A lubricant composition includes at least one base oil, at least one organomolybdenum compound, at least one compound including a dithiophosphate group and at least one fatty triamine. The lubricant composition has good friction properties for both steel/steel contacts and steel/carbon coating contacts, as well as for carbon coating/carbon coating contacts, whilst retaining good anti-wear properties.
LUBRICANT COMPOSITION BASED ON FATTY TRIAMINES

CROSS-REFERENCE TO RELATED APPLICATIONS


TECHNICAL FIELD

[0002] The present invention is applicable to the field of lubricants, in particular lubricants for engines, and more particularly for motor vehicle engines. More particularly, the present invention relates to a lubricant composition comprising at least one base oil, at least one organonobutenylene compound, at least one compound comprising a diithiophosphate group and at least one fatty triamine. The lubricant composition according to the invention has good friction properties for both steel/steel contacts, and steel/carbon coating contacts as well as for carbon coating/carbon coating contacts, whilst retaining good anti-wear properties.

[0003] The present invention also relates to a lubrication process utilizing this composition. The present invention also relates to a process for reducing friction between two steel surfaces, in particular in an engine, and more particularly in a motor vehicle engine. The present invention also relates to a process for reducing friction between a steel surface and a carbon-covered surface, in particular in an engine, and more particularly in a motor vehicle engine. The present invention also relates to a process for reducing friction between two carbon-covered surfaces, and more particularly in a motor vehicle engine.

[0004] The present invention also relates to a process for reducing the fuel consumption of a vehicle, and more particularly of a motor vehicle. The present invention also relates to the use of a fatty triamine in a lubricant composition for reducing friction between two steel surfaces, in particular in an engine, and more particularly in a motor vehicle engine. The present invention also relates to the use of a fatty triamine in a lubricant composition for reducing friction between a steel surface and a carbon-covered surface, in particular in an engine, and more particularly in a motor vehicle engine.

[0005] The present invention also relates to the use of a fatty triamine in a lubricant composition for reducing friction between two carbon-covered surfaces, in particular in an engine, and more particularly in a motor vehicle engine. The present invention also relates to the use of a fatty triamine in a lubricant composition for reducing the fuel consumption of a vehicle, and more particularly of a motor vehicle. The present invention also relates to a composition of the additives concentrate type comprising at least one organonobutenylene compound, at least one compound comprising a diithiophosphate group and at least one fatty triamine.

BACKGROUND

[0006] The objective of lubricants is to reduce the phenomena of friction and wear of the mechanical parts, in particular in vehicle engines, and more particularly in motor vehicle engines. In order to reduce these friction phenomen-ena, it is known to incorporate friction modifiers into the lubricants. Among the friction modifiers, the organonobutenylene compounds represent a family of compounds, the friction phenomenon reduction properties of which have been broadly described, and more particularly with respect to contacts between two steel surfaces. However, it is known to a person skilled in the art that the use of organonobutenylene compounds, in particular of organonobutenylene compounds comprising a diithiophosphate group, can cause worsening of the phenomena of wear of mechanical parts. Thus, in order to solve this problem, the combination of an organonobutenylene compound and an anti-wear compound such as a compound comprising a diithiophosphate group in a lubricant composition has been broadly described.

[0007] The document U.S. Pat. No. 5,650,381 describes in particular a lubricant composition comprising an organonobutenylene compound and a zinc diithiophosphate. Moreover, it is known to apply a coating to parts, in particular metal parts, making it possible to increase their wear resistance under conditions of intensive and repeated friction. Among the existing technologies, carbon coatings are known, and in particular DLC (Diamond Like Carbon) coatings based on an amorphous carbon material with properties close to those of diamond.

[0008] Thus, the DLC coatings are used as coatings of the surfaces of vehicle engine parts, and in particular motor vehicle engine parts. However, it is also known that the properties of reduction of the friction phenomena of a carbon coating, and in particular of a DLC coating, can be altered, or even degraded in the presence of a lubricant. More particularly, it has been observed that the organonobutenylene compounds present in a lubricant can cause a carbon coating present on a surface to become degraded or even to peel off, and this degradation can be exacerbated as the organonobutenylene compounds content in the lubricant increases. Thus, research has been carried out into lubricants that are compatible with surfaces covered with a carbon material, and in particular a DLC coating or a nanodiamond coating, these lubricants comprising no organonobutenylene compounds.

[0009] For example, the document EP 2479247 describes a lubricant comprising a compound based on a zinc phosphate compound and a sulphur-containing compound. Moreover, the document EP 1338641 describes a lubricant comprising an amine as friction modifier compatible with a surface having a DLC coating. However, this document gives no teaching about the friction phenomena reduction properties of these lubricants for steel/steel contacts. Furthermore, this document gives no teaching about the anti-wear properties of these lubricants, either for steel/steel or steel/carbon coating contacts. As the use of carbon coating in engines, in particular of motor vehicles is growing, there is therefore still a need for research into lubricants having both good friction properties for steel/steel contacts, for steel/carbon coating contacts and for carbon coating/carbon coating contacts, whilst retaining good anti-wear properties.

[0010] An objective of the present invention is to provide a lubricant composition overcoming some or all of the abovementioned drawbacks. Another objective of the invention is to provide a lubricant composition the formulation of which is easy to implement. Another objective of the present invention is to provide a lubrication process for reducing
friction between two steel surfaces, between a steel surface and a carbon-covered surface as well as between two carbon-covered surfaces.

SUMMARY

[0011] An object of the invention is therefore a lubricant composition comprising:

[0012] at least one base oil,

[0013] at least one organomolybdenum compound,

[0014] at least one compound comprising a dithiophosphate group, and

[0015] at least one fatty triamine.

[0016] Surprisingly, the applicant has found that the presence of at least one organomolybdenum compound and at least one compound comprising a dithiophosphate group and at least one fatty triamine in a lubricant composition makes it possible to give the lubricant composition good friction properties for steel/steel contacts, steel/carbon coating contacts and carbon coating/carbon coating contacts simultaneously. Thus, the present invention makes it possible to formulate lubricant compositions comprising an optimized organomolybdenum compound content and having good friction properties for steel/steel contacts and steel/carbon coating contacts as well as for carbon coating/carbon coating contacts.

[0017] Advantageously, the lubricant compositions according to the invention have good friction properties for steel/steel contacts, steel/carbon coating contacts and carbon coating/carbon coating contacts, whilst retaining good anti-wear properties. Advantageously, the lubricant compositions according to the invention allow fuel savings in all the operating phases of a vehicle engine, preferably a motor vehicle engine, and more particularly when starting. Advantageously, the lubricant compositions according to the invention have good storage stability as well as a viscosity that varies very little or not at all.

[0018] In an embodiment of the invention, the lubricant composition essentially consists of:

[0019] at least one base oil,

[0020] at least one organomolybdenum compound,

[0021] at least one compound comprising a dithiophosphate group, and

[0022] at least one fatty triamine.

[0023] The invention also relates to an engine oil comprising a lubricant composition as defined above. The invention also relates to the use of a lubricant composition as defined above for reducing friction between two steel surfaces, in particular in a vehicle engine, preferably a motor vehicle engine.

[0024] The invention also relates to the use of an above-mentioned lubricant composition for reducing friction between a steel surface and a carbon-covered surface, in particular in a vehicle engine, preferably a motor vehicle engine. The invention also relates to the use of a lubricant composition as defined above for reducing friction between two carbon-covered surfaces, in particular in a vehicle engine, preferably a motor vehicle engine. The invention also relates to the use of a lubricant composition as defined above for reducing the fuel consumption of vehicles, preferably of motor vehicles.

[0025] The invention also relates to a process for the lubrication of mechanical parts, in particular in transmissions and/or vehicle engines, preferably motor vehicle engines, comprising at least one step of bringing at least one part into contact with a lubricant composition as defined above. The invention also relates to a process for reducing friction between two steel surfaces, in particular in a vehicle engine, preferably a motor vehicle engine, comprising at least one step of bringing at least one of the steel surfaces into contact with a lubricant composition as defined above. The invention also relates to a process for reducing friction between a steel surface and a carbon-covered surface, in particular in a vehicle engine, preferably a motor vehicle engine, comprising at least one step of bringing at least one of the surfaces into contact with a lubricant composition as defined above. The invention also relates to a process for reducing friction between two carbon-covered surfaces, in particular in a vehicle engine, preferably a motor vehicle engine, comprising at least one step of bringing at least one of the carbon-covered surfaces into contact with a lubricant composition as defined above. The invention also relates to a process for reducing the fuel consumption of a vehicle, preferably of a motor vehicle, comprising at least one step of bringing a mechanical part of the vehicle engine into contact with a lubricant composition as defined above.

