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(54) **Title**: LUBRICATING COMPOSITION CONTAINING AN ESTER OF AN AROMATIC CARBOXYLIC ACID

(57) **Abstract**: The invention provides a lubricating composition containing an oil of lubricating viscosity and an ester, thioester, amide or imide of a carboxylic acid compound where said carboxylic acid is characterized in that it is functionalized with a hydroxy-substituted aromatic moiety. The invention further relates to methods of lubricating an internal combustion engine by supplying the described lubricating composition to the internal combustion engine. The invention further relates to the use of the salt of the carboxylic acid compound as an antiwear agent or an antioxidant.

TITLE

LUBRICATING COMPOSITION CONTAINING AN ESTER OF AN AROMATIC CARBOXYLIC ACID

FIELD OF INVENTION

[0001] The invention provides a lubricating composition containing a derivative of an aromatic compound and an oil of lubricating viscosity. The invention further relates to the use of the lubricating composition in an internal combustion engine. The invention further relates to the use of the derivative of the aromatic compound as an antioxidant.

BACKGROUND OF THE INVENTION

[0002] It is well known for lubricating oils to contain a number of surface active additives (including antiwear agents, dispersants, or detergents) used to protect internal combustion engines from corrosion, wear, soot deposits and acid build up. Often, such surface active additives can have harmful effects on engine component wear (in both iron and aluminum based components), bearing corrosion or fuel economy. A common antiwear additive for engine lubricating oils is zinc dialkyldithiophosphate (ZDDP). It is believed that ZDDP antiwear additives protect the engine by forming a protective film on metal surfaces. ZDDP may also have a detrimental impact on fuel economy and efficiency and copper corrosion. Consequently, engine lubricants may also contain a friction modifier to obviate the detrimental impact of ZDDP on fuel economy and corrosion inhibitors to obviate the detrimental impact that ZDDP may have on copper corrosion. Friction modifiers and other additives may also increase lead corrosion.

[0003] Further, engine lubricants containing phosphorus and sulfur compounds such as ZDDP have been shown to contribute in part to particulate emissions and emissions of other pollutants. In addition, sulfur and phosphorus tend to poison the catalysts used in catalytic converters, resulting in a reduction in performance of said catalysts.

[0004] There has been a commercial trend for reduction in emissions (typically reduction of NOx formation, SOx formation) and a reduction in sulfated ash in engine oil lubricants. Consequently, the amounts of phosphorus-containing antiwear agents such as ZDDP, overbased detergents such as calcium or magnesium sulfonates and phenates have been reduced. As a consequence, ashless additives have been contemplated to provide friction, antiwear, or antioxidant performance. It is known

that surface active ashless compounds such as ashless friction modifiers may in some instances increase corrosion of metal, namely, copper or lead. Copper and lead corrosion may be from bearings and other metal engine components derived from alloys using copper or lead. Consequently, there may be a need to reduce the amount of corrosion caused by ashless additives.

[0005] U.S. Patent 3,245,909 discloses lubricating compositions comprising a major amount of lubricating oil and minor amounts of an alkenyl succinimide dispersant and 2,4-dihydroxybenzoic acid.

[0006] U.S. Patents 4,156,655 and 4,376,060 disclose lithium grease compositions made with boric acid, fatty acid and optionally a hydroxycarboxylic acid, including 2,5-dihydroxybenzoic acid (gentisic acid); 2,6-dihydroxybenzoic acid (gamma resorcyclic acid); and 4-hydroxy-4-methoxybenzoic acid.

[0007] U.S. Patent 4,627,928 discloses basic magnesium salts of substituted aromatic hydroxy-containing carboxylic acids including alkyl-substituted 2,5-dihydroxy benzoic acid and alkylated 4,6-dihydroxy toluic acid.

[0008] U.S. Patent 5,143,635 discloses a method of reducing drag in conduits by using an additive composition comprising a quaternary ammonium salt of 2,6-dihydroxybenzoic acid.

[0009] U.S. Patent 5,686,398 discloses fuel and lubricant additives comprising aryl esters of hydroxyaromatic carboxylic acids, including dihydroxybenzoic acid and dihydroxynaphthoic acid.

[0010] U.S. Patent 6,399,549 discloses cyclic coupling products of alkylphenols and at least one hydroxy-substituted aromatic carboxylic acid, which may optionally be selected from 2,4-dihydroxybenzoic acid, 3,5-dihydroxybenzoic acid, 2,5-dihydroxybenzoic acid, and/or 2,6-dihydroxybenzoic acid.

[0011] US Patent 5,576,274 discloses fuel and lubricant additives useful as dispersants and multifunctional viscosity modifiers wherein a dihydroxyaromatic compound is alkylated with an olefinic polymer and then aminated in such a manner as to oxidize the hydroxyl moieties of the dihydroxyaromatic compound to carbonyl groups.

SUMMARY OF THE INVENTION

[0012] The inventors of this invention have discovered a lubricating composition that is capable of providing at least one of antiwear performance, friction modification (particularly for enhancing fuel economy), extreme pressure performance, antioxidant performance, lead, tin or copper (typically lead) corrosion inhibition, decreased corrosiveness towards acrylate or fluoro-elastomer seals, or seal swell performance.

[0013] As used herein reference to the amounts of additives present in the lubricating composition disclosed herein are quoted on an oil free basis i.e., amount of actives, unless otherwise noted.

[0014] The present invention provides for a lubricating composition containing an oil of lubricating viscosity and an additive comprising an ester, a thio ester, amide, or imide of a carboxylic acid or any combination thereof wherein the carbonyl carbon of the acid is attached directly or through a divalent hydrocarbyl linkage to an aromatic moiety wherein said aromatic moiety includes two or more hydroxy-groups, alkoxy-groups, or mixtures thereof, with the proviso that if said aromatic moiety consists of a single ring, then no two hydroxy-groups, alkoxy-groups, or mixtures thereof are located on adjacent carbon atoms of said aromatic ring.

[0015] The invention further provides a method of making the described (thio)esters, amides, or imides of carboxylic acids.

[0016] The invention further provides a method of lubricating an internal combustion engine comprising the step of: (I) supplying to the internal combustion engine the lubricating composition described herein.

[0017] The invention further provides the use of the described (thio)esters, amides, or imides of carboxylic acids.

DETAILED DESCRIPTION OF THE INVENTION

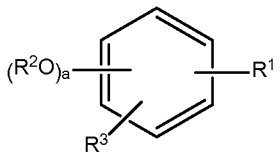
[0018] Various preferred features and embodiments will be described below by way of non-limiting illustration.

[0019] The present invention provides a lubricating composition comprising an oil of lubricating viscosity and an ester, thioester, amide, or imide of a carboxylic acid or any combination thereof wherein the carbonyl carbon of the acid is attached directly or through a divalent hydrocarbyl linkage to an aromatic moiety wherein said aromatic moiety includes two or more hydroxy-groups, alkoxy-groups, or mixtures thereof, with the proviso that if said aromatic moiety consists of a single ring, then no

two hydroxy-groups, alkoxy-groups, or mixtures thereof are located on adjacent carbon atoms of said aromatic ring.

