(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 683 852 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.07.2006 Bulletin 2006/30

(21) Application number: **06100627.6**

(22) Date of filing: **19.01.2006**

(51) Int Cl.:
C10M 171/00 *(2006.01)* ***C10M 163/00*** *(2006.01)*
C10M 167/00 *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **21.01.2005 JP 2005014076**

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(54) Lubricating oil composition

(57) A lubricating oil composition comprising one or more salicylate-type detergents, one or more ashless friction modifiers and base oil, wherein the base oil comprises a base oil component having an oil film thickness of 95 nm or less, when measured under conditions of a sliding speed of 4.4 m/s, a Hertz pressure of 0.53 GPa and an oil temperature of 100°C; and
a method for reducing fuel consumption in an internal combustion engine comprising lubricating said internal combustion engine with the afore-mentioned lubricating oil composition.

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Description

[0001] The present invention relates to a lubricating oil composition, in particular to a lubricating oil composition for use in gasoline engines, which has superior low fuel consumption properties.

[0002] The demand for petroleum in Japan is about 250 million kilolitres a year. Of that, about 40% is consumed as fuels such as gasoline or diesel fuel oil in automobiles. About 20% of the total carbon dioxide gas emissions in Japan emanate from the transport sector, and the trend of these emissions is to increase year by year.

[0003] The Global Warming Conference held in Kyoto in December 1997 discussed reductions in carbon dioxide gas emissions, and Japan agreed to a target of reducing carbon dioxide gas emissions by 6% from the level of 1990. The transport sector was thus put under an obligation to improve fuel consumption by about 20% compared with 1995 by 2010. Hence, reducing the amount of carbon dioxide gas emitted from automobiles by further reducing the fuel consumption of gasoline and diesel internal combustion engines became a most important issue.

[0004] Many techniques have been proposed to reduce the amount of carbon dioxide gas emitted from automotive vehicles by reducing fuel consumption, such as improving engine combustion efficiency or reducing the weight of vehicle bodies or engines. However, the lowest cost burden on society in order to reduce fuel consumption is by reducing friction inside an engine by means of the lubricating oil composition with which the engine is lubricated. In particular, unlike improvements in fuel efficiency, reduction in fuel consumption based on the use of specific lubricating oil compositions, does not require alteration of the engine design or the like. Hence, this approach is convenient and can be applied over a wide range.

[0005] The prior art used in conventional fuel-economy gasoline engine oils has in most cases been achieved by adding a friction modifier, especially an organomolybdenum-type friction modifier, or by using a base oil having a high viscosity index. The prior art in which organomolybdenum-type friction modifiers are incorporated is described in Laid-open Japanese Patent Application 2001-348591, Laid-open Japanese Patent Application 2002-12884, Laid-open Japanese Patent Application 2002-371292, Laid-open Japanese Patent Application 2001-181664, Laid-open Japanese Patent Application 08-302378 and Laid-open Japanese Patent Application 09-3463. However, there is concern that organomolybdenum type friction modifiers are expensive.

[0006] SAE Technical paper 951036 may be cited as a typical example of the prior art which focuses on the characteristics of the base oil of the gasoline engine oil and resolves the aforementioned problems by using a base oil with a large viscosity index.

[0007] It is highly desirable to be able to offer lubricating oil compositions with superior low fuel consumption properties, by which it is therefore possible substantially to reduce the amount of carbon dioxide gas emissions from automobiles, by an approach which is different from the aforementioned prior art.

[0008] It has now been surprisingly found that specific lubricating oil compositions achieve advantageous fuel consumption properties.

[0009] Accordingly, the present invention provides a lubricating oil composition comprising one or more salicylate-type detergents, one or more ashless friction modifiers and base oil, wherein the base oil comprises a base oil component having an oil film thickness of 95 nm or less, when measured under conditions of a sliding speed of 4.4 m/s, a Hertz pressure of 0.53 GPa and an oil temperature of 100°C.

[0010] The oil film thickness of the base oil component is preferably 80 nm or less, more preferably 70 nm or less, when measured under conditions of a sliding speed of 4.4 m/s, a Hertz pressure of 0.53 GPa and an oil temperature of 100°C.