[0026] The invention also relates to the use of a fatty triamine in a lubricant composition comprising at least one base oil, at least one organomolybdenum compound and at least one compound comprising a dithiophosphate group for reducing friction between two steel surfaces, in particular in a vehicle engine, preferably a motor vehicle engine. The invention also relates to the use of a fatty triamine in a lubricant composition comprising at least one base oil, at least one organomolybdenum compound in particular in a vehicle engine, preferably a motor vehicle engine. The invention also relates to the use of a fatty triamine in a lubricant composition comprising at least one base oil, at least one organomolybdenum compound and at least one compound comprising a dithiophosphate group for reducing friction between a steel surface and a carbon-covered surface, in particular in a vehicle engine, preferably a motor vehicle engine.

[0027] The invention also relates to a process of the additives concentrate type comprising:

[0028] at least one organomolybdenum compound,

[0029] at least one compound comprising a dithiophosphate group, and

[0030] at least one fatty triamine.

DETAILED DESCRIPTION

[0031] The percentages given below correspond to percentages by mass of active ingredient.

[0032] Organomolybdenum Compound

[0033] The lubricant composition according to the invention comprises at least one organomolybdenum compound. By organomolybdenum compound according to the invention, is meant any oil-soluble organomolybdenum com-
In an embodiment of the invention, the organomolybdenum compound can be selected from the organic molybdenum complexes such as the molybdenum carboxylates, esters, amides, which can be obtained by reaction of molybdenum oxide or of ammonium molybdates with fats, glycerides, fatty acids or fatty acid derivatives (esters, amides, amides etc.).

In a preferred embodiment of the invention, the organomolybdenum compound is selected from the molybdenum complexes that are free of sulphur and of phosphorus, with amide-type ligands, mainly prepared by the reaction of a source of molybdenum, which can be for example trimolybdenum oxide, and an amine derivative, and fatty acids comprising for example from 4 to 28 carbon atoms, preferentially from 8 to 18 carbon atoms, such as for example the fatty acids contained in animal or vegetable oils. The synthesis of such compounds is for example described in the patents U.S. Pat. No. 4,889,647, EP 0546357, U.S. Pat. No. 5,412,130, EP 1770153.

In a preferred embodiment of the invention, the organomolybdenum compound is selected from the organic molybdenum complexes obtained by the reaction:

(i) of a mono-, di- or triglyceride-type fat, or fatty acid,

(ii) of an amine source of formula (A):

\[
\text{(A)}
\]

\[
\begin{align*}
\text{H} & \quad \text{N} \quad \text{X}_1^1 \text{H}_n \\
& \quad \text{X}_2^2 \text{H}_m
\end{align*}
\]

in which:

X\(^1\) represents an oxygen atom or a nitrogen atom;

X\(^2\) represents an oxygen atom or a nitrogen atom;

n represents 1 when X\(^1\) represents an oxygen atom and m represents 1 when X\(^2\) represents an oxygen atom;

n represents 2 when X\(^1\) represents a nitrogen atom and m represents 2 when X\(^2\) represents a nitrogen atom;

R\(_1\) represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms, preferentially from 3 to 20 carbon atoms, advantageously from 7 to 17 carbon atoms;

and:

\[
\begin{align*}
\text{R}_1 & \quad \text{N} \quad \text{H}_n \quad \text{H}_m \\
& \quad \text{H}_{n+1} \quad \text{H}_{m+1}
\end{align*}
\]

in which:

\[
\begin{align*}
\text{X}_1^1 & \quad \text{represents an oxygen atom or a nitrogen atom;} \\
\text{X}_2^2 & \quad \text{represents an oxygen atom or a nitrogen atom;} \\
n & \quad \text{represents 1 when X}_1^1 \text{ represents an oxygen atom and m represents 1 when X}_2^2 \text{ represents an oxygen atom;} \\
n & \quad \text{represents 2 when X}_1^1 \text{ represents a nitrogen atom and m represents 2 when X}_2^2 \text{ represents a nitrogen atom;} \\
\text{R}_1 & \quad \text{represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms, preferentially from 3 to 20 carbon atoms, advantageously from 7 to 17 carbon atoms;} \\
\text{R}_1 & \quad \text{represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms, preferentially from 3 to 20 carbon atoms, advantageously from 7 to 17 carbon atoms.}
\end{align*}
\]

In an embodiment of the invention, the organic molybdenum complex can comprise from 2 to 8.5% by weight of molybdenum with respect to the weight of the complex.

In a preferred embodiment of the invention, the organic molybdenum complex is constituted by at least one of the compounds of formula (I) or (II), alone or in a mixture:

\[
\begin{align*}
\text{R}_1 & \quad \text{N} \quad \text{H}_n \quad \text{H}_m \\
& \quad \text{H}_{n+1} \quad \text{H}_{m+1}
\end{align*}
\]

in which:

\[
\begin{align*}
\text{X}_1^1 & \quad \text{represents an oxygen atom or a nitrogen atom;} \\
\text{X}_2^2 & \quad \text{represents an oxygen atom or a nitrogen atom;} \\
n & \quad \text{represents 1 when X}_1^1 \text{ represents an oxygen atom and m represents 1 when X}_2^2 \text{ represents an oxygen atom;} \\
n & \quad \text{represents 2 when X}_1^1 \text{ represents a nitrogen atom and m represents 2 when X}_2^2 \text{ represents a nitrogen atom;} \\
\text{R}_1 & \quad \text{represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms, preferentially from 3 to 20 carbon atoms, advantageously from 7 to 17 carbon atoms.}
\end{align*}
\]

In an embodiment of the invention, the organic molybdenum complex is prepared by the reaction:

(i) of a mono-, di- or triglyceride-type fat, or fatty acid,

(ii) of diethanolamine or 2-(2-aminoethyl) aminooethanol,

(iii) of a source of molybdenum selected from trimolybdenum oxide or the molybdates, preferentially ammonium molybdate, in a quantity sufficient to provide 0.1 to 20.0% of molybdenum with respect to the weight of complex.

In a preferred embodiment of the invention, the organic molybdenum complex is constituted by at least one compound of formula (I-a) or (II-a), alone or in a mixture:
in which $R_1$ represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms, preferentially from 3 to 20 carbon atoms, advantageously from 7 to 17 carbon atoms,

in which $R_1$ represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms, preferentially from 3 to 20 carbon atoms, advantageously from 7 to 17 carbon atoms.

Moreover, an embodiment, the organomolybdenum compound can be selected from the molybdenum dithiophosphates or molybdenum dithiocarbamates. In a preferred embodiment of the invention, the organomolybdenum compound is selected from the molybdenum dithiocarbamates. The molybdenum dithiocarbamate compounds (Mo-DTC compounds) are complexes formed by a metal core linked to one or more ligands, the ligand being a dithiocarbamate group of alkyls. These compounds are well known to a person skilled in the art.

In an embodiment of the invention, the Mo-DTC compound can comprise from 1 to 40%, preferably from 2 to 30%, more preferably from 3 to 28%, advantageously from 4 to 15% by mass of molybdenum, with respect to the total mass of Mo-DTC compound. In another embodiment of the invention, the Mo-DTC compound can comprise from 1 to 40%, preferably from 2 to 30%, more preferably from 3 to 28%, advantageously from 4 to 15% by mass of sulphur, with respect to the total mass of Mo-DTC compound. In another embodiment of the invention, the Mo-DTC compound can be selected from those the core of which has two molybdenum atoms (also called dimeric Mo-DTC) and those the core of which present three molybdenum atoms (also called trimeric Mo-DTC).

Another embodiment of the invention, the trimeric Mo-DTC compounds correspond to the formula MoSSKn in which:

- $k$ represents an integer at least equal to 4, preferably ranging from 4 to 10, advantageously from 4 to 7.
- $n$ is an integer ranging from 1 to 4, and
- $L$ is a dithiocarbamate group of alkyls comprising from 1 to 100 carbon atoms, preferably from 1 to 40 carbon atoms, advantageously from 3 to 20 carbon atoms.

As examples of trimeric Mo-DTC compounds according to the invention, the compounds and their preparation processes as described in the documents EP 0757093, EP 0719851, EP 0743354 or EP 1013749 may be mentioned. In a preferred embodiment of the invention, the Mo-DTC compound is a dimeric Mo-DTC compound. As examples of dimeric Mo-DTC compounds, the compounds

and their preparation processes as described in the documents EP 0757093, EP 0719851, EP 0743354 or EP 1013749 may be mentioned.