The (thio)ester, amide or imide of a carboxylic acid

[0020] In one embodiment the present invention provides a lubricating composition comprising an oil of lubricating viscosity and an ester, thioester, amide or imide of a carboxylic acid wherein the carboxylic acid comprises a compound of Formula (1):

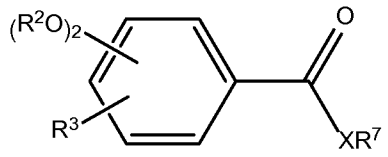


Formula (1)

wherein a may be an integer from 2 to 4, or from 2 to 3, or even just 2 or just 3; R^1 may be –C(O)OH, or $–R^4$-C(O)OH; each R^2 may be independently hydrogen, a linear or branched hydrocarbyl group containing 1 to 10 carbon atoms, or mixtures thereof; R^3 may be hydrogen or a hydrocarbyl group containing 1 to 30 carbon atoms; R^4 may be a divalent hydrocarbyl group of 1 to 10 carbon atoms which includes –CH=CH-; $-C(R^5)_2C(R^5)_2-$ (such as $-CH_2CH_2-$), each R^5 may be hydrogen, –CN, NH_2, an ester group $–C(O)O-R^6$, or mixtures thereof; and R^6 may be hydrogen or a hydrocarbyl group containing 1 to 30, or 6 to 20, or 8 to 15 carbon atoms, with the proviso that no two hydroxy-groups, alkoxy-groups, or mixtures thereof (i.e. $–(OR^2)$) are attached to adjacent carbon atoms of the aromatic ring. In some embodiments the R^1 and R^3 groups may be linked to form a ring, for example a 5 member or 6 member ring. In some of these embodiments the linked group of R^1 and R^3 may be $-O-C(=O)-CH_2CH_2-$ or $-C(=O)-O-CH_2CH_2-$.

[0021] In one embodiment, the aromatic moiety has from 2 to 4 hydroxy-groups, alkoxy-groups, or mixtures thereof, where no two of said hydroxy-groups or alkoxy-groups are located on adjacent carbon atoms of an aromatic ring of said aromatic moiety. By saying adjacent carbon atoms of the aromatic moiety, it is meant that, for example one hydroxy group is bonded to a carbon atom of a ring structure in the aromatic moiety and a second hydroxy group is not bonded to the next carbon atom in the same ring structure of the aromatic moiety.

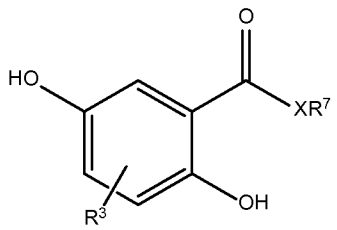
[0022] In one embodiment the present invention provides a lubricating composition comprising an oil of lubricating viscosity and an ester, thioester, amide, or imide according to Formula (2):



Formula (2)

wherein each R^2 may be independently hydrogen, a linear or branched hydrocarbyl group containing 1 to 10 carbon atoms, or mixtures thereof; R^3 may be hydrogen or a hydrocarbyl group containing 1 to 30 carbon atoms; X may be –O-, -S-, or >NR^8; R^7 may be may be a linear or branched hydrocarbyl group (typically alkyl or alkaryl) containing 1 to 40 carbon atoms, 3 to 30 carbon atoms, 4 to 30 carbon atoms, 6 to 30 carbon atoms, 8 to 24 carbon atoms, or 10 to 18 carbon atoms; and R^8 may be hydrogen or a linear or branched hydrocarbyl group containing 1 to 24 carbon atoms, or 8 to 18 carbon atoms, (typically R^8 is hydrogen); with the proviso that the two –OR^2 groups are not attached to adjacent carbon atoms on the aromatic ring.

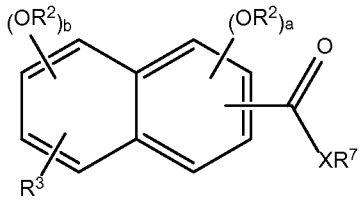
[0023] In one embodiment the present invention provides a lubricating composition comprising an oil of lubricating viscosity and an ester, thioester, amide, or imide according to Formula (3):



Formula (3)

where X is -O-, -S-, or >NR^8, or combinations thereof; R^3 may be hydrogen or a hydrocarbyl group containing 1 to 30 carbon atoms; R^7 may be may be a linear or branched hydrocarbyl group (typically alkyl, alkaryl, alkoxy) containing 1 to 40 carbon atoms, 3 to 30 carbon atoms, 4 to 30 carbon atoms, 6 to 30 carbon atoms, 8 to 24 carbon atoms, or 10 to 18 carbon atoms; and R^8 may be hydrogen or a linear or branched hydrocarbyl group containing 1 to 24 carbon atoms, or 8 to 18 carbon atoms, (typically R^8 is hydrogen).

[0024] In one embodiment the present invention provides a lubricating composition comprising an oil of lubricating viscosity and an ester, thioester, amide or imide of a carboxylic acid comprising at least one carbonyl functional group wherein the carbonyl carbon of the acid is attached directly or through a divalent hydrocarbyl linkage to an aromatic moiety, wherein said aromatic moiety comprises at least two rings and includes two or more hydroxy-groups, alkoxy-groups, or mixtures thereof. A suitable aromatic carboxylic acid may be represented by Formula (4):



Formula (4)

where a is 0 to 2, b is 0 to 2, and a+b is 2 to 4; each R^2 is independently hydrogen, linear or branched hydrocarbyl groups containing 1 to 10 carbon atoms, or mixtures thereof; X is -O-, -S-, or $>NR^8$, or combinations thereof; R^3 is hydrogen or a hydrocarbyl group containing 1 to 30 carbon atoms, R^7 is a linear or branched hydrocarbyl group containing 1 to 30 carbon atoms, and R^8 is hydrogen or a hydrocarbyl group of 1 to 30 carbon atoms.

[0025] In one embodiment each of the R^2 groups in any of the formulas above may be hydrogen. Also, in any of the formulas above, two of the OR groups may be linked to form a cyclic group, for example a 5 member or 6 member ring. For example, two R^2 groups in any of the formulas above may be linked to form a ring. In some embodiments, in Formula (4a) the R^3 group and one of the R^2 groups may be linked to form a ring.

[0026] In one embodiment the compound of the invention may be present in a lubricating composition in a range of 0.01 wt % to 10 wt %, 0.1 wt % to 8 wt %, 0.5 wt % to 7 wt %, or 0.25 wt% to 2 wt% of the lubricating composition. In one embodiment the salted acid compound of the invention may be present in a lubricating composition at a minimum amount of 0.01, 0.1, 0.25, 0.5, 1 or even 2 wt% of the lubricating composition. In any of these embodiments the salted acid compound of the invention may be present in a lubricating composition at a maximum amount of 10, 8, 7, 5, 2 or even 1 wt% of the lubricating composition.