[0011] The method of measuring the afore-mentioned oil film thickness in the present invention is according to the method in SAE Technical Paper 961142 using the film thickness rig shown in Figure 1 therein.

[0012] In a preferred embodiment of the present invention, there is provided a lubricating oil composition wherein the afore-mentioned base oil component is present in an amount of 5 % or more by mass, more preferably in an amount of 7 % or more by mass and most preferably in an amount of 9 % or more by mass, of the entire base oil.

[0013] The one or more salicylate-type detergents in the lubricating oil composition of the present invention are preferably present in an amount in the range of from 0.5 to 10.0 % by mass, more preferably in an amount in the range of from 1.0 to 8.0 % by mass and most preferably in an amount in the range of from 1.0 to 5.0 % by mass, based on the total mass of the lubricating oil composition.

[0014] Increasing the amount of one or more salicylate-type detergents has the effect of improving the detergency and oxidation stability, but if the amount thereof exceeds 10.0 % by mass, then the additional effectiveness may decrease. Further, the addition of a large amount of detergents is connected with an increase in ash inside the lubricating oil composition which thereby leads to an increase in the amount of piston deposits generated. Hence, it is desirable to use 10.0 % by mass or less. Furthermore, if the amount of said one or more salicylate detergents is less than 0.5 % by mass, then no effect may be obtained. Hence an amount of 0.5 % or above by mass of the one or more salicylate-type detergents is preferred.

[0015] The one or more salicylate-type detergents that may be conveniently used in the lubricating oil composition of

the present invention include oil-soluble basic salts of aromatic carboxylic acids and Group 2 metals of the Periodic Table having atomic numbers between 12 and 56, i.e. where the total base number is 12 mg.KOH/g or more, these being compounds shown in Japanese Patents 1271215 and 1031507.

[0016] However, in the present invention, calcium salts and magnesium salts are preferred for the alkyl salicylate metallic salt compounds. As the salicylate-type detergents in the present invention, calcium alkyl benzene salicylates are especially preferred.

[0017] In the case of alkyl salicylate beryllium salts and barium salts, there is a possibility that water soluble salts may occur because of the reaction between the moisture content due to combustion in the internal combustion engine and the weak acids formed by oxidation and deterioration of the lubricating oil, and these salts may not be desirable on environmental grounds given the toxicity of their products. Furthermore, in the case of beryllium salts, since the hardness of crystals of beryllium carbonate produced by reaction with carbon dioxide is high, there is concern that this could be detrimental to the anti-friction properties. As regards other metals, the cost of metals is high and there may be difficulties in making them available for use.

[0018] The one or more salicylate-type detergents used in the present invention can be either neutral or overbased. The expression "overbased" is equivalent to "basic", "superbased", "hyperbased" and "high-metal containing salts". These detergents contain an excess metal content compared to the amount of metal which would be present according to the stoichiometry of the metal and the acidic organic compound reacted with the metal. Processes for making such neutral and basic metal salts are well known in the art. Neutral salts can be made by heating a mineral oil solution of an acidic organic compound with a stoichiometric equivalent amount of a metal neutralizing agent such as the metal oxide, hydroxide, carbonate, bicarbonate, or sulfide at a temperature above 50 °C and filtering the resulting mass. Basic salts are made similarly with the exception that a stoichiometric excess of the metal is used. Preferably, overbased salicylate-type detergents are used.

[0019] Detergents can be characterized by their total base number (TBN). Preferably, the total base numbers of the one or more salicylate-type detergents in the lubricating oil composition of the present invention are each, independently, in the range of from 30 to 600 mg.KOH/g, more preferably in the range of from 50 to 400 mg.KOH/g and most preferably in the range of from 30 to 350 mg.KOH/g, as measured by ISO 3771.

[0020] Salicylate-type detergents that may be conveniently used may be either substituted or unsubstituted. Suitable substituents include aliphatic groups containing from 1 to 40 carbon atoms and optionally containing one or more oxygen and/or nitrogen atoms, and hydroxy groups. Preferred substituents are alkyl groups containing in the range of from 6 to 30 carbon atoms, preferably in the range of from 12 to 20 carbon atoms. Preferably, the substituents are linear. The salicylate-type detergents may contain in the range of from 1 to 4 substituents, preferably in the range of from 1 to 3, most preferably 1 or 2 substituents. Most preferably, the salicylate-type detergents may be substituted by 1 linear alkyl group containing in the range of from 14 to 18 carbon atoms.