The dimeric Mo-DTC compounds correspond generally to the compounds of formula (III):

$\text{III}$

in which:

- $R_1$, $R_2$, $R_3$, $R_4$, $R_5$, identical or different, represent independently a hydrocarbon group selected from the alkyl, alkenyl, aryl, cycloalkyl or cycloalkenyl groups,
- $X_1$, $X_2$, $X_3$, and $X_4$, identical or different, represent independently an oxygen atom or a sulphur atom.

By alkyl group within the meaning of the invention, is meant a linear or branched, saturated or unsaturated hydrocarbon-containing group comprising from 1 to 24 carbon atoms. In an embodiment of the invention, the alkyl group is selected from the group formed by methyl, ethyl, propyl, isopropyl, n-butyl, iso-butyl, tert-butyl, n-pentyl, iso-pentyl, neopentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, hexadecyl, stearyl, icosyl, docosyl, eicosyl, tetradecyl, triacontyl, 2-ethylhexyl, 2-butylcyclohexyl, 2-butyldecyl, 2-hexylcyclohexyl, 2-ethylhexyl, 2-hexyldecyl, 2-octyldecyl, 2-octylundecyl, 2-decyltetradecyl, 2-dodecylhexadecyl, 2-hexadecyloctadecyl, 2-tetradecyloctadecyl, myristyl, palmityl and stearyl. By alkenyl group within the meaning of the present invention, is meant a linear or branched hydrocarbon-containing group comprising at least one double bond and comprising from 2 to 24 carbon atoms. The alkenyl group can be selected from vinyl, allyl, propenyl, butenyl, isobutenyl, pentenyl, isopentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, tetradecenyl and olefin.

By aryl group within the meaning of the present invention, is meant a polycyclic aromatic hydrocarbon or an aromatic group, substituted or not substituted with an alkyl group. The aryl group can comprise from 6 to 24 carbon atoms. In an embodiment, the aryl group can be selected from the group formed by phenyl, tolyl, xylyl, guaynyl, mesityl, benzyl, phenethyl, styryl, cinammoyl, benzhydryl, trimethyl, ethylphenyl, propylphenyl, butylphenyl, pentylphenyl, hexylphenyl, heptylphenyl, octylphenyl, nonylphenyl, decylphenyl, undecylphenyl, dodecylphenyl, phenylphenyl, benzylphenyl, phenyl-styrenyl, p-cumylphenyl and naphthyl.

Within the meaning of the present invention, the cycloalkyl groups and the cycloalkenyl groups can be selected, non-limitatively, from the group constituted by cyclopentyl, cyclohexyl, cycloheptyl, methylecyclopentyl, methylecyclohexyl, methylecycloheptyl, cyclopentenyl, cyclohexenyl, cycloheptenyl, methylecyclopentenyl, methylecyclohexenyl. The cycloalkyl groups and the cycloalkenyl groups can comprise from 3 to 24 carbon atoms.

In a preferred embodiment of the invention, $R_1$, $R_2$, $R_3$, and $R_4$, identical or different, represent independently an alkyl group comprising from 4 to 18 carbon atoms or an alkenyl group comprising from 2 to 24 carbon atoms. In an embodiment of the invention, $X_1$, $X_2$, $X_3$, and $X_4$, can be identical and can represent a sulphur atom. In another embodiment of the invention, $X_1$, $X_2$, $X_3$, and $X_4$, can be identical and can represent a sulphur atom. In another embodiment of the invention, $X_1$, $X_2$, $X_3$, and $X_4$, can represent an oxygen atom.
ment of the invention, X₃ and X₄ can represent an oxygen atom and X₅ and X₆ can represent a sulphur atom.

[0077] In another embodiment of the invention: the ratio of the number of sulphur atoms to the number of oxygen atoms (S/O) of the Mo-DTC compound can vary from (1/3) to (3/1). In another embodiment of the invention, the Mo-DTC compound of formula (A) can be selected from a symmetrical Mo-DTC compound, an asymmetrical Mo-DTC compound and a combination thereof. By symmetrical Mo-DTC compound according to the invention, is meant an Mo-DTC compound of formula (III) in which the R₃, R₄, R₅, and R₆ groups are identical. By asymmetrical Mo-DTC compound according to the invention, is meant an Mo-DTC compound of formula (III) in which the R₃ and R₆ groups are identical, the R₅ and R₆ groups are identical and the R₄ and R₅ groups are different from the R₃ and R₄ groups. In a preferred embodiment of the invention, the Mo-DTC compound is a mixture of at least one symmetrical Mo-DTC compound and at least one asymmetrical Mo-DTC compound.

[0078] In an embodiment of the invention, R₃ and R₆, which are identical, represent an alkyl group comprising from 5 to 15 carbon atoms and R₄ and R₅, which are identical and different from R₃ and R₅, represent an alkyl group comprising from 5 to 15 carbon atoms. In a preferred embodiment of the invention, R₅ and R₆, which are identical, represent an alkyl group comprising from 6 to 10 carbon atoms and R₃ and R₄ represent an alkyl group comprising from 10 to 15 carbon atoms. In another preferred embodiment of the invention, R₃ and R₄, which are identical, represent an alkyl group comprising from 10 to 15 carbon atoms and R₅ and R₆ represent an alkyl group comprising from 6 to 10 carbon atoms. In another preferred embodiment of the invention, R₃, R₅, R₆ and R₇, which are identical, represent an alkyl group comprising from 5 to 15 carbon atoms, preferably from 8 to 13 carbon atoms.

[0079] Advantageously, the Mo-DTC compound is selected from the compounds of formula (III) in which:

[0080] X₃ and X₄ represent an oxygen atom,

[0081] X₃ and X₄ represent a sulphur atom,

[0082] R₄ represents an alkyl group comprising 8 carbon atoms or an alkyl group comprising 13 carbon atoms,

[0083] R₅ represents an alkyl group comprising 8 carbon atoms or an alkyl group comprising 13 carbon atoms,

[0084] R₆ represents an alkyl group comprising 8 carbon atoms or an alkyl group comprising 13 carbon atoms,

[0085] R₇ represents an alkyl group comprising 8 carbon atoms or an alkyl group comprising 13 carbon atoms.

[0086] Thus, advantageously, the Mo-DTC compound is selected from the compounds of formula (III-a)

\[
\text{R}_3 \text{O-S-S-R}_4 \text{O-S-S-R}_5 \text{O-S-S-R}_6 \text{O-S-S-R}_7
\]

in which the R₃, R₄, R₅, and R₆ groups are as defined for formula (III).

[0087] More advantageously, the Mo-DTC compound is a mixture of:

[0088] an Mo-DTC compound of formula (III-a) in which R₃, R₄, R₅, and R₆ represent an alkyl group comprising 8 carbon atoms,

\[\text{R}_3 \text{OR}_4 \text{OR}_5 \text{OR}_6 \text{OR}_7\]

[0089] an Mo-DTC compound of formula (III-a) in which R₃, R₄, R₅, and R₆ represent an alkyl group comprising 13 carbon atoms, and

[0090] an Mo-DTC compound of formula (III-a) in which R₃ and R₄ represent an alkyl group comprising 13 carbon atoms and R₅ and R₆ represent an alkyl group comprising 8 carbon atoms, and/or

[0091] an Mo-DTC compound of formula (A1) in which R₃ and R₅ represent an alkyl group comprising 8 carbon atoms and R₄ and R₆ represent an alkyl group comprising 13 carbon atoms.

[0092] As examples of Mo-DTC compounds, the products Molynan L, Molynan 807 or Molynan 822 marketed by R.T. Vanderbilt Company or the products Sakuru-lube 200, Sakuru-lube 165, Sakuru-lube 125 or Sakuru-lube 600 marketed by Adeka may be mentioned. In an embodiment of the invention, the content by weight of organomolybdenum compound ranges from 0.05 to 3%, preferably from 0.1 to 2%, advantageously from 0.1 to 1% with respect to the total weight of the lubricant composition.

[0093] Compound Comprising a Dithiophosphate Group

[0094] The lubricant composition according to the invention comprises at least one compound comprising a dithiophosphate group. For the sake of simplicity of the description, the compound comprising a dithiophosphate group is called “dithiophosphate” in the remainder of the present description. The dithiophosphate, without being imitative, can be selected from the ammonium dithiophosphates, the amine dithiophosphates, the ester dithiophosphates and the metal dithiophosphates, alone or in a mixture.

[0095] In an embodiment of the invention, the dithiophosphate is selected from the ammonium dithiophosphates of formula (IV):

\[
\text{R}_4 \text{O-S-S-R}_6 \text{NH}_4
\]

in which R₄ and R₆ represent independently of one another an optionally substituted hydrocarbon-containing group, comprising from 1 to 30 carbon atoms.

