

(19)



(11)

EP 1 560 900 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

21.08.2019 Bulletin 2019/34

(51) Int Cl.:

C10L 1/06 (2006.01)

(86) International application number:

PCT/GB2003/004777

(21) Application number: **03811014.4**

(22) Date of filing: **05.11.2003**

(87) International publication number:

WO 2004/044106 (27.05.2004 Gazette 2004/22)

(54) AVIATION GASOLINE COMPOSITION, ITS PREPARATION AND USE

FLUGBENZINZUSAMMENSETZUNG, HERSTELLUNG UND VERWENDUNG DAVON

COMPOSITION DE CARBURANT D'AVIATION, PREPARATION ET UTILISATION

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR**

(30) Priority: **14.11.2002 GB 0226587**
14.11.2002 US 294210
05.08.2003 US 493030 P

(43) Date of publication of application:
10.08.2005 Bulletin 2005/32

(60) Divisional application:
13160668.3 / 2 612 897

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EP 1 560 900 B1

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Description

[0001] The present invention relates in general to a fuel composition and in particular to an aviation gasoline (Avgas).

[0002] International Patent Publication WO 02/40620 relates to an aviation gasoline fuel composition possessing a high motor octane number and which contains reduced amounts of tetraethyl lead compound. The Avgas composition is said to preferably contain about 20 to about 80 vol % iso-octane, about 5 to about 18 vol % toluene, about 1 to about 20 vol % C₄ to C₅ paraffins, about 0 to about 1 ml/gallon tetraethyl lead (TEL) and the balance light alkylate. The motor octane number is said to be preferably greater than or equal to about 100. The fuel is said to be preferably suitable as a substitute for Grade 100LL aviation fuel, This patent publication illustrates only compositions with 0.9 ml/gallon tetraethyl lead.

[0003] WO 99/49003 relates to an unleaded formulated motor gasoline comprising a base blend composition having a MON of at least 80 comprising component (a) at least 5% (by volume of the total composition) of at least one hydrocarbon having the following formula (I): R-CH₂-CH(CH₃)₂-CH₃ wherein R is hydrogen or methyl and component (b) at least one saturated liquid aliphatic hydrocarbon having 4 to 12 carbon atoms.

[0004] DE 197 44 109 relates to a fuel composition which consists of C₈ isoparaffins, C₆ isoparaffins, and C₅ isoparaffins as well as engine oil if appropriate US 6,451,075 B1 discloses an aviation low-lead fuel comprising 2,2,4-tri-methylpentane.

[0005] There is a need for an aviation fuel which can be used in moderately powered engines (such as presently use leaded aviation gasoline with a MON of at least 91) as well as in high performance engines (such as presently use leaded aviation gasoline with a MON of at least 99.5 MON) which have been modified to use lower octane number fuels.

[0006] Thus, according to the present invention there is provided an aviation gasoline composition according to claim 1.

[0007] The composition of the present invention solves the technical problem defined above by the presence of 2, 2, 4-tri-methylpentane in an amount of 60 to 90 vol. % in the composition which, in the substantial absence of lead compounds, provides a fuel with a motor octane number of at least 92 and less than 98.

[0008] The composition of the present invention can provide the same performance in full size spark ignition aviation engines as known leaded 91/96 or 91/98 aviation gasoline, the higher MON value compensating for the absence of lead compounds such as tetraethyl lead.

[0009] The motor octane number is defined according to ASTM D2700 standard, which is known in the art.

[0010] The composition of the present invention preferably has a MON of at least 93 and more preferably of at least 94.

[0011] By substantially free of lead compounds is meant that the amount of lead compounds in the composition according to the present invention is not greater than 0.003g of lead per litre. Lead compounds in particular which should be absent include tetraethyl lead.

[0012] The 2,2,4-trimethylpentane (herein referred to as iso-octane) may be prepared as described in WO 02/40620. Iso-octane may be prepared by the hydrogenation of di-isobutylene, which in turn may be prepared by the dimerisation of isobutenes. Such dimerisation may be performed using converted MTBE production facilities.

[0013] The 2,2,4-trimethylpentane may be provided as a substantially pure component and/or as a component in one or more alkylate process streams.

[0014] The composition of the present invention comprises 2,2,4-trimethylpentane (from whatever source) in an amount of 60 - 90 vol %.