[0021] Generally, mono-alkyl salicylic acids are prepared by alkylation of phenol and subsequent carboxylation. Therefore, a small amount (generally at most 20 %mol) of dialkyl salicylate and unsubstituted salicylate can be present in the mono-alkyl salicylate.

[0022] Calcium and magnesium salicylate-type detergents which may be used in the present invention are commercially available. For example, a commercial magnesium salicylate is that available under the trade designation "Infineum C9012" from Infineum. Examples of commercial calcium detergents include the calcium salicylates which are available from Infineum under the trade designations "Infineum M7101", "Infineum M7102" and "Infineum M7105".

[0023] The one or more ashless friction modifiers in the lubricating oil composition of the present invention are preferably present in an amount in the range of from 0.01 to 5.0 % by mass, more preferably in an amount in the range of from 0.05 to 2.5 % by mass and most preferably in an amount in the range of from 0.5 to 2.5 % by mass, based on the total mass of the lubricating oil composition.

[0024] Increasing the amount of the one or more ashless friction modifiers in the lubricating oil composition of the present invention has the effect of improving the low fuel consumption characteristics. However, if the amount thereof exceeds 5.0 % by mass, then the additional effectiveness may decrease. Hence, an amount of 5.0 % by mass or less is preferred.

[0025] Furthermore, if the amount of said one or more ashless friction modifiers is less than 0.01 % by mass, then no effect may be obtained. Hence, an amount of 0.01 % or above by mass of the one or more ashless friction modifiers is preferred.

[0026] With ashless friction modifiers based on alkyl carboxylic acids, alkyl carboxylic acid esters, alkyl amines, alkyl amides and alkyl ethers, the greater the length of the alkyl group, the greater the friction-reducing effect. However, as the alkyl chain increases in length, the solubility in the base oil may be reduced.

[0027] An oleyl group has sufficient length in terms of alkyl chain length to display a friction-reducing action, and furthermore it includes unsaturated bonds within its molecules. Ashless friction modifier compounds containing an oleyl group have a higher solubility in respect of the lubricating oil base oil than other ashless friction modifiers. It is therefore more advantageous than other ashless friction modifiers in respect of friction-reducing effect.

[0028] The one or more ashless friction modifiers are preferably compounds containing an oleyl group.

[0029] As base oil in the lubricating oil composition of the present invention, mineral oils, synthetic oils and mixtures of two or more base oils selected from mineral oils and synthetic oils may be used.

[0030] The base oil components which satisfy the conditions of oil film thickness as measured under the afore-mentioned conditions may also be selected from mineral oils and synthetic oils. Mineral oils, mixtures of mineral oils and synthetic oils with no aromatic constituent, or mixtures of synthetic oils with an aromatic constituent and synthetic oils with no aromatic constituent may be cited as examples.

[0031] In general, in addition to detergents and friction modifiers, additives such as anti-wear agents, ashless dispersants, anti-oxidants, viscosity index improvers, pour-point depressants and anti-foaming agents may be incorporated into the lubricating oil composition of the present invention.

[0032] As an anti-wear agent, zinc dithiophosphate (ZnDTP) may be generally incorporated. Preferred zinc dithiophates are those in the forms having an alkyl group with 3 to 12 carbons and where its alcohol residual group is secondary (Sec-ZnDTP) or primary (Pri-ZnDTP), or a mixture thereof. The amount of zinc dithiophosphate present in the lubricating oil composition of the present invention is preferably in the range of from 0.03 to 0.1 % by mass in terms of elemental phosphorus content, more preferably in the range of from 0.03 to 0.08 % by mass in terms of elemental phosphorus content, based on the total mass of the lubricating oil composition.