[0096] In a preferred embodiment of the invention, R₄ and R₆ represent independently of one another an optionally substituted hydrocarbon-containing group, comprising from 2 to 24 carbon atoms, more preferably from 3 to 18 carbon atoms, advantageously from 5 to 12 carbon atoms. In another preferred embodiment of the invention, R₄ and R₆ represent independently of one another an optionally substituted hydrocarbon-containing group, said hydrocarbon-containing group being able to be an alkyl, alkenyl, alkynyl, phenyl or benzyl group. In a preferred embodiment of the invention, R₄ and R₆ represent independently of one another a linear or branched hydrocarbon-containing alkyl group, in another preferred embodiment of the invention, R₄ and R₆ represent independently of one another a hydrocarbon-containing group optionally substituted with at least one oxygen, nitrogen, sulphur and/or phosphorus atom, preferably with at least one oxygen atom.

[0097] As examples of ammonium dithiophosphate, the dimethyl ammonium dithiophosphates, the diethyl ammo-
nium dithiophosphates and the dibutyl ammonium dithio-
phosphates may be mentioned. In another embodiment of
the invention, the dithiophosphate is selected from the amine
dithiophosphates of general formula (V):

\[
\begin{align*}
\text{R}_n &-\text{O}-\text{S}-\text{R}_{11} \\
\text{R}_{10} &\quad \text{R}_{12} \\
\text{R}_{11} &-\text{O} \\
\end{align*}
\]  

(V)

[0098] in which:

[0099] \( \text{R}_n \) and \( \text{R}_{10} \) represent independently of one
another a hydrocarbon-containing group, optionally
substituted, comprising from 1 to 30 carbon atoms.

[0100] \( \text{R}_{11}, \text{R}_{12} \) and \( \text{R}_{13} \) represent independently of one
another a hydrogen atom or a hydrocarbon-
containing group of 1 to 30 carbon atoms, it being
understood that at least one of the \( \text{R}_{11}, \text{R}_{12} \) and \( \text{R}_{13} \)
groups does not represent a hydrogen atom.

[0101] In a preferred embodiment of the invention, \( \text{R}_n \) and
\( \text{R}_{10} \) represent independently of one another a hydrocarbon-
containing group, optionally substituted, comprising from 2
to 24 carbon atoms, more preferentially from 3 to 18 carbon
atoms, advantageously from 5 to 12 carbon atoms. In
another preferred embodiment of the invention, \( \text{R}_n \) and \( \text{R}_{10} \)
represent independently of one another an unsubstituted
hydrocarbon-containing group, said hydrocarbon-
containing group being able to be an alkyl, alkenyl, alkynyl, phenyl
or benzyl group. In another preferred embodiment of the
invention, \( \text{R}_n \) and \( \text{R}_{10} \) represent independently of one
another a linear or branched hydrocarbon-containing alkyl
group, more preferentially a linear hydrocarbon-containing
alkyl group.

[0102] In another embodiment of the invention, the dithio-
phosphate is selected from the ester dithiophosphates of
general formula (VI):

\[
\begin{align*}
\text{R}_{18} &-\text{O}-\text{S}-\text{OR}_{17} \\
\text{R}_{19} &\quad \text{M}^{+} \\
\text{R}_{10} &-\text{O} \\
\end{align*}
\]  

(VI)

[0103] in which:

[0104] \( \text{R}_{11}, \text{R}_{12} \) and \( \text{R}_{13} \) represent independently of one
another a hydrocarbon-containing group, optionally
substituted, comprising from 1 to 30 carbon atoms.

[0105] \( \text{R}_{13} \) and \( \text{R}_{17} \) represent independently of one
another a hydrocarbon-containing group comprising
from 1 to 18 carbon atoms.

[0106] In a preferred embodiment of the invention, \( \text{R}_{14} \)
and \( \text{R}_{15} \) represent independently of one another an option-
ally substituted hydrocarbon-containing group, comprising
from 2 to 24 carbon atoms, more preferentially from 3 to 18
carbon atoms, advantageously from 5 to 12 carbon atoms. In
another preferred embodiment of the invention, \( \text{R}_{14} \) and \( \text{R}_{15} \)
represent independently of one another an unsubstituted
hydrocarbon-containing group, said hydrocarbon-
containing group being able to be an alkyl, alkenyl, alkynyl, phenyl
or benzyl group. In another preferred embodiment of the
invention, \( \text{R}_{14} \) and \( \text{R}_{15} \) represent independently of one
another a linear or branched hydrocarbon-containing alkyl

[0107] In another preferred embodiment of the invention, \( \text{R}_{14} \)
and \( \text{R}_{15} \) represent independently of one another a hydrocarbon-
containing group optionally substituted with at least
one oxygen, nitrogen, sulphur and/or phosphorus atom,
preferably with at least one oxygen atom. In another pre-
ferred embodiment of the invention, \( \text{R}_{14} \) and \( \text{R}_{15} \) represent
independently of one another, a hydrocarbon-containing
group comprising from 2 to 6 carbon atoms. In another
preferred embodiment of the invention, \( \text{R}_{14} \) and \( \text{R}_{15} \)
represent independently of one another a hydrocarbon-
containing group comprising from 2 to 6 carbon atoms.

[0108] In another embodiment, the dithiophosphate is
selected from the metal dithiophosphates of general formula
(VII):

[0109] in which:

[0110] \( \text{R}_{18} \) and \( \text{R}_{19} \) represent independently of one
another an optionally substituted hydrocarbon-
containing group, comprising from 1 to 30 carbon
atoms,

[0111] \( \text{M} \) represents a metal cation, and

[0112] \( \text{n} \) is the valency of this metal cation.

[0113] In a preferred embodiment of the invention, the
metal is selected from the group constituted by zinc, al-
uminium, copper, iron, mercury, silver, cadmium, tin, lead,
antimony, bismuth, thallium, chromium, molybdenum,
cobalt, nickel, tungsten, sodium, calcium, magnesium, mangan-
ese and arsenic. The preferred metals are zinc, molyb-
denum, antimony, preferably zinc and molybdenum. In a
preferred embodiment of the invention, the metal is zinc.
Mixtures of metals can be used. The metal dithiophosphates
are neutral as exemplified in formula (VII) or basic when a
stoichiometric excess of metal is present.

[0114] In a preferred embodiment of the invention, \( \text{R}_{18} \)
and \( \text{R}_{19} \) represent independently of one another an option-
ally substituted hydrocarbon-containing group, comprising
from 2 to 24 carbon atoms, more preferentially from 3 to 18
carbon atoms, advantageously from 5 to 12 carbon atoms. In
another preferred embodiment of the invention, \( \text{R}_{18} \) and \( \text{R}_{19} \)
represent independently of one another an unsubstituted
hydrocarbon-containing group, said hydrocarbon-
containing group being able to be an alkyl, alkenyl, alkynyl, phenyl
or benzyl group. In another preferred embodiment of the
invention, \( \text{R}_{18} \) and \( \text{R}_{19} \) represent independently of one
another a linear or branched hydrocarbon-containing alkyl.
group, more preferentially a linear hydrocarbon-containing alkyl group. In another preferred embodiment of the invention, R₈₋₁₀ and R₁₀₋₁₄ represent independently of one another a hydrocarbon-containing group optionally substituted with at least one oxygen, nitrogen, sulphur and/or phosphorus atom, preferably with at least one oxygen atom.

[0015] Advantageously, the dithiophosphate according to the invention is a zinc dithiophosphate of formula (VII-a) or formula (VII-b):

\[
\text{(VII-a)}
\]

\[
\text{(VII-b)}
\]

in which \( R_{18} \) and \( R_{19} \) are as defined above.

[0016] As metal dithiophosphates according to the invention, Additin® RC 3038, Additin® RC 3045, Additin® RC 3048, Additin® RC 3058, Additin® RC 3060, Additin® RC 3180, Additin® RC 3212, Additin® RC 3580, Kikukule® Z112, Lührz® 1371, Lührz® 1375, Lührz® 1395, Lührz® 5179, Olos® 260, Olos® 267 may be mentioned as an embodiment of the invention, the content by weight of dithiophosphate ranges from 0.1 to 5%, preferably from 0.1 to 3%, advantageously from 0.5 to 2% with respect to the total weight of the lubricant composition.