[0027] In one embodiment the compound of the invention may be borated or non-borated. Borating agents are known in the art and include boric acid, boron trioxide, or borate esters. Borating may occur by reaction of the amine salt of aromatic carboxylic acid of formula (1) with the borating agent at a reaction temperature of 80 °C to 200 °C, or 100 °C to 160 °C.

[0028] In one embodiment the compound of the invention (typically a compound derived from formulae (1), (2), (3), and/or (4) may be present in a lubricating composition in a range of 0.01 wt % to 5 wt %, or 0.1 wt % to 4 wt %, or 0.2 wt % to 3 wt %, or 0.5 wt % to 2 wt % of the lubricating composition.

[0029] In one embodiment the lubricating composition of the invention further includes an antiwear agent such as a metal dihydrocarbyl dithiophosphate (typically zinc dialkyldithiophosphate), wherein the metal dihydrocarbyl dithiophosphate contributes at least 100 ppm, or at least 200 ppm, or 200 ppm to 1000 ppm, or 300 ppm to 800 ppm, or 400 ppm to 600 ppm of phosphorus to the lubricating composition.

[0030] In one embodiment the invention provides a method of lubricating an internal combustion engine comprising the step of supplying to the internal combustion engine a lubricating composition as disclosed herein. Generally the lubricant is added to the lubricating system of the internal combustion engine, which then delivers the lubricating composition to the critical parts of the engine, during its operation, that require lubrication.

[0031] In one embodiment the invention provides for the use of the ester, thioester, amide or imide of a carboxylic acid compound, described herein, as at least one of an antioxidant, a dispersant, an antiwear agent, a friction modifier, an extreme pressure agent, a lead, tin or copper (typically lead) corrosion inhibitor, a seal additive that decreases corrosion of acrylate or fluoro-elastomer seals, or a seal additive to improve seal swell performance.

[0032] The present invention provides lubricating compositions, methods for lubricating an engine using said compositions, and the use of the compositions to obtain one or more of any of the benefits described above.

[0033] The ester, thioester, amide or imide of a carboxylic acid compound of formula (1) may be derived from 2,5-dihydroxybenzoic acid, 2,6-dihydroxybenzoic acid, mixtures thereof, or reactive equivalents. The ester, thioester, amide or imide of a carboxylic acid compound of formula (4) may be

derived from 1,4-dihydroxy-2-naphthoic acid, 3,5-dihydroxynaphthoic acid, 3,7-dihydroxy naphthoic acid, mixtures thereof, or reactive equivalents.

[0034] In one embodiment formulae (1), (2), (3), and/or (4) may have R^3 defined as hydrogen, alkyl, aryl, alkaryl, alkoxy, aryloxy group, or mixtures thereof. Typically, R^3 may be hydrogen.

[0035] In different embodiments R^3 may be defined as an alkyl group containing 8 to 18, or 5 to 10 carbon atoms.

[0036] In one embodiment, the carboxylic acid may be a (poly)hydroxy substituted aromatic compound, an ether and/or alkoxy substituted aromatic compound, or combination thereof. In different embodiments the carboxylic acid compound of the present invention includes at least two substituent groups where the substituent groups are –OH, –OR, or mixtures thereof, wherein R is a hydrocarbyl group. In different embodiments R contains from 1 to 10, 1 to 6 or 1 to 4 carbon atoms. Within any of the single aromatic ring carboxylic acid compounds described herein, the substituent groups are not adjacent to one another and have one (or more) open position between them. For example, the substituent groups may be present in positions 2 and 4, 2 and 5 or 2 and 6 on the 6-membered aromatic ring of the compound.

[0037] In one embodiment the carboxylic acid compound may be an ether-containing aromatic compound, and more specifically, a polyether aromatic compound. In one embodiment the carboxylic acid compound may be 1,3-dimethoxybenzoic acid. In one embodiment the compounds of the present invention contains two or three substituents groups where each substituent group is independently a hydroxy-group, a methoxy-group, an ethoxy-group, a propoxy-group, a butoxy-group, a pentoxy-group, a hexoxy-group, or mixtures thereof.

[0038] The ester of a carboxylic acid comprising an aromatic moiety substituted with two or more hydroxy-groups, alkoxy-groups, or mixtures thereof as described above may be derived from reaction of the carboxylic acid or reactive equivalents with suitable alcohols. Reactive equivalents include (but are not limited to) acid chlorides, acid anhydrides, and lower hydrocarbyl esters.

[0039] Suitable alcohols include both monohydric alcohol and polyhydric alcohols. The carbon atoms of the alcohol may be linear hydrocarbyl chains, branched hydrocarbyl chains, or mixtures thereof. Examples of a suitable

branched alcohol include 2-ethylhexanol, isotridecanol, Guerbet alcohols, or mixtures thereof.

[0040] Examples of a monohydric alcohol include methanol, ethanol, propanol, butanol, pentanol, hexanol, heptanol, octanol, nonanol, decanol, undecanol, dodecanol, tridecanol, tetradecanol, pentadecanol, hexadecanol, heptadecanol, octadecanol, nonadecanol, eicosanol, or mixtures thereof. In one embodiment the monohydric alcohol contains 8 to 20 carbon atoms.

[0041] In one embodiment, the ester of a carboxylic acid comprising an aromatic moiety substituted with two or more hydroxy-groups, alkoxy-groups, or mixtures thereof as described above is an aliphatic ester, i.e. derived from an aliphatic alcohol.

[0042] The amide of a carboxylic acid comprising an aromatic moiety substituted with two or more hydroxy-groups, alkoxy-groups, or mixtures thereof as described above may be derived from reaction of the carboxylic acid or reactive equivalents with suitable primary and secondary amines. Reactive equivalents include (but are not limited to) acid chlorides, acid anhydrides, and hydrocarbyl esters.

[0043] Examples of suitable primary amines include ethylamine, propylamine, butylamine, 2-ethylhexylamine, octylamine, and dodecylamine, as well as such fatty amines as n-octylamine, n-decylamine, n-dodecylamine, n-tetradecylamine, n-hexadecylamine, n-octadecylamine and oleylamine. Other useful fatty amines include commercially available fatty amines such as "Armeen®" amines (products available from Akzo Chemicals, Chicago, Illinois), such as Armeen C, Armeen O, Armeen OL, Armeen T, Armeen HT, Armeen S and Armeen SD, wherein the letter designation relates to the fatty group, such as coco, oleyl, tallow, or stearyl groups.

[0044] Examples of suitable secondary amines include dimethylamine, diethylamine, dipropylamine, dibutylamine, diamylamine, dihexylamine, diheptylamine, methylethylamine, ethylbutylamine, bis-2-ethylhexylamine, N-methyl-1-amino-cyclohexane, Armeen® 2C and ethylamylamine. The secondary amines may be cyclic amines such as piperidine, piperazine and morpholine.