[0033] Ashless dispersants may be conveniently present in an amount in the range of from 2 to 10 % by mass. Ashless dispersants that may be conveniently used include polyalkenyl succinimides and polyalkenyl succinic acid esters as disclosed in Japanese Laid-Open Patent Applications JP 53-050291 A, JP 56-120679 A, JP 53-056610 A and JP 58-171488 A and boron derivatives of these compounds.

[0034] Examples of anti-oxidants that may be conveniently used in the lubricating oil composition of the present ivnention include phenolic-based anti-oxidants such as 2-t-butylphenol, 2-t-butyl-4-methylphenol, 2-t-butyl-5-methylphenol, 2,4-di-t-butylphenol, 2,4-dimethyl-6-t-butylphenol, 2-t-butyl-4-methoxyphenol, 3-t-butyl-4-methoxyphenol, 2,6-di-t-butylphenol, 2,6-di-t-butyl-4-methylphenol, 2,6-di-t-butyl-4-ethylphenol, 2,6-di-t-butyl-4-methoxyphenol, 2,6-di-t-butyl-4-ethoxyphenol, 3,5-di-t-butyl-4-hydroxybenzyl mercapto-octylacetate, n-dodecyl-3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate, 2'-ethylhexyl-3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate, 2,6-di-t-butyl-α-dimethylamino-p-cresol, 4,4'-methylenebis(2,6-di-t-butylphenol), 4,4'-bis(2,6-di-t-butylphenol), 2,2-bis(3,5-di-t-butyl-4-hydroxyphenyl)propane, 4,4'-cyclohexylidene bis(2,6-t-butylphenol), hexamethylene glycol bis[3-(3,5-di-t-butyl-4-hydroxyphenyl) propionate] (e.g. as manufactured by Ciba Specialty Chemicals, Inc. under the trade designation "Irganox L109"), 2,2'-thio-[diethyl-3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate] (e.g. as manufactured by Ciba Specialty Chemicals, Inc. under the trade designation "Irganox L115"), tetrakis[methylene-3-(3,5-di-t-butyl-4- hydroxyphenyl)propionate]methane (e.g. as manufactured by Ciba Specialty Chemicals, Inc. under the trade designation "Irganox L101"), 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene (e.g. as manufactured by Shell Japan, Inc. under the trade designation "Ionox 330"), bis-[3,3'-bis-(4'-hydroxy-3'-t-butylphenyl)butylic acid]glycol ester, 2-(3',5'-di-t-butyl-4-hydroxyphenyl)methyl-4-(2'',4''-di-t-butyl-3''-hydroxyphenyl)methyl-6-t-butylphenol, 2,6-bis(2'-hydroxy-3'-t-butyl-5'-methylbenzyl)-4-methylphenol and amine-based anti-oxidants such as p,p'-dioctyldiphenylamine, p,p'-di-α-methylbenzyldiphenylamine, N-p-butylphenyl-N-p'-octylphenylamine, mono-t-butyldiphenylamine, monooctyldiphenylamine, di(2,4-diethylphenyl)amine, di(2-ethyl-4-nonylphenyl)amine, octylphenyl-1-naphthylamine, N-t-dodecylphenyl-1-naphthylamine, 1-naphthylamine, phenyl-1-naphthylamine, phenyl-2-naphthylamine, N-hexylphenyl-2-naphthylamine, N-octylphenyl-2-naphthylamine, N,N'-diisopropyl-p-phenylenediamine, N,N'-diphenyl-p-phenylenediamine and organomolybdenum compounds such as molybdenum dithiocarbamate and molybdenum alkylamine salts.

[0035] Anti-oxidants may be used singly or in combination in the lubricating oil composition of the present invention.

[0036] Such anti-oxidants may be conveniently present in amount in the range of from 0.01 to 5% by mass, more preferably in an amount in the range of from 0.1 to 3% by mass, based on the total mass of the lubricating oil composition.

[0037] Examples of viscosity index improvers that may be conveniently used in the lubricating oil composition of the present invention include styrene-butadiene copolymers, styrene-isoprene star copolymers, polymethacrylates and ethylene-propylene copolymers described in Japanese Laid-Open Patent Application JP 47-010386 A, Japanese Laid-Open Patent Application JP 47-006527 A, Japanese Laid-Open Patent Application JP 56-084704 A, Japanese Laid-Open Patent Application JP 58-109515 A and Japanese Laid-Open Patent Application JP 59-136394 A.