[0017] Fatty Triamine

[0018] The lubricant composition according to the invention comprises at least one fatty triamine. The fatty triamines are mainly obtained from carboxylic acids. The starting fatty acids for obtaining fatty triamines according to the invention can be selected from myristic, pentadecyl, palmitic, margarine, stearic, nonadecyl, arachidic, heneicosanoic, behenic, tricosanoic, lignoceric, pentacosanoic, cerotic, heptacosanoic, montanic, nonacosanoic, melissic, hentriacontaneoic, lacceroic acids or unsaturated fatty acids such as palmitoleic, oleic, erucic, nervonic, linoleic, linolenic, gamma-linolenic, delta-homo-gamma-linolenic, arachidonic, eicosapentaenoic, docosahexaenoic acids.

[0019] The preferred fatty acids can originate from the hydrolysis of the triglycerides present in vegetable or animal oils such as coconut, palm, olive, groundnut, rapeseed, sunflower, soya, cotton, linseed oil, beef tallow, etc. The natural oils may have been genetically modified so as to enrich their content of certain fatty acids. By way of example, rapeseed oil or oleic sunflower oil may be mentioned. In an embodiment of the invention, the fatty triamines can be obtained from natural vegetable or animal resources.

[0020] In another embodiment of the invention, the fatty triamine is selected from the compounds of formula (VII):

\[
\text{(VII)}
\]

in which \( R_{20} \) represents a linear or branched, saturated or unsaturated alkyl group, comprising at least 10 carbon atoms, preferentially from 10 to 22 carbon atoms, more preferentially from 14 to 22 carbon atoms, advantageously from 16 to 20 carbon atoms.

[0121] In a preferred embodiment of the invention, \( R_{20} \) represents a mixture of at least one saturated alkyl group comprising from 16 to 18 carbon atoms and a mono-unsaturated alkyl group comprising from 16 to 18 carbon atoms.

[0122] In another embodiment of the invention, the fatty triamine is selected from the compounds of formula (IX):

\[
R_{23}--\text{NH}--(\text{CH}_2)_{2}--\text{CH}_2--\text{NH}_2--\text{H} \tag{IX}
\]

in which \( R_{23} \) represents a linear or branched, saturated or unsaturated alkyl group, comprising at least 10 carbon atoms, preferentially from 10 to 22 carbon atoms, more preferentially from 14 to 22 carbon atoms, advantageously from 16 to 20 carbon atoms.

[0123] In an embodiment of the invention, the content by weight of fatty triamine ranges from 0.1 to 5%, preferably from 0.1 to 3%, advantageously from 0.5 to 2% with respect to the total weight of the composition. In another embodiment of the invention, the lubricant composition comprises a mass ratio (organononylbenzyl compound/fatty triamine) ranging from 1/10 to 1, preferably from 1/5 to 4/5. In another embodiment of the invention, the lubricant composition comprises a mass ratio (organononylbenzyl compound/fatty triamine) ranging from 1/10 to 1/1, preferably ranging from 1/5 to 4/5.

[0124] Base Oil

[0125] The lubricant compositions according to the invention can contain any type of lubricant base oil, mineral, synthetic, natural or animal or vegetable, suitable for their use. The base oil or oils used in the lubricant compositions according to the present invention can be oils of mineral or synthetic origin of groups I to V according to the classes defined in the API classification (or their equivalents according to the ATIEL classification) as summarized below, alone or in mixture.

<p>| TABLE 1 |
|-----------------|-----------------|--------------|</p>
<table>
<thead>
<tr>
<th>Saturates content</th>
<th>Sulphur content</th>
<th>Viscosity index (VI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I Mineral oils</td>
<td>&gt;90%</td>
<td>&gt;0.03%</td>
</tr>
<tr>
<td>Group II Hydrocracked oils</td>
<td>≥90%</td>
<td>≤0.03%</td>
</tr>
<tr>
<td>Group III Hydrocracked or hydrogenated oils</td>
<td>≥90%</td>
<td>≤0.03%</td>
</tr>
<tr>
<td>Group IV Polyalphalenoins (PAO)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group V Ester and other bases not included in the bases of groups I to IV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[0126] The mineral base oils according to the invention include all types of bases obtained by atmospheric and vacuum distillation of crude oil, followed by refining operations such as solvent extraction, deasphalting, solvent dewaxing, hydrocracking and hydroisomerization, hydrofinishing. The base oils of the compositions according to the present invention can also be synthetic oils, such as certain esters of carboxylic acids and of alcohols, or polyalphalenoins. The polyalphalenoins used as base oils are for example obtained from monomers having from 4 to 32 carbon atoms (for example octene, decene), and a viscosity at 100°C comprised between 1.5 and 15 cSt (mea-
sured according to the standard ASTM D 445). Their average molecular weight is typically comprised between 250 and 3000 according to the standard ASTM D5296. Mixtures of synthetic and mineral oils can also be used.

[0127] There is no limitation as regards the use of one lubricant base or another in order to produce the lubricant compositions according to the invention, except that they must have properties, in particular of viscosity, viscosity index, sulphur content, resistance to oxidation, suitable for use in a vehicle engine, preferentially a motor vehicle engine. In an embodiment of the invention, the lubricant bases represent at least 50% by mass, with respect to the total mass of the lubricant composition, preferentially at least 60%, or also at least 70%. Typically, they represent between 75 and 99.9% by mass, with respect to the total mass of the lubricant compositions according to the invention.

[0128] In a preferred embodiment of the invention, the lubricant compositions comprise mineral bases of group I and/or III, or synthetic bases of group IV according to the API classification. In another preferred embodiment of the invention, the lubricant compositions have a kinematic viscosity at 100°C measured according to the standard ASTM D445 ranging from 4 to 25 cSt, preferably from 5 to 22 cSt, advantageously from 5 to 13 cSt. In another preferred embodiment of the invention, the lubricant compositions have a viscosity index (VI) greater than or equal to 140, preferentially greater than or equal to 150, measured according to the standard ASTM 2270.

[0129] Other Additives

[0130] The lubricant compositions according to the invention can also additionally contain at least one additive selected from the detergents, anti-wear additives different from a diethiophosphate, extreme pressure additives, dispersants, pour-point improvers, anti-foaming agents, thickeners and mixtures thereof. In an embodiment, the lubricant composition can additionally comprise at least one antioxidant additive. The antioxidant additives slow down the degradation of the lubricant compositions in service, in particular of the engine oils in service, degradation which can in particular result in the formation of deposits, the presence of sludges, or an increase in the viscosity of the lubricant composition, in particular of the engine oil. The antioxidant additives act in particular as radical inhibitors or hydroperoxide destroyers. Among the antioxidants commonly used, antioxidants of the phenolic or amine type, or phosphorus- and sulphur-containing antioxidants may be mentioned. Some of these antioxidants, for example the phosphorus- and sulphur-containing antioxidants, may generate ashes. The phenolic antioxidants may be ash-free, or be in the form of neutral or basic metal salts.

[0131] The antioxidant agents can be in particular selected from the sterically hindered phenols, the esters of sterically hindered phenols and the sterically hindered phenols comprising a thioether bridge, the diphenylamines, the diphenylamines substituted at least with one C1-C12 alkyl group, the N,N dialkyaryl diamines and combinations thereof. By sterically hindered phenol, is meant within the meaning of the present invention a compound comprising a phenol group in which at least one vicinal carbon of the carbon bearing the alcohol function is substituted with at least one C1-C10 alkyl group, preferably a C1-C6 alkyl group, preferably a C4 alkyl group, preferably with the tert-butyl group. The amine compounds are another class of antioxidants which can be used, optionally in combination with the phenolic antioxidants. Typical examples are the aromatic amines of formula R2R3R5N, in which R2 represents an aliphatic group or an optionally substituted aromatic group, R3 represents an optionally substituted aromatic group, R24 represents a hydrogen atom, an alkyl group, an aryl group or a group of formula R5(S)O,R23, where R5 represents an alkylenegroup or an alkenylene group, R24 represents an alkyl group, an alkenyl group or an aryl group and z represents an integer equal to 0, 1 or 2. Sulphurized alkyl phenols or their alkali or alkaline-earth metal salts can also be used as antioxidants. Another class of antioxidants is that of the copper compounds, for example the copper thio- or diethiophosphate, salts of copper and of carboxyhydrates, dithiocarbamates, sulphonates, phenates, copper acetylacetates. Copper I and II salts of succinic acid or anthranide can also be used.

[0132] The lubricant composition according to the invention can contain any type of antioxidant additives known to a person skilled in the art. Advantageously, the ash-free antioxidants are used. In an embodiment, the lubricant composition according to the invention can comprise from 0.5 to 2% of at least one antioxidant additive by weight with respect to the total mass of the lubricant composition.