[0015] The composition of the present invention comprises at least 0.01 vol % C₄ alkane. The composition of the present invention comprises less than 5 vol %, preferably less than 2 vol % C₄ alkane. The composition of the present invention comprises at least 10 vol % C₅ alkane. The composition of the present invention may comprise less than 40 vol %, preferably less than 20 vol % C₅ alkane. 2-methyl butane is preferred over n-pentane.

[0016] The composition of the present invention may optionally comprise alkylate in an amount of up to 90 vol %, for example up to 70 vol %. Preferably, the alkylate if present in the composition of the present invention, has been distilled such that it has a boiling point not greater than 170 °C. The alkylate component may comprise at least one tri-methyl pentane.

[0017] The composition of the present invention may comprise isomerate and/or isopentane (2-methyl butane) in a combined total amount of up to 40 vol %, preferably in an amount of less than 20 vol %. Isopentane used in the composition of the present invention may be provided as a substantially pure component and/or as a component in a C₅ refinery stream, for example from an isomerisation unit.

[0018] The composition of the present invention may optionally comprise hydrocrackate. If present in the composition of the present invention, the amount of hydrocrackate is preferably up to 40 vol %, more preferably up to 20 vol %.

[0019] Aromatics are present in the composition of the present invention in an amount of up to 30 vol %, preferably up to 25 vol %. Toluene is optionally present in the composition of the present invention in an amount of up to 30 vol %. Preferably, the amount of toluene, if present in the composition of the present invention, is less than 20 vol %, more preferably not greater than 10 vol %. Other aromatic compounds, for example ethylbenzene and xylene, may be present in the composition of the present invention in place of or in addition to toluene. Such aromatic compounds may be

obtained by distillation of a process stream from a catalytic reformer.

[0020] Naphtha may be present in the composition of the present invention. If present in the composition of the present invention, the amount of naphtha is preferably not greater than 30 vol %, and more preferably is less than 10 vol %.

[0021] Olefins are preferably not present in the composition of the present invention, but their presence is not excluded.

[0022] The composition of the present invention may comprise a dye, or may be undyed. The composition of the present invention may comprise one or more anti-oxidants such as hindered phenols.

[0023] The composition of the present invention may comprise one or more lubricity improvers such as acids, esters and/or amides. Biofuel may also be present in the composition of the present invention. The composition of the present invention may comprise one or more additives to reduce valve seat recession, such as phosphorus, potassium or sodium based valve seat recession additives.

[0024] The composition of the present invention may independently have one or more of the features listed in Table 1 below and preferably all of the features.

TABLE 1

Feature	Range/value
Vapour pressure	38 to 49 kPa
Distillation properties :	
10 % evaporation	by 75 °C max
40 % evaporation	by 75 °C min
50 % evaporation	by 105 °C max
90 % evaporation	by 135 °C max
Final boiling point	< 170 °C
Supercharge	> 96 or > 98 ON
Calorific value	> 43.5 MJ/kg
Freezing point	Less than or equal to - 58 °C

[0025] Preferably, the composition of the present invention meets the Def Stan 91-90 standard and/or ASTM D910 standards with the provisos (i) that the MON value is at least 92 and less than 98 (ii) the supercharge is greater than 96 and (iii) the composition is substantially free of any lead compounds.

[0026] The composition of the present invention is made by blending together one or more process streams selected from the group consisting of iso-octane, alkylate, isopentane, isomerate, hydrocrackate, aromatics and naphtha streams. Preferably, the composition of the present invention is made by adding to one or more of these process streams or a blend thereof, one or more aviation gasoline additives selected from the group consisting of dye, anti-oxidants, lubricity improvers and additives to reduce valve seat recession.

[0027] The composition of the present invention may further comprise at least one fuel system icing inhibitor. Such icing inhibitors are preferably added at the point of use of the composition. Suitable fuel system icing inhibitors comprise alcohols or ethers for example diethylene glycol monomethyl ether and isopropanol. The icing inhibitor may be used in an amount of up to 5 % by volume in the fuel composition.

[0028] The composition of the present invention may be used in spark ignition aviation engines. The aviation engines may be capable of operating at 30 metres or more above sea level. The aviation engines may be used to propel heavier than air craft such as light aircraft. The aviation engines may be used to propel lighter than air craft such as airships. Thus, according to a further embodiment of the present invention there is provided a method of operating a spark ignition aviation engine as defined in claim 14.