[0045] The amine may be a compound typically having a tertiary amino group. Amines with a tertiary amino group include 1-aminopiperidine, 1-(2-aminoethyl)piperidine, 1-(3-aminopropyl)-2-pipecoline, 1-methyl-(4-methyl-amino)piperidine, 4-(1-pyrrolidinyl)piperidine, 1-(2-aminoethyl)pyrrolidine, 2-

(2-aminoethyl)-1-methylpyrrolidine, N,N-diethylethylenediamine, N,N-dimethylethylenediamine, N,N-dibutylethylenediamine, N,N-diethyl-1,3-diaminopropane, N,N-dimethyl-1,3-diaminopropane, N,N,N'-trimethylethylenediamine, N,N-dimethyl-N'-ethylethylenediamine, N,N-diethyl-N'-methylethylenediamine, N,N,N'-triethylethylenediamine, 3-dimethylaminopropylamine, 3-diethylamino-propylamine, 3-dibutylaminopropylamine, N,N,N'-trimethyl-1,3-propanediamine, N,N,2,2-tetramethyl-1,3-propanediamine, 2-amino-5-diethylaminopentane, N,N,N',N'-tetraethyldiethylenetriamine, 3,3'-diamino-N-methyldipropylamine, 3,3'-iminobis(N,N-dimethylpropylamine), or mixtures thereof.

[0046] In some embodiments the amine may be N,N-dimethyl-1,3-diaminopropane, N,N-diethyl-1,3-diaminopropane, N,N-dimethylethylenediamine, N,N-diethylethylenediamine, N,N-dibutylethylenediamine, or mixtures thereof.

[0047] In one embodiment the amines may be in the form of a mixture. Examples of suitable mixtures of amines include (i) an amine with 11 to 14 carbon atoms on tertiary alkyl primary groups, (ii) an amine with 14 to 18 carbon atoms on tertiary alkyl primary groups, or (iii) an amine with 18 to 22 carbon atoms on tertiary alkyl primary groups. Other examples of tertiary alkyl primary amines include tert-butylamine, tert-hexylamine, tert-octylamine (such as 1,1-dimethylhexylamine), tert-decylamine (such as 1,1-dimethyloctylamine), tert-dodecylamine, tert-tetradecylamine, tert-hexadecylamine, tert-octadecylamine, tert-tetracosanylamine, and tert-octacosanylamine.

[0048] In one embodiment a useful mixture of amines includes "Primene® 81R" or "Primene® JMT." Primene® 81R and Primene® JMT (both produced and sold by Rohm & Haas) may be mixtures of C11 to C14 tertiary alkyl primary amines and C18 to C22 tertiary alkyl primary amines respectively.

Oils of Lubricating Viscosity

[0049] The lubricating composition comprises an oil of lubricating viscosity. Such oils include natural and synthetic oils, oil derived from hydrocracking, hydrogenation, and hydrofinishing, unrefined, refined, re-refined oils or mixtures thereof. A more detailed description of unrefined, refined and re-refined oils is provided in International Publication WO2008/147704, paragraphs [0054] to [0056]. A more detailed description of natural and synthetic lubricating oils is described in paragraphs [0058] to [0059] respectively of WO2008/147704.

Synthetic oils may also be produced by Fischer-Tropsch reactions and typically may be hydroisomerized Fischer-Tropsch hydrocarbons or waxes. In one embodiment oils may be prepared by a Fischer-Tropsch gas-to-liquid synthetic procedure as well as other gas-to-liquid oils.

[0050] Oils of lubricating viscosity may also be defined as specified in April 2008 version of "Appendix E - API Base Oil Interchangeability Guidelines for Passenger Car Motor Oils and Diesel Engine Oils", section 1.3 Sub-heading 1.3. "Base Stock Categories". In one embodiment the oil of lubricating viscosity may be an API Group II or Group III oil. In one embodiment the oil of lubricating viscosity may be an API Group I oil.

[0051] The amount of the oil of lubricating viscosity present is typically the balance remaining after subtracting from 100 wt % the sum of the amount of the compound of the invention and the other performance additives.

[0052] The lubricating composition may be in the form of a concentrate and/or a fully formulated lubricant. If the lubricating composition of the invention is in the form of a concentrate which may be combined with additional oil to form, in whole or in part, a finished lubricant, the ratio of the of these additives to the oil of lubricating viscosity and/or to diluent oil include the ranges of 1:99 to 99:1 by weight, or 80:20 to 10:90 by weight.

Other Performance Additives

[0053] The composition optionally comprises other performance additives. The other performance additives include at least one of metal deactivators, viscosity modifiers, detergents, friction modifiers (other than the compound of the present invention), antiwear agents (other than the compound of the present invention), corrosion inhibitors (other than the compound of the present invention), dispersants, dispersant viscosity modifiers, extreme pressure agents, antioxidants, foam inhibitors, demulsifiers, pour point depressants, seal swelling agents and mixtures thereof. Typically, fully-formulated lubricating oil will contain one or more of these performance additives.

[0054] In one embodiment the lubricating composition further includes other additives. In one embodiment the invention provides a lubricating composition further comprising at least one of a dispersant, an antiwear agent (other than the compound of the present invention), a dispersant viscosity modifier, a friction modifier, a viscosity modifier, an antioxidant, an overbased detergent, or

mixtures thereof. In one embodiment the invention provides a lubricating composition further comprising at least one of a polyisobutylene succinimide dispersant, an antiwear agent, a dispersant viscosity modifier, a friction modifier, a viscosity modifier (typically an olefin copolymer such as an ethylene-propylene copolymer), an antioxidant (including phenolic and aminic antioxidants), an overbased detergent (including overbased sulfonates and phenates), or mixtures thereof.

[0055] The dispersant of the present invention may be a succinimide dispersant, or mixtures thereof. In one embodiment the dispersant may be present as a single dispersant. In one embodiment the dispersant may be present as a mixture of two or three different dispersants, wherein at least one may be a succinimide dispersant.

[0056] The succinimide dispersant may be a derivative of an aliphatic polyamine, or mixtures thereof. The aliphatic polyamine may be aliphatic polyamine such as an ethylenepolyamine, a propylenepolyamine, a butylenepolyamine, or mixtures thereof. In one embodiment the aliphatic polyamine may be ethylenepolyamine. In one embodiment the aliphatic polyamine may be selected from the group consisting of ethylenediamine, diethylenetriamine, triethylenetetramine, tetraethylenepentamine, pentaethylenehexamine, polyamine still bottoms, and mixtures thereof.

[0057] The dispersant may be a N-substituted long chain alkenyl succinimide. Examples of N-substituted long chain alkenyl succinimide include polyisobutylene succinimide. Typically the polyisobutylene from which polyisobutylene succinic anhydride is derived has a number average molecular weight of 350 to 5000, or 550 to 3000 or 750 to 2500. Succinimide dispersants and their preparation are disclosed, for instance in US Patents 3,172,892, 3,219,666, 3,316,177, 3,340,281, 3,351,552, 3,381,022, 3,433,744, 3,444,170, 3,467,668, 3,501,405, 3,542,680, 3,576,743, 3,632,511, 4,234,435, Re 26,433, and 6,165,235, 7,238,650 and EP Patent Application 0 355 895 A.