[0133] In an embodiment, the lubricant composition according to the invention can also comprise a detergent additive. The detergent additives reduce in particular the formation of deposits on the surface of the metal parts by dissolving the by-products of oxidation and combustion. The detergents that can be used in the lubricant composition according to the invention are well known to a person skilled in the art. The detergents commonly used in the formulation of lubricant compositions can be anionic compounds comprising a lipophilic long hydrocarbon-containing chain and a hydrophilic head. The associated cation is typically a metal cation of an alkali or alkaline-earth metal. The detergents are preferentially selected from the alkali or alkaline-earth metal salts of carboxylic acids, sulphonates, salicylates, naphthenates, as well as the salts of phenates. The alkali or alkaline-earth metals are preferentially calcium, magnesium, sodium or barium. These metal salts can contain the metal in an approximately stoichiometric quantity or in excess (in a quantity greater than the stoichiometric quantity). In the latter case, these detergents are referred to as overbased detergents. The excess metal providing the detergent with its overbased character is present in the form of metal salts which are insoluble in oil, for example carbonate, hydroxide, oxalate, acetate, gluconate, preferentially carbonate.

[0134] In an embodiment, the lubricant composition according to the invention can comprise from 2 to 4% by weight of detergent, with respect to the total mass of the lubricant composition. In an embodiment, the lubricant composition according to the invention can also comprise at least one pour point depressant additive. The pour point depressant additives in particular improve the low-temperature behaviour of the lubricant compositions, by slowing down the formation of paraffin crystals. As examples of pour point depressant additives, the alkyl poly methacrylates, polyacrylates, polyarylamides, polyalkylyphenols, polyalkyl-naphthalenes, alkylated polystyrenes may be mentioned.

[0135] In an embodiment, the lubricant composition according to the invention can also comprise at least one dispersant. The dispersants can be selected from the groups formed by the Mannich base or bases. In an embodiment, the
lubricant composition according to the invention can comprise from 0.2 to 10% by mass of dispersants with respect to the total mass of the lubricant composition.

[0136] In an embodiment, the lubricant composition can also comprise at least one polymer improving the viscosity index. Among these polymers the polymer esters, the ethylene and propylene copolymers, the homopolymers or copolymers of styrene, butadiene or isoprene, hydrogenated or not, and the polyethylene units (PE) may be mentioned. In an embodiment, the lubricant composition according to the invention can comprise from 1 to 15% by mass of polymers improving the viscosity index, with respect to the total mass of the lubricant composition.

[0137] In an embodiment of the invention, the lubricant composition comprises:

[0138] from 75 to 99.75% of at least one base oil,
[0139] from 0.05 to 3% of at least one organomolybdien compound,
[0140] from 0.1 to 5% of at least one compound comprising a dithiophosphate group,
[0141] from 0.1 to 5% of at least one fatty triamine.

[0142] In another embodiment of the invention, the lubricant composition comprises:

[0143] from 75 to 99.25% of at least one base oil,
[0144] from 0.05 to 3% of at least one organomolybdien compound,
[0145] from 0.1 to 5% of at least one compound comprising a dithiophosphate group,
[0146] from 0.1 to 5% of at least one fatty triamine,
[0147] from 0.5 to 5% of at least one other additive.

[0148] In another embodiment of the invention, the lubricant composition essentially consists of:

[0149] 75 to 99.75% of at least one base oil,
[0150] 0.05 to 3% of at least one organomolybdien compound,
[0151] 0.1 to 5% of at least one compound comprising a dithiophosphate group,
[0152] 0.1 to 5% of at least one fatty triamine.

[0153] In another embodiment of the invention, the lubricant composition essentially consists of:

[0154] 75 to 99.25% of at least one base oil,
[0155] 0.05 to 3% of at least one organomolybdien compound,
[0156] 0.1 to 5% of at least one compound comprising a dithiophosphate group,
[0157] 0.1 to 5% of at least one fatty triamine,
[0158] 0.5 to 5% of at least one other additive.

[0159] All of the characteristics and preferences presented for the base oil, organomolybdien compound, compound comprising a dithiophosphate group, the fatty triamine and the additional additive also apply to the above lubricant compositions. In an embodiment of the invention, the lubricant composition is not an emulsion. In another embodiment of the invention, the lubricant composition is anhydrous. An object of the invention is also an engine oil comprising a lubricant composition according to the invention. All of the characteristics and preferences presented for the lubricant composition also apply to the engine oil according to the invention.

[0160] In an embodiment of the invention, the engine oil can be of grades OW-20 and 5W-30 according to the SAE J300 classification, characterized by a kinematic viscosity at 100°C. (KV100) ranging from 5.6 to 12.5 cSt measured according to the international standard ASTM D445. In another embodiment of the invention, the engine oil can be characterized by a viscosity index, calculated according to the international standard ASTM D2230, greater than or equal to 130, preferably greater than or equal to 150. In order to formulate an engine oil, base oils having a sulphur content less than 0.3%, for example mineral oils of group III, and synthetic bases free of sulphur, preferably of group IV, or mixtures thereof may advantageously be used.

[0161] An object of the invention is also the use of a lubricant composition as defined above for the lubrication of mechanical parts, in particular in transmissions and/or vehicle engines, preferably motor vehicle engines. An object of the invention is also the use of a lubricant composition as defined above for reducing friction between two steel surfaces, in particular in a vehicle engine, preferably a motor vehicle engine. An object of the invention is also the use of a lubricant composition as defined above for reducing friction between two carbon-covered surfaces, in particular in a vehicle engine, preferably a motor vehicle engine.

[0162] By carbon coating according to the invention, is meant any coating comprising carbon. These carbon coatings can be selected from diamond coatings, and more particularly nanodiamond coatings. Such coatings can be presented in the form of at least one nanocrystalline diamond layer, having a purity ranging from 70 to 90%.

[0163] In an embodiment of the invention, the carbon coatings are selected from nanodiamond coatings in the form of at least one nanocrystalline diamond layer having a purity ranging from 70 to 99%, preferably ranging from 70 to 97%, advantageously of 75% and a thickness ranging from 0.1 to 3µ, preferably ranging from 0.5 to 2µ, advantageously of 1.5µ. These carbon coatings can also be selected from DLC (Diamond Like Carbon) type coatings. Any type of DLC coating can be used as carbon coating according to the invention. The DLCs group together a set of families of amorphous materials essentially containing carbon.

[0164] Among these families, two families are mainly known and used: the hydrogenated DLCs, in particular the hydrogenated DLCs known as a-C:H and the non-hydrogenated DLCs, in particular the non-hydrogenated DLCs known as a-C or the non-hydrogenated DLCs known as to-C. The DLCs have properties which vary as a function of their sp3 hybrid carbon content and their hydrogen content. Certain variants of DLC can be doped with metal elements, such as iron, chromium or tungsten.

[0165] Compared with diamond coatings, the DLC coatings are generally less mechanically and thermally resistant as these are amorphous materials. However, they are generally less rough and above all can be applied to the majority of substrates at a low temperature. In an embodiment of the invention, the DLCs are selected from the hydrogenated DLCs, in particular the hydrogenated DLCs known as a-C:H. In a preferred embodiment of the invention, the DLCs are selected from the hydrogenated DLCs, in particular the hydrogenated DLCs known as a-C:H containing from 10 to 40% of hydrogen.

[0166] The above use also makes it possible to not worsen, or even to reduce the wear between two steel surfaces, in
particular in a vehicle engine, preferably a motor vehicle engine. The above use also makes it possible to not worsen, or even to reduce the wear between a steel surface and a carbon-covered surface, in particular in a vehicle engine, preferably a motor vehicle engine. The above use also makes it possible to not worsen, or even to reduce the wear between two carbon-covered surfaces, in particular in a vehicle engine, preferably a motor vehicle engine.

[0167] The invention also relates to the use of a lubricant composition as defined above for reducing the fuel consumption of vehicles, preferably of motor vehicles. All of the characteristics and preferences presented for the lubricant composition also apply to the above uses. The invention also relates to a process for the lubrication of mechanical parts, in particular in transmissions and/or vehicle engines, preferably motor vehicle engines, comprising at least one step of bringing at least one part into contact with a lubricant composition as defined above.

[0168] An object of the invention is also a process for reducing friction between two steel surfaces, in particular in a vehicle engine, preferably a motor vehicle engine, comprising at least one step of bringing at least one of the steel surfaces into contact with a lubricant composition as defined above. An object of the invention is also a process for reducing friction between a steel surface and a carbon-covered surface, in particular in a vehicle engine, preferably a motor vehicle engine, comprising at least one step of bringing at least one of the surfaces into contact with a lubricant composition as defined above. An object of the invention is also a process for reducing friction between two carbon-covered surfaces, in particular in a vehicle engine, preferably a motor vehicle engine, comprising at least one step of bringing at least one of the carbon-covered surfaces into contact with a lubricant composition as defined above.