[0029] The present invention will now be illustrated by reference only to the following examples. Compositions were prepared by blending amounts of components as listed in Table 2 below.

TABLE 2

Component	Example 1 (W02/421)	Example 2 (W02/579)
	Amount	Amount
Alkylate, initial boiling point to 170 °C fraction *	24 vol %	24 vol %
Naphtha	2.4 vol %	-
Toluene	8 vol %	8 vol %

EP 1 560 900 B1

(continued)

Component	Example 1 (W02/421)	Example 2 (W02/579)
	Amount	Amount
Isopentane	16 vol %	16 vol %
Iso-octane	49.6 vol %	52 vol %
* the alkylate fraction comprised approximately 30 vol % iso-octane such that the total amount of iso-octane in the composition was about 60 vol %.		

[0030] The properties of the compositions were determined and these are listed in Table 3 below.

TABLE 3

Property	Units	W02/421	W02/579
MON		93.2	95.0
Supercharge		99	99
Lead	gPb/litre	0.00	0.00
D1319 FIA Aromatics	% v/v	6.5	7.4
D1319 FIA Olefins	% v/v	0.6	0
D1319 FIA Saturates	% v/v	92.9	92.6
D3338 Specific Energy	MJ/kg	44.086	44.071
D381 Existent Gum (Air)	Mg/100ml	1	< 1
IP365 Composite Density	kg/m ³	700.9	698.8
D86 Initial Boiling Point	°C	39.7	32.5
D86 Final Boiling Point	°C	123.4	119.5
D86 Loss	% v/v	0.6	0.5
D86 Recovery	% v/v	98.3	99.0
D86 Residue	% v/v	1.1	0.5
D86 10% Evaporated	°C	67.1	69.5
D86 40% Evaporated	°C	96.2	96.0
D86 50% Evaporated	°C	99.3	98.5
D86 90% Evaporated	°C	104.0	101.0
D86 Sum of 10% and 50% Evaporated temps	°C	166.4	168.0
D873 16Hr Accelerated Gum	Mg/100ml	3	1
D873 Lead Precipitate	Mg/100ml	0	0
IP 16 Freeze point	°C	<-80	<-60
IP 154 Copper Corrosion 2Hrs @100 °C	-	1a	1
IP289 Water Reaction Interface Rating	-	1	1b
IP289 Water Reaction Volume change	-	0	0
Vapour Pressure	KPa	45.1	41.1
Sulphur (D2622mod)	% w/w	0.0011	0.0010
Anti-oxidant	mg/L	12	12

[0031] The properties of the compositions show that these are suitable for use as aviation gasolines, in particular, the compositions of the present invention meet the Def Stan 91-90 standard and/or ASTM D910 standards with the provisos (i) that the MON value is at least 92 and less than 98 (ii) the supercharge is greater than 96 and (iii) the composition is substantially free of any lead compounds.

Claims

1. An aviation gasoline composition comprising 2,2,4-tri-methylpentane and at least one C₄ or C₅ alkane wherein the amount of 2,2,4-trimethylpentane in said composition is 60 to 90 vol %, the composition comprises at least 0.01 vol% and less than 5 vol % C₄ alkane, the composition comprises at least 10 vol % C₅ alkane, the composition comprises aromatics in an amount of up to 30 vol %, the amount of lead compounds in the composition is not greater than 0.003g of lead per litre, the composition has a final boiling point of less than 170 °C, the composition has a motor octane number of at least 92 and less than 98 and the composition has a supercharge of greater than 96 ON.
2. A composition as claimed in claim 1 in which the composition has a MON of at least 93.
3. A composition as claimed in claim 1 in which the composition has a MON of at least 94.
4. A composition as claimed in any one of the preceding claims in which the composition comprises alkylate in an amount of up to 90 vol %.
5. A composition as claimed in claim 4 in which the alkylate has been distilled such that it has a boiling point not greater than 170 °C.
6. A composition as claimed in any one of the preceding claims in which the composition comprises isomerate and/or isopentane (2-methyl butane) in a combined total amount of up to 40 vol %.
7. A composition as claimed in any one of the preceding claims in which the composition comprises isomerate and/or isopentane (2-methyl butane) in a combined total amount of less than 20 vol %.
8. A composition as claimed in any one of the preceding claims in which the composition comprises aromatics in an amount of up to 25 vol %.
9. A composition as claimed in any one of the preceding claims in which the composition comprises a dye.
10. A composition as claimed in any one of the preceding claims in which the composition comprises one or more anti-oxidants such as hindered phenols.
11. A composition as claimed in any one of the preceding claims in which the composition comprises one or more lubricity improvers such as acids, esters and/or amides.
12. A composition as claimed in any one of the preceding claims in which the composition comprises biofuel.
13. A composition as claimed in any one of the preceding claims in which the composition comprises one or more additives to reduce valve seat recession, such as phosphorus, potassium or sodium based valve seat recession additives.
14. A method of operating a spark ignition aviation engine which comprises providing said engine with an aviation gasoline composition as claimed in any one of claims 1 to 13.
15. A method as claimed in claim 14 which further comprises adding to said aviation gasoline composition, at the point of use, at least one fuel system icing inhibitor.
16. A method of making an aviation gasoline composition according to any of claims 1 to 13 which comprises blending together one or more process streams selected from the group consisting of iso-octane, alkylate, isopentane, isomerate, hydrocrackate, aromatics and naphtha streams.