[0058] The dispersant may also be post-treated by conventional methods by a reaction with any of a variety of agents. Among these are boron compounds, urea, thiourea, dimercaptothiadiazoles, carbon disulphide, aldehydes, ketones, carboxylic acids, hydrocarbon-substituted succinic anhydrides, maleic anhydride, nitriles, epoxides, and phosphorus compounds.

[0059] The dispersant may be present at 0.01 wt % to 20 wt %, or 0.1 wt % to 15 wt %, or 0.1 wt % to 10 wt %, or 1 wt % to 6 wt % of the lubricating composition.

[0060] In one embodiment the lubricating composition of the invention further comprises a dispersant viscosity modifier. The dispersant viscosity modifier may be present at 0 wt % to 5 wt %, or 0 wt % to 4 wt %, or 0.05 wt % to 2 wt % of the lubricating composition.

[0061] The dispersant viscosity modifier may include functionalized polyolefins, for example, ethylene-propylene copolymers that have been functionalized with an acylating agent such as maleic anhydride and an amine; polymethacrylates functionalized with an amine, or esterified styrene-maleic anhydride copolymers reacted with an amine. More detailed description of dispersant viscosity modifiers are disclosed in International Publication WO2006/015130 or U.S. Patents 4,863,623; 6,107,257; 6,107,258; and 6,117,825. In one embodiment the dispersant viscosity modifier may include those described in U.S. Patent 4,863,623 (see column 2, line 15 to column 3, line 52) or in International Publication WO2006/015130 (see page 2, paragraph [0008] and preparative examples are described paragraphs [0065] to [0073]).

[0062] In one embodiment the invention provides a lubricating composition which further includes a phosphorus-containing antiwear agent. Typically the phosphorus-containing antiwear agent may be a zinc dialkyldithiophosphate, or mixtures thereof. Zinc dialkyldithiophosphates are known in the art. The antiwear agent may be present at 0 wt % to 3 wt %, or 0.1 wt % to 1.5 wt %, or 0.5 wt % to 0.9 wt % of the lubricating composition.

[0063] In one embodiment the invention provides a lubricating composition further comprising a molybdenum compound. The molybdenum compound may be selected from the group consisting of molybdenum dialkyldithiophosphates, molybdenum dithiocarbamates, amine salts of molybdenum compounds, and mixtures thereof. The molybdenum compound may provide the lubricating composition with 0 to 1000 ppm, or 5 to 1000 ppm, or 10 to 750 ppm 5 ppm to 300 ppm, or 20 ppm to 250 ppm of molybdenum.

[0064] In one embodiment the invention provides a lubricating composition further comprising an overbased detergent. The overbased detergent may be

selected from the group consisting of non-sulfur containing phenates, sulfur containing phenates, sulfonates, salixarates, salicylates, and mixtures thereof.

[0065] The overbased detergent may also include "hybrid" detergents formed with mixed surfactant systems including phenate and/or sulfonate components, e.g. phenate/salicylates, sulfonate/phenates, sulfonate/salicylates, sulfonates/phenates/salicylates, as described; for example, in US Patents 6,429,178; 6,429,179; 6,153,565; and 6,281,179. Where, for example, a hybrid sulfonate/phenate detergent is employed, the hybrid detergent would be considered equivalent to amounts of distinct phenate and sulfonate detergents introducing like amounts of phenate and sulfonate soaps, respectively.

[0066] Typically an overbased detergent may be sodium salts, calcium salts, magnesium salts, or mixtures thereof of the phenates, sulfur containing phenates, sulfonates, salixarates and salicylates. Overbased phenates and salicylates, typically have a total base number of 180 to 450 TBN. Overbased sulfonates typically have a total base number of 250 to 600, or 300 to 500. Overbased detergents are known in the art. In one embodiment the sulfonate detergent may be predominantly a linear alkylbenzene sulfonate detergent having a metal ratio of at least 8 as is described in paragraphs [0026] to [0037] of US Patent Application 2005065045 (and granted as US 7,407,919). The linear alkylbenzene sulfonate detergent may be particularly useful for assisting in improving fuel economy. The linear alkyl group may be attached to the benzene ring any where along the linear chain of the alkyl group, but often in the 2, 3 or 4 position of the linear chain, and in some instances in predominantly in the 2 position, resulting in the linear alkylbenzene sulfonate detergent. Overbased detergents are known in the art. The overbased detergent may be present at 0 wt % to 15 wt %, or 0.1 wt % to 10 wt %, or 0.2 wt % to 8 wt %, or 0.2 wt % to 3 wt %. For example in a heavy duty diesel engine the detergent may be present at or 2 wt % to 3 wt % of the lubricating composition. For a passenger car engine the detergent may be present at 0.2 wt % to 1 wt % of the lubricating composition.

[0067] In one embodiment the lubricating composition includes an antioxidant, or mixtures thereof. The antioxidant may be present at 0 wt % to 15 wt 5, or 0.1 wt % to 10 wt %, or 0.5 wt % to 5 wt % of the lubricating composition.

[0068] Antioxidants include sulfurized olefins, alkylated diarylamines (typically alkylated diphenylamines such as dinonyl diphenylamine, octyl diphenylamine, dioctyl diphenylamine), hindered phenols, molybdenum compounds (such as molybdenum dithiocarbamates), or mixtures thereof.

[0069] The hindered phenol antioxidant often contains a secondary butyl and/or a tertiary butyl group as a sterically hindering group. The phenol group may be further substituted with a hydrocarbyl group (typically linear or branched alkyl) and/or a bridging group linking to a second aromatic group. Examples of suitable hindered phenol antioxidants include 2,6-di-tert-butylphenol, 4-methyl-2,6-di-tert-butylphenol, 4-ethyl-2,6-di-tert-butylphenol, 4-propyl-2,6-di-tert-butylphenol or 4-butyl-2,6-di-tert-butylphenol, or 4-dodecyl-2,6-di-tert-butylphenol. In one embodiment the hindered phenol antioxidant may be an ester and may include, e.g., Irganox™ L-135 from Ciba. A more detailed description of suitable ester-containing hindered phenol antioxidant chemistry is found in US Patent 6,559,105.

[0070] Examples of suitable friction modifiers include long chain fatty acid derivatives of amines, fatty esters, or epoxides; fatty imidazolines such as condensation products of carboxylic acids and polyalkylene-polyamines; amine salts of alkylphosphoric acids; fatty alkyl tartrates; fatty alkyl tartrimides; or fatty alkyl tartramides. In some embodiments the term fatty, as used herein, can mean having a C8-22 linear alkyl group.