[0169] The above process also makes it possible to not worsen, or even to reduce the wear between two steel surfaces, in particular in a vehicle engine, preferably a motor vehicle engine. The above process also makes it possible to not worsen, or even to reduce the wear between a steel surface and a carbon-covered surface, in particular in a vehicle engine, preferably a motor vehicle engine. The above process also makes it possible to not worsen, or even to reduce the wear between two carbon-covered surfaces, in particular in a vehicle engine, preferably a motor vehicle engine.

[0170] An object of the invention is also a process for reducing the fuel consumption of a vehicle, preferably of a motor vehicle, comprising at least one step of bringing a mechanical part of the vehicle engine into contact with a lubricant composition as defined above. All of the characteristics and preferences presented for the lubricant composition also apply to the above processes. The vehicles can comprise a two or four stroke internal combustion engine.

[0171] The engines can be gasoline engines or diesel engines intended to be supplied with standard gasoline or diesel. By “standard gasoline” or by “standard diesel”, is meant within the meaning of the present invention, engines which are supplied with a fuel obtained after refining of an oil of mineral origin (such as petroleum for example). The engines can also be gasoline engines or diesel engines modified to be supplied with a fuel based on oils originating from renewable materials such as fuels based on alcohol or biodiesel fuel. The vehicles can be light vehicles such as cars and motorcycles. The vehicles can also be heavy goods vehicles, public works vehicles and ships.

[0172] An object of the invention is also the use of a fatty triamine in a lubricant composition comprising at least one base oil, at least one organonanodiphenyl compound and at least one compound comprising a dithiophosphate group for reducing friction between two steel surfaces, in particular in a vehicle engine, preferably a motor vehicle engine. An object of the invention is also the use of a fatty triamine in a lubricant composition comprising at least one base oil, at least one organonanodiphenyl compound and at least one compound comprising a dithiophosphate group for reducing friction between a steel surface and a carbon-covered surface, in particular in a vehicle engine, preferably a motor vehicle engine. An object of the invention is also the use of a fatty triamine in a lubricant composition comprising at least one base oil, at least one organonanodiphenyl compound and at least one compound comprising a dithiophosphate group for reducing friction between two carbon-covered surfaces, in particular in a vehicle engine, preferably a motor vehicle engine.

[0173] The above use also makes it possible to not worsen, or even to reduce the wear between two steel surfaces, in particular in a vehicle engine, preferably a motor vehicle engine. The above use also makes it possible to not worsen, or even to reduce the wear between a steel surface and a carbon-covered surface, in particular in a vehicle engine, preferably a motor vehicle engine. The above use also makes it possible to not worsen, or even to reduce the wear between two carbon-covered surfaces, in particular in a vehicle engine, preferably a motor vehicle engine.

[0174] An object of the invention is also the use of a fatty triamine in a lubricant composition comprising at least one base oil, at least one organonanodiphenyl compound and at least one compound comprising a dithiophosphate group for reducing the fuel consumption of a vehicle, preferably of a motor vehicle. All of the characteristics and preferences presented for the base oil, the fatty triamine, the organonanodiphenyl compound and the compound comprising a dithiophosphate group also apply to the above uses.

[0175] The invention also relates to a composition of the additives concentrate type comprising:

[0176] at least one organonanodiphenyl compound,

[0177] at least one compound comprising a dithiophosphate group, and

[0178] at least one fatty triamine.

[0179] All of the characteristics and preferences presented for the fatty triamine, the organonanodiphenyl compound and the compound comprising a dithiophosphate group also apply to the composition of the abovementioned additives concentrate type. In an embodiment of the invention, the composition of the additives concentrate type also comprises at least one additional additive. The additional additive can be selected from the abovementioned additives. In an embodiment of the invention, at least one base oil can be added to the composition of the additives concentrate type according to the invention, in order to obtain a lubricant composition according to the invention.

[0180] The different objects of the present invention and their implementations will be better understood on reading the following examples. These examples are given as an indication, non limitatively.
EXAMPLES

Example 1

[0181] Lubricant compositions No. 1 to No. 6 are prepared from the following compounds:

[0182] a base oil of group III having a viscosity at 100° C. of 4.3 cSt measured according to the standard ASTM D445,

[0183] a compound comprising a dithiophosphate group: zinc dithiophosphate (Lo 1371 marketed by Lubrizol),

[0184] an organomolybdenum compound 1: organomolybdenum complex of formula (I-a) in which R₁ represents a hydrocarbon group comprising 11 carbon atoms (Molyvan 855 marketed by Vanderbilt company),

[0185] an organomolybdenum compound 2: molybdenum dithiocarbamate (Sakuran-lube 525 marketed by Adeka company),

[0186] a fatty triamine of formula (VIII) in which R₂₀ represents a hydrocarbon group comprising from 16 to 18 carbon atoms (Triameen YT marketed by AKZO), Lubricant compositions No. 1 to No. 6 are described in Table II; the percentages given are percentages by mass.

TABLE II

<table>
<thead>
<tr>
<th>Lubricant composition</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
<th>No. 4</th>
<th>No. 5</th>
<th>No. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base oil</td>
<td>100</td>
<td>98.5</td>
<td>98.6</td>
<td>97.5</td>
<td>97.6</td>
<td>99</td>
</tr>
<tr>
<td>Compound comprising a dithiophosphate group</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Organomolybdenum compound 1</td>
<td>0.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organomolybdenum compound 2</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatty triamine</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[0187] Test 1: Assessment of the Friction Properties of Lubricant Compositions on a Steel/Steel Contact

[0188] The friction properties of lubricant compositions No. 1, No. 2 and No. 4 on steel/steel contacts are assessed by measurement of the coefficient of friction. The coefficient of friction is assessed using a ball-on-flat linear tribometer under the following conditions:

[0189] grade of the steel: 100c6
[0190] temperature: 80° C.,
[0191] normal load of 5N,
[0192] travel of 5 mm.

A difference of at least 0.01 between two coefficient of friction values is considered as significant for showing the influence on said coefficient of friction. Table III shows the coefficient of friction of lubricant compositions No. 1, No. 2 and No. 4.

TABLE III

<table>
<thead>
<tr>
<th>Composition</th>
<th>Coefficient of friction</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>0.150</td>
</tr>
<tr>
<td>No. 2</td>
<td>0.035</td>
</tr>
<tr>
<td>No. 4</td>
<td>0.025</td>
</tr>
</tbody>
</table>

[0193] These results show that lubricant composition according to the invention No. 4 has improved friction properties for steel/steel contacts, relative to a lubricant composition comprising an organomolybdenum compound according to the invention and a compound comprising a dithiophosphate group according to the invention but comprising no fatty triamine according to the invention (composition No. 2). In addition to these results relating to the coefficient of friction, it was observed that the wear of the surface of the balls is not worsened by the use of lubricant composition according to the invention No. 4, in comparison with lubricant composition No. 2.

[0194] Test 2: Assessment of the Friction Properties of Lubricant Compositions on a DLC/Steel Contact

[0195] The friction properties of lubricant compositions No. 1, No. 2, No. 4 and No. 6 on the DLC/steel contacts are assessed by measurement of the coefficient of friction. The coefficient of friction is assessed using a DLC ball/steel flat linear tribometer under the following conditions:

[0196] grade of the steel: 100c6,
[0197] nature of the DLC coating of the balls: hydrogenated DLC aC₈H containing between 31 and 33% of hydrogen and having a molar ratio (sp² carbon/sp³ carbon) equal to 55/45,
[0198] thickness of the DLC layer: 1.5µ,
[0199] temperature: 110° C.,
[0200] normal load of 5 N,
[0201] travel of 10 mm.

A difference of at least 0.01 between two coefficient of friction values is considered as significant for showing the influence on said coefficient of friction. Table IV shows the coefficient of friction of lubricant compositions No. 1, No. 2, No. 4 and No. 6.