[0038] Viscosity index improvers may be conveniently used in an amount in the range of from 1 to 20% by mass, based on the total mass of the lubricating oil composition.

[0039] It is also possible to use dispersant-type viscosity index improvers in which polar monomers containing nitrogen and oxygen atoms in their molecules have been copolymerised with these.

[0040] Examples of pour-point depressants that may be conveniently used in the lubricating oil composition of the present invention include methacrylate polymers, for example, as described in Japanese Laid-Open Patent Applications JP 47-025207 A and JP 47-042806 A.

[0041] Examples of rust preventing agents that may be conveniently used in the lubricating oil composition of the present invention include alkenyl succinic acid and partial esters thereof, benzotriazole-type compounds and thiadiazole-

type compounds.

[0042] As the defoaming agent, dimethylpolysiloxane and polyacrylates may be conveniently used.

[0043] The present invention further provides the use of a lubricating oil composition as hereinbefore described to reduce fuel consumption in an internal combustion engine, in particular in a gasoline internal combustion engine.

[0044] In another embodiment of the present invention there is provided a method of lubricating an internal combustion engine, in particular a gasoline internal combustion engine, comprising applying a lubricating oil composition as hereinbefore described thereto.

[0045] The present invention also provides a method of reducing fuel consumption in an internal combustion engine, in particular in a gasoline internal combustion engine, comprising lubricating said internal combustion engine with a lubricating oil composition as hereinbefore described.

EXAMPLES

[0046] The present invention is described below with reference to the following Examples which are not intended to limit the scope of the present invention in any way.

[0047] In order to clarify further the characteristics of the present invention, a low fuel consumption lubricating oil composition for use in gasoline engines which is currently in general use in the relevant field is compared in Table 1 to lubricating oil composition which is according to a preferred embodiment of the present invention.

TABLE 1

	Preferred embodiment of the lubrication oil composition of the present invention	Prior Art low fuel consumption engine oil
Base Oil A (oil film thickness 95nm or less)*	10 % or more by mass	-
Base Oil B (oil film thickness greater than 95nm)*	Balance	Balance
Detergent	Calcium salicylate	Calcium sulphonate
Ashless friction modifier	Ashless friction modifier	Organomolybdenum friction modifier
Viscosity index improver	Viscosity index improver	Viscosity index improver
Ashless dispersant	Ashless dispersant	Ashless dispersant
ZnDTP	ZnDTP	ZnDTP
Anti-oxidant	Anti-oxidant	Anti-oxidant
Pour-point depressant	Pour-point depressant	Pour-point depressant
Defoaming agent	Defoaming agent	Defoaming agent

* as measured under conditions of a sliding speed of 4.4 m/s, a Hertz pressure of 0.53 GPa and an oil temperature of 100°C.

(1) A lubricating oil composition with superior low fuel consumption properties is obtained by the present invention.

(2) The present invention achieves advantageous fuel consumption properties by the use of a combination of a specific base oil and a specific additive combination.

(3) The present invention has been able to achieve advantageous fuel consumption properties even without the use of ash containing friction-reducing agents such as organomolybdenum compounds.

[0048] The experiment methods used in the Examples were as follows:-

The oil film thickness of the base oil was measured by the method described in SAE Technical Paper 961142 (using the film thickness rig of Figure 1 therein).
The high-temperature/high-shear viscosity was obtained by the experimental method of ASTM D5481.
The kinematic viscosities at 100°C and 40°C were obtained by the experimental method of JIS K2283.
The viscosity index was obtained by the experimental method of JIS K2283.