17. A method as claimed in claim 16 which further comprises adding to one or more of said process streams or a blend thereof, one or more aviation gasoline additives selected from the group consisting of dye, anti-oxidants, lubricity improvers and additives to reduce valve seat recession.

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Patentansprüche

1. Flugbenzinzusammensetzung, umfassend 2,2,4-Trimethylpentan und mindestens ein C₄- oder C₅-Alkan, wobei die Menge an 2,2,4-Trimethylpentan in der Zusammensetzung 60 bis 90 Vol.-% beträgt, die Zusammensetzung mindestens 0,01 Vol.-% und weniger als 5 Vol.-% C₄-Alkan umfasst, die Zusammensetzung mindestens 10 Vol.-% C₅-Alkan umfasst, die Zusammensetzung Aromaten in einer Menge von bis zu 30 Vol.-% umfasst, die Menge an Bleiverbindungen in der Zusammensetzung nicht größer ist als 0,003 g Blei pro Liter, die Zusammensetzung einen Endsiedepunkt von weniger als 170 °C hat, die Zusammensetzung eine Motor-Oktananzahl von mindestens 92 und weniger als 98 hat und die Zusammensetzung einen Supercharge von mehr als 96 OZ hat.
2. Zusammensetzung nach Anspruch 1, wobei die Zusammensetzung eine MOZ von mindestens 93 hat.
3. Zusammensetzung nach Anspruch 1, wobei die Zusammensetzung eine MOZ von mindestens 94 hat.
4. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung Alkylat in einer Menge von bis zu 90 Vol.-% umfasst.
5. Zusammensetzung nach Anspruch 4, wobei das Alkylat destilliert wurde, so dass es einen Siedepunkt von nicht höher als 170 °C hat.
6. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung Isomerat und/oder Isopentan (2-Methylbutan) in einer kombinierten Gesamtmenge von bis zu 40 Vol.-% umfasst.
7. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung Isomerat und/oder Isopentan (2-Methylbutan) in einer kombinierten Gesamtmenge von weniger als 20 Vol.-% umfasst.
8. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung Aromaten in einer Menge von bis zu 25 Vol.-% umfasst.
9. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung einen Farbstoff umfasst.
10. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung ein oder mehrere Antioxidationsmittel wie gehinderte Phenole umfasst.
11. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung ein oder mehrere Schmierfähigkeitsverbesserer wie Säuren, Ester und/oder Amide umfasst.
12. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung Biokraftstoff umfasst.
13. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung ein oder mehrere Additive zur Verringerung des Ventilsitzverschleißes wie Phosphor-, Kalium- oder Natrium-basierte Ventilsitzverschleiß-Additive umfasst.
14. Verfahren zum Betreiben eines Flugmotors mit Fremdzündung, welches die Versorgung des Motors mit einer Flugbenzinzusammensetzung nach einem der Ansprüche 1 bis 13 umfasst.
15. Verfahren nach Anspruch 14, das ferner das Zugeben mindestens eines Vereisungshemmers für das Kraftstoffsystem zu der Flugbenzinzusammensetzung am Einsatzort umfasst.
16. Verfahren zur Herstellung einer Flugbenzinzusammensetzung nach einem der Ansprüche 1 bis 13, welches das Vermischen eines oder mehrerer Prozessströme, ausgewählt aus der Gruppe, bestehend aus Isooctan-, Alkylat-, Isopentan-, Isomerat-, Hydrocrack-, Aromaten- und Schwerbenzinströmen, umfasst.