[0071] Friction modifiers may also encompass materials such as sulfurised fatty compounds and olefins, molybdenum dialkyldithiophosphates, molybdenum dithiocarbamates, sunflower oil or monoester of a polyol and an aliphatic carboxylic acid.

[0072] In one embodiment the friction modifier may be selected from the group consisting of long chain fatty acid derivatives of amines, long chain fatty esters, or long chain fatty epoxides; fatty imidazolines; amine salts of alkylphosphoric acids; fatty alkyl tartrates; fatty alkyl tartrimides; and fatty alkyl tartramides. The friction modifier may be present at 0 wt % to 6 wt %, or 0.05 wt % to 4 wt %, or 0.1 wt % to 2 wt % of the lubricating composition.

[0073] In one embodiment the friction modifier may be a long chain fatty acid ester. In another embodiment the long chain fatty acid ester may be a

mono-ester or a diester or a mixture thereof, and in another embodiment the long chain fatty acid ester may be a triglyceride.

[0074] Other performance additives such as corrosion inhibitors include those described in paragraphs 5 to 8 of US Application US05/038319, published as WO2006/047486, octyl octanamide, condensation products of dodecenyl succinic acid or anhydride and a fatty acid such as oleic acid with a polyamine. In one embodiment the corrosion inhibitors include the Synalox® corrosion inhibitor. The Synalox® corrosion inhibitor may be a homopolymer or copolymer of propylene oxide. The Synalox® corrosion inhibitor is described in more detail in a product brochure with Form No. 118-01453-0702 AMS, published by The Dow Chemical Company. The product brochure is entitled "SYNALOX Lubricants, High-Performance Polyglycols for Demanding Applications."

[0075] Metal deactivators including derivatives of benzotriazoles (typically tolyltriazole), dimercaptothiadiazole derivatives, 1,2,4-triazoles, benzimidazoles, 2-alkyldithiobenzimidazoles, or 2-alkyldithiobenzothiazoles; foam inhibitors including copolymers of ethyl acrylate and 2-ethylhexylacrylate and optionally vinyl acetate; demulsifiers including trialkyl phosphates, polyethylene glycols, polyethylene oxides, polypropylene oxides and (ethylene oxide-propylene oxide) polymers; pour point depressants including esters of maleic anhydride-styrene, polymethacrylates, polyacrylates or polyacrylamides may be useful. Foam inhibitors that may be useful in the compositions of the invention include copolymers of ethyl acrylate and 2-ethylhexyl acrylate and optionally vinyl acetate; demulsifiers including trialkyl phosphates, polyethylene glycols, polyethylene oxides, polypropylene oxides and (ethylene oxide-propylene oxide) polymers.

[0076] Pour point depressants that may be useful in the compositions of the invention include polyalphaolefins, esters of maleic anhydride-styrene, poly(meth)acrylates, polyacrylates or polyacrylamides.

[0077] In different embodiments the lubricating composition may have a composition as described in the following table:

Additive	Embodiments (wt %)		
	A	B	C
Additive of Invention (typically derived from formulae (1), (2), (3) or (4))	0.1 to 4	0.2 to 3	0.5 to 2
Dispersant	0.05 to 12	0.75 to 8	0.5 to 6
Dispersant Viscosity Modifier	0 or 0.05 to 5	0 or 0.05 to 4	0.05 to 2
Overbased Detergent	0 or 0.05 to 15	0.1 to 10	0.2 to 8
Antioxidant	0 or 0.05 to 15	0.1 to 10	0.5 to 5
Antiwear Agent	0 or 0.05 to 15	0.1 to 10	0.3 to 5
Friction Modifier	0 or 0.05 to 6	0.05 to 4	0.1 to 2
Viscosity Modifier	0 or 0.05 to 10	0.5 to 8	1 to 6
Any Other Performance Additive	0 or 0.05 to 10	0 or 0.05 to 8	0 or 0.05 to 6
Oil of Lubricating Viscosity	Balance to 100 %	Balance to 100 %	Balance to 100 %

[0078] The ester, thioester, amide, or imide of a carboxylic acid of invention (typically derived from formula (1), (2), (3) or (4)) may be present in embodiments (D) 0.1 wt % to 8 wt %, or (E) 1 wt % to 7 wt %, or (F) 2 wt % to 6 wt % of the lubricating composition, with the amount of dispersant viscosity modifier, overbased detergent, antioxidant, antiwear agent, friction modifier, viscosity modifier, any other performance additive (excluding a dispersant) and an oil of lubricating viscosity in amounts shown in the table above for embodiments (A) to (C). The compound of invention derived from formula (1) or formula (4) may also exhibit dispersant performance. If the compound of invention derived from formula (1) or formula (4) exhibits dispersant performance, a portion or all of the dispersant ranges quoted in embodiments (D) to (F) may be 0 wt % to 12 wt %, or 0 wt % to 8 wt % or 0 wt % to 6 wt % of the lubricating composition.

Industrial Application

[0079] The lubricating composition may be utilized in an internal combustion engine. The engine components may have a surface of steel or aluminum (typically a surface of steel).

[0080] An aluminum surface may be comprised of an aluminum alloy that may be a eutectic or hyper-eutectic aluminum alloy (such as those derived from aluminum silicates, aluminum oxides, or other ceramic materials). The aluminum surface may be present on a cylinder bore, cylinder block, or piston ring having an aluminum alloy, or aluminum composite.

[0081] The internal combustion engine may or may not have an Exhaust Gas Recirculation system. The internal combustion engine may be fitted with an emission control system or a turbocharger. Examples of the emission control system include diesel particulate filters (DPF), or systems employing selective catalytic reduction (SCR).

[0082] In one embodiment the internal combustion engine may be a diesel fuelled engine (typically a heavy duty diesel engine), a gasoline fuelled engine, a natural gas fuelled engine or a mixed gasoline/alcohol fuelled engine. In one embodiment the internal combustion engine may be a diesel fuelled engine and in another embodiment a gasoline fuelled engine.

[0083] The internal combustion engine may be a 2-stroke or 4-stroke engine. Suitable internal combustion engines include marine diesel engines, aviation piston engines, low-load diesel engines, and automobile and truck engines.

[0084] The internal combustion engine of the present invention is distinct from gas turbine. In an internal combustion engine individual combustion events which through the rod and crankshaft translate from a linear reciprocating force into a rotational torque. In contrast, in a gas turbine (may also be referred to as a jet engine) it is a continuous combustion process that generates a rotational torque continuously without translation and can also develop thrust at the exhaust outlet. These differences result in the operation conditions of a gas turbine and internal combustion engine different operating environments and stresses.