Evaluation of low fuel consumption properties

[0049] Figure 1 represents a schematic drawing of the engine torque loss test apparatus used for evaluation of low fuel consumption properties. 1, 2 and 3 in said Figure represent the test engine, the torque meter and the motor, respectively.
[0050] A 3.0 L engine with a direct-acting valve train system was used. The engine speed was regulated from idle revolutions to 2800 rpm by means of an electric motor at an engine oil temperature of 80°C.
[0051] The friction properties of the engine oils were evaluated by gauging the friction loss torque produced.
[0052] The results show the extent to which engine loss torque at the various engine speeds has been improved as percentage improvement of engine loss torque relative to Comparative Example 1.
[0053] The properties of the base oils used in the Examples and the Comparative Examples are shown in Table 2. The compositions of the Examples and the Comparative Examples are shown in Table 3, and the results of their low fuel consumption evaluations are shown in Table 4. Table 4 shows the degree of improvement of each of the Examples and Comparative Examples relative to Comparative Example 1. Hence, the data in Table 4 for Comparative Example 1 are precisely 0.

TABLE 2

	Base oil A	Base oil B	Base oil C	Base oil D	Base oil E
Oil film thickness* (nm)	64	101	100	118	111
High-temperature/high-shear viscosity at 100°C (mPas)	2.9	3.8	3.2	5.0	3.8
Kinematic viscosity at 100°C ($mm^2 s^{-1}$)	3.9	5.1	4.3	6.4	4.6
Kinematic viscosity at 40°C ($mm^2 s^{-1}$)	16.2	23.9	20.2	35.4	25.2
Viscosity index	140	147	123	134	99
*Measured under conditions of sliding speed 4.4 m/s, Hertz pressure 0.53 GPa, oil temperature 100°C in accordance with the method described in SAE Technical Paper 961142 (using the film thickness rig of Figure 1 therein).					

[0054] The base oils in Table 2 were as follows:-
Base Oil A: Group III base oil available from the Shell group under the trade designation "XHVI-4".
Base Oil B: Group III base oil available from the Shell group under the trade designation "XHVI-5.2".
Base Oil C: Polyalphaolefin (PAO) synthetic oil.
Base Oil D: Mineral Oil available from SK Corp. under the trade designation "Yubase 6".
Base Oil E: HVI60 mineral oil.

TABLE 3

	Example 1	Example 2	Comparative Example 1	Comparative Example 2	Comparative Example 3
Viscosity Grade	5W-30	0W-30	5W-30	5W-30	5W-30
Base oil A	10	Balance	-	-	-
Base oil B	Balance	-	30	-	-
Base oil C	-	-	-	35	Balance
Base oil D	-	-	-	Balance	-
Base oil E	-	-	Balance	-	10
Calcium salicylate	3.5	3.5	-	3.5	-
Calcium sulphonate	-	-	4.5	-	4.5
Ashless friction modifier	1.5	1.5	-	1.5	1.5
Viscosity index improver	4.5	6.8	4.5	4.0	4.5
Ashless dispersant	6.0	6.0	6.0	6.0	6.0
ZnDTP	1.0	1.0	1.0	1.0	1.0
Anti-oxidant	1.0	1.0	1.0	1.0	1.0
Pour-point depressant	0.3	0.3	0.3	0.3	0.3
Defoaming agent	0.003	0.003	0.003	0.003	0.003
Total (% by mass)	100	100	100	100	100

TABLE 4

		Example 1	Example 2	Comparative Example 1	Comparative Example 2	Comparative Example 3
	Viscosity Grade	5W-30	0W-30	5W-30	5W-30	5W-30
Engine torque improvement % (with Comparative Example 1 taken as the standard)	Idle	11.6	13.1	0.0	8.8	4.7
	1000 rpm	4.4	5.8	0.0	1.1	0.4
	1600 rpm	1.2	3.1	0.0	-1.4	-1.5
	2800 rpm	0.2	1.5	0.0	-1.4	-1.3

[0055] 5W-30 and 0W-30 in Table 4 are SAE engine viscosity grades in the viscosity classifications of SAE engine oils.

[0056] "Idle" in Table 4 refers to the state where no shaft horsepower is being produced and the rated number of revolutions is maintained by overcoming the mechanical losses of the engine.

[0057] The calcium salicylate in Table 3 was that available from Infineum Japan Inc. under the trade designation "Infineum M7101", and the calcium sulphonate was that available from Lubrizol Japan, Inc. under the trade designation "Lz 52".

