performance can be improved.

[0021] The fuel is favorably employed as a fuel for an automobile engine to improve the characteristics of the engine (including the acceleration, the low temperature startup, and the anti-knocking) . The fuel can replace the gasoline for use in any gasoline-specific internal combustion engine.

[0022] Example 1 of the fuel of the present invention was prepared having the ingredients listed in Table 1 and tested for use in an gasoline-specific internal combustion engine (made of aluminum) for an automobile through examining the performance of the automobile and analyzing the exhaust gas.

Table 1

Alcohol component	56.0 percent by weight
Isopropyl alcohol	25.0 percent by weight

Table 1 (continued)

N-butyl alcohol Isobutyl alcohol	12.0 percent by weight 18.8 percent by weight
MTBE	not higher than 0.1 percent by weight
Hydrocarbon component Aromatic substances Non-aromatic substances	44 percent by weight 0.8 percent by weight 43.2 percent by weight
Ignition point TCC	not higher than -20 °C
Octane rating	95.9

[0023] Also, Example 2 of the fuel of the present invention was prepared having the ingredients listed in Table 2 and tested for use in the gasoline-specific internal combustion engine (made of aluminum) for an automobile through examining the performance of the automobile and measuring the exhaust gas.

Table 2

Alcohol component Isopropyl alcohol N-butyl alcohol Isobutyl alcohol	56.7 percent by weight 25.5 percent by weight 12.2 percent by weight 19.0 percent by weight
MTBE	not higher than 0.1 percent by weight
Hydrocarbon component Aromatic substances Non-aromatic substances	43.3 percent by weight 0.9 percent by weight 42.4 percent by weight
Ignition point TCC	not higher than -20 °C
Octane rating	95.6

[0024] As the automobile engine consumed Examples 1 and 2 of the fuel, its performance was equal to that with gasoline. More particularly, results of the low temperature startup and the acceleration were good while no knocking occurred. The exhaust gas was measured where CO (carbon monoxide) and HC (hydrocarbon) were about 1/10 and 1/4 respectively as compared with the exhaust gas from the combustion of gasoline. It is hence proved that the fuel is more environment friendly than the gasoline. Also, the test had been repeated throughout the duration of one year, its results revealed no declination in the performance of the engine but remained at a desired level.

Industrial Applicability

[0025] The fuel for an internal combustion engine according to the present invention contains carbon-rich alcohols including isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol and can thus be less corrosive to aluminum, minimizing corrosion of the internal combustion engine. As the fuel has 50 to 75 percent by weight of the alcohol component, it can minimize the generation or concentration of NOx and COx in the exhaust gas while ensuring the performance of an automobile engine. Moreover, the ignition point of the fuel is not higher than -20 °C, hence contributing to improvement of the low temperature startup.

Claims

1. A fuel for an internal combustion engine **characterized by** 50 to 75 percent by weight of an alcohol component including isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol and 25 to 49.9 percent by weight of a hydrocarbon component, wherein the ignition point is not higher than -20 °C.

2. A fuel for an internal combustion engine according to claim 1, wherein the alcohol component is 50 to 60 percent by weight and the hydrocarbon component is 40 to 4 9. 9 percent by weight.

3. A fuel for an internal combustion engine according to claim 1 or 2, wherein the alcohol component contains 15 to 30 percent by weight of isopropyl alcohol, 15 to 25 percent by weight of isobutyl alcohol, and 7 to 20 percent by weight of n-butyl alcohol.

4. A fuel for an internal combustion engine according to claim 3, wherein the weight ratio between isopropyl alcohol, isobutyl alcohol, and n-butyl alcohol is expressed by (1.8-2.2):(1.3-1.7):1.

5. A fuel for an internal combustion engine according to any of claims 1 to 4, further containing not higher than 6.0 percent by weight of MTBE.

6. A fuel for an internal combustion engine according to any of claims 1 to 5, wherein the hydrocarbon component contains 0.2 to 1.0 percent by weight of aromatic substances and 48.9 to 49.7 percent by weight of non-aromatic substances.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/04560

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] C10L1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] C10L1/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
JICST FILE , PATENT FILE(PATOLIS)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2001-311087 A (Takao HAMADA), 09 November, 2001 (09.11.01), Claim 2; Par. Nos. [0033], [0034] (Family: none)	1-6
Y	JP 7-278576 A (Furukawa Kasei Yugen Kaisha), 24 October, 1995 (24.10.95), Claim 1; Par. No. [0009], table 1; Par. No. [0016] (Family: none)	1-6
Y	JP 6-128573 A (Nippon Oil Co., Ltd.), 10 May, 1994 (10.05.94), Claim 1; Par. No. [0009] (Family: none)	1-6

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search	Date of mailing of the international search report
23 May, 2003 (23.05.03)	10 June, 2003 (10.06.03)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/04560

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	"Alcohol-Kei Nenryo(GAIAX) no Haishutsu Gas Jittai Chosa no Chosa Kekka ni Tsuite", Kankyo to Sokutei Gijutsu, 2001 Nen, Vol.28, No.4, pages 4 to 8	1-6

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