[0085] The lubricant composition for an internal combustion engine may be suitable for any engine lubricant irrespective of the sulfur, phosphorus or sulfated ash (ASTM D-874) content. The sulfur content of the engine oil lubricant may be 1 wt % or less, or 0.8 wt % or less, or 0.5 wt % or less, or 0.3 wt % or less. In one embodiment the sulfur content may be in the range of 0.001 wt % to 0.5 wt %, or 0.01 wt % to 0.3 wt %. The phosphorus content may be 0.2 wt % or less, or 0.12 wt % or less, or 0.1 wt % or less, or 0.085 wt % or less, or 0.08 wt % or less, or even 0.06 wt % or less, 0.055 wt % or less, or 0.05 wt % or

less. In one embodiment the phosphorus content may be 100 ppm to 1000 ppm, or 200 ppm to 600 ppm. The total sulfated ash content may be 2 wt % or less, or 1.5 wt % or less, or 1.1 wt % or less, or 1 wt % or less, or 0.8 wt % or less, or 0.5 wt % or less, or 0.4 wt % or less. In one embodiment the sulfated ash content may be 0.05 wt % to 0.9 wt %, or 0.1 wt % to 0.2 wt % or to 0.45 wt %.

[0086] In one embodiment the lubricating composition may be an engine oil, wherein the lubricating composition may be characterized as having at least one of (i) a sulfur content of 0.5 wt % or less, (ii) a phosphorus content of 0.1 wt % or less, (iii) a sulfated ash content of 1.5 wt % or less, or combinations thereof.

Lubricating Compositions

[0087] A series of 5W-30 engine lubricants in a Group II base oil of lubricating viscosity are prepared containing the additive composition of the present invention as well as conventional additives including polymeric viscosity modifier, ashless succinimide dispersant, overbased detergents, antioxidants (combination of phenolic ester and diarylamine), zinc dialkyldithiophosphate (ZDDP), as well as other performance additives as follows. Amounts shown are weight percent.

Table 1 – Lubricating Oil Composition Formulations

	Comp EX1	Comp EX2	Comp EX3	EX1	EX2	EX3
Base Oil	Balance to = 100%					
RE1[1]	0	0	0	1.0	0	0.5
RE2[2]	0	0	0	0	1.0	0
Antioxidant[3]	0	1.2	1.2	0	0	0.6
ZDDP[4]	0.76	0.76	0.45	0.45	0.45	0.45
OCP VM[5]	7	7	7	7	7	7
Additional Additives[6]	5.6	5.6	5.6	5.6	5.6	5.6
%Phosphorus	0.076	0.076	0.050	0.050	0.050	0.050
%Sulfur	0.25	0.25	0.20	0.20	0.20	0.20
%Ash	0.85	0.85	0.8	0.8	0.8	0.8

1 RE^1 is 2-ethylhexyl ester of 2,5-dihydroxybenzoic acid

2 RE^2 is 2-ethylhexyl ester of 3,5-dihydroxynaphthoic acid

3 Mixture of phenolic ester and diarylamine (1:1 wt)

4 Secondary Zinc dialkyldithiophosphate (mixture of C_3-C_6 alkyl)

5 90% Oil

6 Conventional additives include polyalkylene succinimide dispersant (4 wt%), overbased calcium sulfonate detergent (1.3 wt%), as well as friction modifier

and anti-foam agent, each of which may contain a conventional amount of diluent (not separately accounted for).

Oxidation and Wear Performance of Amine-salted Carboxylic Acids

[0088] The lubricating oil compositions summarized in Table 1 are evaluated for boundary lubrication friction performance and wear in a programmed temperature high frequency reciprocating rig (HFRR) available from PCS Instruments. HFRR conditions for the evaluations were 500g load, 75 minute duration, 1000 micrometer stroke, 20 Hertz frequency, and at a temperature of 105°C. The wear and contact potential are then measured.

[0089] The lubricating compositions are also subjected to the ACEA E5 oxidation bench test (CECL85) which determined oxidative stability of a sample by pressure differential scanning calorimetry. Results are reported as the time (in minutes) until the oil breaks and takes up oxidation.

[0090] It is known that some of the materials described above may interact in the final formulation, so that the components of the final formulation may be different from those that are initially added. The products formed thereby, including the products formed upon employing lubricant composition of the present invention in its intended use, may not be susceptible of easy description. Nevertheless, all such modifications and reaction products are included within the scope of the present invention; the present invention encompasses lubricant composition prepared by admixing the components described above.

[0091] Each of the documents referred to above is incorporated herein by reference, as is the priority document and all related applications, if any, which this application claims the benefit of. Except in the Examples, or where otherwise explicitly indicated, all numerical quantities in this description specifying amounts of materials, reaction conditions, molecular weights, number of carbon atoms, and the like, are to be understood as modified by the word "about." Unless otherwise indicated, each chemical or composition referred to herein should be interpreted as being a commercial grade material which may contain the isomers, by-products, derivatives, and other such materials which are normally understood to be present in the commercial grade. However, the amount of each chemical component is presented exclusive of any solvent or diluent oil, which may be customarily present in the commercial material, unless

otherwise indicated. It is to be understood that the upper and lower amount, range, and ratio limits set forth herein may be independently combined. Similarly, the ranges and amounts for each element of the invention may be used together with ranges or amounts for any of the other elements.

[0092] As used herein, the term "hydrocarbyl substituent" or "hydrocarbyl group" is used in its ordinary sense, which is well-known to those skilled in the art. Specifically, it refers to a group having a carbon atom directly attached to the remainder of the molecule and having predominantly hydrocarbon character. Examples of hydrocarbyl groups include: hydrocarbon substituents, including aliphatic, alicyclic, and aromatic substituents; substituted hydrocarbon substituents, that is, substituents containing non-hydrocarbon groups which, in the context of this invention, do not alter the predominantly hydrocarbon nature of the substituent; and hetero substituents, that is, substituents which similarly have a predominantly hydrocarbon character but contain other than carbon in a ring or chain. A more detailed definition of the term "hydrocarbyl substituent" or "hydrocarbyl group" is described in paragraphs [0118] to [0119] of International Publication WO2008147704.

[0093] While the invention has been explained in relation to its preferred embodiments, it is to be understood that various modifications thereof will become apparent to those skilled in the art upon reading the specification. Therefore, it is to be understood that the invention disclosed herein is intended to cover such modifications as fall within the scope of the appended claims.

What is claimed is:

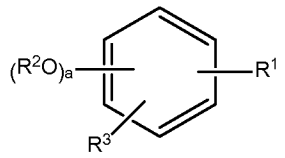
1. A lubricating composition comprising an oil of lubricating viscosity and an additive comprising an ester, thioester, amide, or imide of a carboxylic acid or any combination thereof wherein the carbonyl carbon of the acid is attached directly or through a divalent hydrocarbyl linkage to an aromatic moiety wherein said aromatic moiety includes two or more hydroxy-groups, alkoxy-groups, or mixtures thereof, with the proviso that if said aromatic moiety consists of a single ring, then no two hydroxy-groups, alkoxy-groups, or mixtures thereof are located on adjacent carbon atoms of said aromatic ring.