17. Verfahren nach Anspruch 16, das ferner das Zugabe eines oder mehrerer Flugbenzinadditive, ausgewählt aus der Gruppe, bestehend aus Farbstoffen, Antioxidationsmitteln, Schmierfähigkeitsverbesserern und Additiven zur Verringerung des Ventilsitzverschleißes, zu einem oder mehreren der Prozessströme oder einer Mischung aus diesen umfasst.

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Revendications

1. Composition de carburant d'aviation comprenant du 2,2,4-tri-méthylpentane et au moins un alcane en C₄ ou C₅ dans laquelle la quantité de 2,2,4-triméthylpentane dans ladite composition est de 60 à 90 % en vol., la composition comprend au moins 0,01 % en vol. et moins de 5 % en vol. d'alcane en C₄, la composition comprend au moins 10 % en vol. d'alcane en C₅, la composition comprend des composés aromatiques en une quantité allant jusqu'à 30 % en vol., la quantité de composés de plomb dans la composition n'est pas supérieure à 0,003 g de plomb par litre, la composition a un point d'ébullition finale de moins de 170 °C, la composition présente un indice d'octane moteur d'au moins 92 et de moins de 98 et la composition présente une supercharge supérieure à 96 10.
2. Composition selon la revendication 1 dans laquelle la composition présente un IOM d'au moins 93.
3. Composition selon la revendication 1 dans laquelle la composition présente un IOM d'au moins 94.
4. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend un alkylat en une quantité allant jusqu'à 90 % en vol.
5. Composition selon la revendication 4 dans laquelle l'alkylat a été distillé de telle manière qu'il présente un point d'ébullition non supérieur à 170 °C.
6. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend un isomérat et/ou de l'isopentane (2-méthylbutane) en une quantité combinée totale allant jusqu'à 40 % en vol.
7. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend un isomérat et/ou de l'isopentane (2-méthylbutane) en une quantité combinée totale de moins de 20 % en vol.
8. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend des composés aromatiques en une quantité allant jusqu'à 25 % en vol.
9. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend un colorant.
10. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend un ou plusieurs anti-oxydants tels que des phénols à encombrement.
11. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend un ou plusieurs agents améliorant la lubrification tels que des acides, esters et/ou amides.
12. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend un biocarburant.
13. Composition selon l'une quelconque des revendications précédentes dans laquelle la composition comprend un ou plusieurs additifs pour réduire l'érosion des sièges de soupape, tels que des additifs de réduction de l'érosion des sièges de soupape à base de phosphore, de potassium ou de sodium.
14. Procédé de fonctionnement d'un moteur d'aviation à étincelles qui comprend la fourniture audit moteur d'une composition de carburant d'aviation selon l'une quelconque des revendications 1 à 13.
15. Procédé selon la revendication 14 qui comprend en outre l'ajout à ladite composition de carburant d'aviation, au point d'utilisation, d'au moins un inhibiteur de givrage de circuit de carburant.
16. Procédé de préparation d'une composition de carburant d'aviation selon l'une quelconque des revendications 1 à

EP 1 560 900 B1

13 qui comprend le mélange d'un ou plusieurs liquides à traiter choisis dans le groupe constitué de l'iso-octane, d'un alkylat, de l'isopentane, d'un isomérat, d'un produit d'hydrocraquage, de composés aromatiques et de flux de naphta.

- 5 **17.** Procédé selon la revendication 16 qui comprend en outre l'ajout, aux un ou plusieurs desdits liquides à traiter ou à un mélange de ceux-ci, d'un ou plusieurs additifs de carburant d'aviation choisis dans le groupe constitué d'un colorant, d'anti-oxydants, d'agents améliorant la lubrification et d'additifs pour réduire l'érosion des sièges de sou-
- 10 pape.

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REFERENCES CITED IN THE DESCRIPTION

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