[0058] The ashless friction modifier in Table 3 was the oleic acid ester available from Kao, Inc. under the trade designation "Emazol MO".

[0059] The viscosity index improver in Table 3 was the polymethacrylate available from Degussa Japan, Inc. under the trade designation "Viscoplex 6-950".

[0060] The ashless dispersant was the polyalkenyl succinimide available from Infineum Japan, Inc. under the trade designation "Infineum M7107".

[0061] The anti-wear agent (ZnDTP) was that available from Lubrizol Japan, Inc. under the trade designation "Lz 1395".

[0062] The anti-oxidant was the phenolic anti-oxidant available from Ciba Specialty Chemicals, Inc. under the trade designation "Irganox L135".

[0063] The pour-point depressant was the polymethacrylate available from Infineum Japan, Inc. under the trade designation "Infineum V351".

[0064] The defoaming agent was dimethylpolysiloxane available from Dow Corning, Inc.

Claims

1. A lubricating oil composition comprising one or more salicylate-type detergents, one or more ashless friction modifiers and base oil, wherein the base oil comprises a base oil component having an oil film thickness of 95 nm or less, when measured under conditions of a sliding speed of 4.4 m/s, a Hertz pressure of 0.53 GPa and an oil temperature of 100°C.

2. Lubricating oil composition according to Claim 1, wherein the base oil component is present in an amount of 5 % or more by mass, of the entire base oil.

3. Lubricating oil composition according to Claim 1 or 2, wherein the one or more salicylate-type detergents are present in an amount in the range of from 0.5 to 10.0 % by mass, based on the total mass of the lubricating oil composition.

4. Lubricating oil composition according to any one of Claims 1 to 3, wherein the one or more ashless friction modifiers are present in an amount in the range of from 0.01 to 5.0 % by mass, based on the total mass of the lubricating oil composition.

5. Lubricating oil composition according to any one of Claims 1 to 4, wherein the one or more salicylate-type detergents are selected from calcium and magnesium salicylate-type detergents.

6. Lubricating oil composition according to any one of Claims 1 to 5, wherein the one or more ashless friction modifiers are compounds containing an oleyl group.

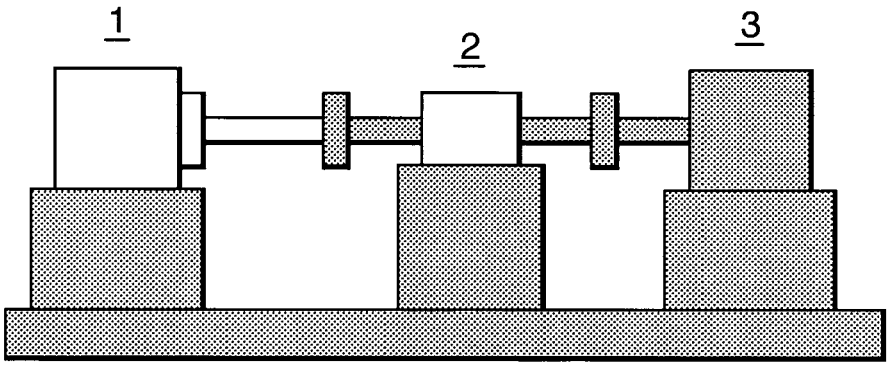
7. Lubricating oil composition according to any one of Claims 1 to 6, wherein the base oil comprises a base oil component having an oil film thickness of 80 nm or less, when measured under conditions of a sliding speed of 4.4 m/s, a Hertz pressure of 0.53 GPa and an oil temperature of 100 °C.

8. Use of a lubricating oil composition according to any one of Claims 1 to 7, to reduce fuel consumption in an internal combustion engine, in particular in a gasoline internal combustion engine.

9. A method of reducing fuel consumption in an internal combustion engine, in particular in a gasoline internal combustion engine, comprising lubricating said internal combustion engine with a lubricating oil composition according to any one of Claims 1 to 7.

10. A method of lubricating an internal combustion engine, in particular a gasoline internal combustion engine, comprising applying a lubricating oil composition according to any one of Claims 1 to 7 thereto.

Fig.1.



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 10 0627

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 May 2006	Bertrand, S

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