2. The lubricating composition of claim 1 wherein the additive comprises an ester, thioester, amide, or imide of a carboxylic acid, or any combination thereof, wherein the carbonyl carbon of the acid is attached directly to or through a hydrocarbyl linkage to an aromatic moiety wherein said aromatic moiety consists of a single aromatic ring and includes two or more hydroxy-groups, alkoxy-groups, or mixtures thereof;

wherein no two of said hydroxy-groups, alkoxy-groups, or mixtures thereof are located on adjacent carbon atoms of said aromatic ring.

3. The lubricating composition of claim 1 wherein the additive comprises an ester, thioester, amide, or imide of a carboxylic acid, or any combination thereof, wherein the carbonyl carbon of the acid is attached directly to or through a divalent hydrocarbyl linkage to an aromatic moiety wherein said aromatic moiety consists of at least two aromatic rings and includes two or more hydroxy-groups, alkoxy-groups, or mixtures thereof.

4. The lubricating composition of claim 1 wherein the (thio)ester, amide, or imide of a carboxylic acid, or any combination thereof, comprises a compound of Formula (1):



Formula (1)

wherein a is an integer from 2 to 4;

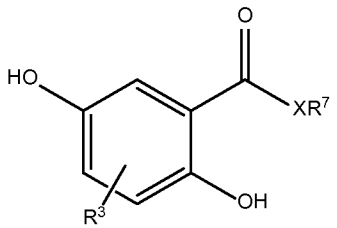
R^1 is $–C(O)XR^5$, or $–R^4$-C(O) XR^5, where X is -O-, -S-, $-NR^6$-, or combinations thereof, R^4 is a divalent hydrocarbyl group of 1 to 10 carbon atoms, R^5 is a linear or branched hydrocarbyl group containing 1 to 30 carbon atoms, R^6 is hydrogen or a hydrocarbyl group of 1 to 30 carbon atoms;

each R^2 is independently hydrogen, linear or branched hydrocarbyl groups containing 1 to 10 carbon atoms, or mixtures thereof; and

R^3 is hydrogen or a hydrocarbyl group containing 1 to 30 carbon atoms;

With the proviso that no two $–(OR^2)$ groups are attached to adjacent carbon atoms of the aromatic ring.

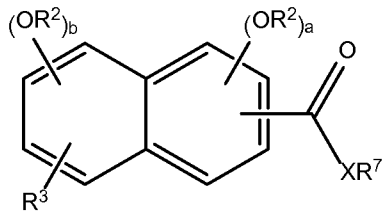
5. The lubricating composition of claim 1, wherein the (thio)ester, amide, or imide of a carboxylic acid has the Formula (3):



Formula (3)

Where X is -O-, -S-, or $–NR^8$, or combinations thereof; R^3 is hydrogen or a hydrocarbyl group containing 1 to 30 carbon atoms, R^7 is a linear or branched hydrocarbyl group containing 1 to 30 carbon atoms, and R^8 is hydrogen or a hydrocarbyl group of 1 to 30 carbon atoms.

6. The lubricating composition of claim 1, wherein the (thio)ester, amide, or imide of a carboxylic acid has the Formula (4):



Formula (4)

where a is 0 to 2, b is 0 to 2, and a+b is 2 to 4; each R^2 is independently hydrogen, linear or branched hydrocarbyl groups containing 1 to 10 carbon atoms, or mixtures thereof; X is -O-, -S-, or $-NR^8$, or combinations thereof; R^3 is hydrogen or a hydrocarbyl group containing 1 to 30 carbon atoms, R^7 is a linear or branched hydrocarbyl group containing 1 to 30 carbon atoms, and R^8 is hydrogen or a hydrocarbyl group of 1 to 30 carbon atoms.

7. The lubricating composition of any of claims 2 to 4, wherein each R^2 is hydrogen.

8. The lubricating composition of any preceding claim wherein said ester, amide, or imide of a carboxylic acid, or any combination thereof, is derived from 2,5-dihydroxybenzoic acid, 1,4-dihydroxy-2-naphthoic acid, 3,5-dihydroxynaphthoic acid, 3,7-dihydroxynaphthoic acid, reactive equivalents, or mixtures thereof.

9. The lubricating composition of any preceding claim, wherein said ester, amide, or imide of a carboxylic acid, or any combination thereof, is present in a range of 0.01 wt % to 10 wt % of the lubricating composition.

10. The lubricating composition of any preceding claim, wherein the lubricating composition is characterized as having (i) a sulfur content of 0.5 wt % or less, (ii) a phosphorus content of 0.1 wt % or less, (iii) a sulfated ash content of 1.5 wt % or less, or any combination thereof.

11. The lubricating composition of any preceding claim further comprising an antiwear agent, a dispersant viscosity modifier, a friction modifier, a viscosity modifier, an antioxidant, an overbased detergent, or mixtures thereof.

12. The lubricating composition of any preceding claim, further comprising a metal dihydrocarbyl dithiophosphate that contributes at least 100 ppm of phosphorus to the overall composition.

13. The lubricating composition of claim 12, wherein the friction modifier is selected from the group consisting of long chain fatty acid derivatives of amines, long chain fatty esters, long chain fatty epoxides, fatty imidazolines, amine salts of alkylphosphoric acids, fatty alkyl tartrates, fatty alkyl tartrimides, fatty alkyl tartramides, and combinations thereof.

14. The lubricating composition of any preceding claim further comprising a dispersant viscosity modifier.

15. The lubricating composition of any preceding claim further comprising an overbased detergent, wherein the overbased detergent is selected from the group consisting of phenates, sulfur containing phenates, sulfonates, salixarates, salicylates, and mixtures thereof.

16. A method of lubricating an internal combustion engine comprising the step of: (I) supplying to the internal combustion engine the lubricating composition of any preceding claim 1 to 15.

17. The use an additive comprising an ester, thioester, amide, or imide of a carboxylic acid, or any combination thereof, wherein the carbonyl carbon of the acid is attached directly to or through a hydrocarbyl linkage to an aromatic moiety wherein said aromatic moiety includes two or more hydroxy-groups, alkoxy-groups, or mixtures thereof, with the proviso that if said aromatic moiety consists of a single ring, then no two hydroxy-groups, alkoxy-groups, or mixtures thereof are located on adjacent carbon atoms of said aromatic ring, as an antioxidant in a lubricating composition.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/042192

A. CLASSIFICATION OF SUBJECT MATTER
INV. C10M129/76
ADD.

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)
C10M

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 25 20 994 A1 (CIBA GEIGY AG) 4 December 1975 (1975-12-04) claims 1,3,4; examples 7-10	1,2,7,9, 11,17

X	Roman Merkl: "Antimicrobial and Antioxidant Properties of Phenolic Acid Alkyl Ester", Czech Journal of Food Science, 1 January 2010 (2010-01-01), pages 275-279, XP55034604, Retrieved from the Internet: URL:http://www.agriculturejournals.cz/publ icFiles/26117.pdf [retrieved on 2012-08-03]	1,2,4,5, 7-9,17
Y	page 276 - page 277; figure 1	10-15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 September 2012	14/09/2012

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International application No
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