TABLE IV

<table>
<thead>
<tr>
<th>Composition</th>
<th>Coefficient of friction</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>0.070</td>
</tr>
<tr>
<td>No. 2</td>
<td>0.070</td>
</tr>
<tr>
<td>No. 4</td>
<td>0.053</td>
</tr>
<tr>
<td>No. 6</td>
<td>0.080</td>
</tr>
</tbody>
</table>

[0202] These results show that lubricant composition according to the invention No. 4 has improved friction properties on DLC/steel contacts, in comparison with a lubricant composition comprising an organomolybdenum compound according to the invention and a compound comprising a dithiophosphate group according to the invention but comprising no fatty triamine according to the invention (composition No. 2), as well as in comparison with a lubricant composition comprising a fatty triamine according to the invention but comprising no organomolybdenum compound according to the invention and no compound comprising a dithiophosphate group according to the invention (composition No. 6). It is of interest to note that the coefficient of friction of lubricant compositions No. 2 and No. 6 are higher than the coefficient of friction of lubricant composition according to the invention No. 4, thus demonstrating a synergistic effect of the combination of an organomolybdenum compound according to the invention, a compound comprising a dithiophosphate group according to the invention and a fatty triamine according to the invention, for reducing friction on DLC/steel contacts. In conjunction with these results relating to the coefficient of friction, it has been observed that the wear of the DLC coating of the balls is not worsened by the use of lubricant composition according to the invention No. 4, in comparison with lubricant compositions No. 2 and No. 6.
[0204] Test 3: Assessment of the Friction Properties of Lubricant Compositions on a DLC/Steel Contact

[0205] The friction properties of lubricant compositions No. 1, No. 2 and No. 4 on DLC/steel contacts are assessed by measurement of the coefficient of friction. The coefficient of friction is assessed using a DLC ball/steel flat HFFR tribometer under the following conditions:

[0206] grade of the steel: 100C6
[0207] nature of the DLC coating: hydrogenated DLC a-C:H containing between 31 and 33% of hydrogen and having a molar ratio (sp² carbon/sp³ carbon) equal to 55/45,
[0208] thickness of the DLC layer: 1.5 μm,
[0209] temperature: 110 °C,
[0210] frequency: 20 Hz.

A difference of at least 0.01 between two coefficient of friction values is considered as significant for showing the influence on said coefficient of friction. Table V shows the coefficient of friction of lubricant compositions No. 1, No. 2 and No. 4.

<table>
<thead>
<tr>
<th>TABLE V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
</tr>
<tr>
<td>Coefficient of friction DLC/steel</td>
</tr>
</tbody>
</table>

[0211] These results confirm the results of test 2; in fact, they demonstrate that the lubricant composition according to the invention No. 4 has improved friction properties for DLC/steel contacts, relative to a lubricant composition comprising an organomolybdenum compound according to the invention and a compound comprising a diethiophosphate group according to the invention but comprising no fatty triamine according to the invention (composition No. 2).

[0212] Test 4: Assessment of the Friction Properties of Lubricant Compositions on a DLC/Steel Contact

[0213] The friction properties of lubricant compositions No. 1, No. 3 and No. 5 on the DLC/steel contacts are assessed by measurement of the coefficient of friction. The coefficient of friction is assessed according to the method described in test 3. A difference of at least 0.01 between two coefficient of friction values is considered as significant for showing the influence on said coefficient of friction. Table VI shows the coefficient of friction of lubricant compositions No. 1, No. 3 and No. 5.

<table>
<thead>
<tr>
<th>TABLE VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
</tr>
<tr>
<td>Coefficient of friction DLC/steel</td>
</tr>
</tbody>
</table>

[0214] These results confirm the results of test 2 and test 3; in fact, they demonstrate that the lubricant composition according to the invention No. 5 has improved friction properties for DLC/steel contacts, relative to a lubricant composition comprising an organomolybdenum compound according to the invention and a compound comprising a diethiophosphate group according to the invention but comprising no fatty triamine according to the invention (composition No. 3), in the presence of an organomolybdenum compound 2 that is different from organomolybdenum compound 1.

Example 2

[0215] Lubricant compositions No. 7 to No. 10 are prepared from the following compounds:

[0216] a polyalphaolefin type oil of having a viscosity at 100 °C of 4 cSt measured according to the standard ASTM D445,

[0217] a compound comprising a dithiophosphate group: zinc diethiophosphate (Lz 1371 marketed by Lubrizol company),

[0218] an organomolybdenum compound 1: organomolybdenum complex of formula (Ia) in which R₁ represents a hydrocarbon group comprising 11 carbon atoms (Molyvan 855 marketed by Vanderbilt company),

[0219] a fatty triamine of formula (VIII) in which R₂₀ represents a hydrocarbon group comprising from 16 to 18 carbon atoms (Triameen YT marketed by AKZO). Lubricant compositions No. 7 to No. 10 are described in Table VII; the percentages given are percentages by mass.

<table>
<thead>
<tr>
<th>TABLE VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubricant composition</td>
</tr>
<tr>
<td>Base oil</td>
</tr>
<tr>
<td>Compound comprising a dithiophosphate group</td>
</tr>
<tr>
<td>Organomolybdenum compound 1</td>
</tr>
<tr>
<td>Fatty triamine</td>
</tr>
</tbody>
</table>

[0220] Test 5: Assessment of the Friction Properties of Lubricant Compositions on a Steel/Steel Contact

[0221] The friction properties of lubricant compositions No. 7, No. 8, No. 9 and No. 10 on steel/steel contacts are assessed by measurement of the coefficient of friction. The coefficient of friction is assessed according to the method described in test 1. A difference of at least 0.01 between two coefficient of friction values is considered as significant for showing the influence on said coefficient of friction. Table VIII shows the coefficient of friction of lubricant compositions No. 7, No. 8, No. 9 and No. 10.

<table>
<thead>
<tr>
<th>TABLE VIII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
</tr>
<tr>
<td>Coefficient of friction steel/steel</td>
</tr>
</tbody>
</table>

[0222] These results show that lubricant composition according to the invention No. 9 has improved friction properties on steel/steel contacts, in comparison with a lubricant composition comprising an organomolybdenum compound according to the invention and a compound comprising a dithiophosphate group according to the invention but comprising no fatty triamine according to the invention (composition No. 8), as well as in comparison with a lubricant composition comprising a fatty triamine according to the invention but comprising no organomolyb-
denum compound according to the invention and no compound comprising a dithiophosphate group according to the invention (composition No. 10). It is of interest to note that the coefficients of friction of lubricant compositions No. 8 and No. 10 are higher than the coefficient of friction of lubricant composition according to the invention No. 9, thus demonstrating a synergistic effect of the combination of an organomolybdenum compound according to the invention, a compound comprising a dithiophosphate group according to the invention and a fatty triamine according to the invention for reducing friction on steel/steel contacts. In addition to these results relating to the coefficient of friction, it has been observed that the wear to the surface of the balls is not worsened by the use of the lubricant composition according to the invention No. 9, in comparison with the lubricant compositions No. 8 and 10.

[0223] Test 6: Assessment of the Friction Properties of Lubricant Compositions on a Steel/Diamond Contact

[0224] The friction properties of lubricant compositions No. 7, No. 8 and No. 9 on steel/diamond contacts are assessed by measurement of the coefficient of friction. The coefficient of friction is assessed using a nanodiamond ball/steel flat linear tribometer under the following conditions:

[0225] grade of the steel: 100C6,
[0226] nature of the nanodiamond coating: nanocrystalline diamond layer comprising approximately 75% of sp³ hybrid carbon atoms (purity of approximately 75%), of thickness equal to 1.5 μm, surface roughness equal to 14 nm, hardness of approximately 74 GPa and having a Young’s modulus equal to 620 GPa,
[0227] temperature: 80°C,
[0228] normal load of 10 N,
[0229] travel of 5 mm.

[0230] A difference of at least 0.01 between two coefficients of friction mass values is considered as significant for showing the influence on said coefficient of friction. Table IX shows the coefficient of friction of lubricant compositions No. 7, No. 8 and No. 9.

| Table IX |
| Composition | No. 7 | No. 8 | No. 9 |
| Coefficient of friction | 0.110 | 0.070 | 0.060 |

[0231] These results show that the lubricant composition according to the invention No. 9 has improved friction properties for steel/diamond contacts, relative to a lubricant composition comprising an organomolybdenum compound according to the invention and a compound comprising a dithiophosphate group according to the invention but comprising no fatty triamine according to the invention (composition No. 8). In addition to these results relating to the coefficient of friction, it has been observed that the wear to the surface of the balls is not worsened by the use of the lubricant composition according to the invention No. 9, in comparison with the lubricant composition No. 8.

[0232] Test 7: Assessment of the Friction Properties of Lubricant Compositions on a DLC/Steel Contact

[0233] The friction properties of lubricant compositions No. 7, No. 8 and No. 9 on DLC/steel contacts are assessed by measurement of the coefficient of friction. The coefficient of friction is assessed according to the method described in test 2. A difference of at least 0.01 between two coefficient of friction values is considered as significant for showing the influence on said coefficient of friction. Table X shows the coefficient of friction of lubricant compositions No. 7, No. 8 and No. 9.

| Table X |
| Composition | No. 7 | No. 8 | No. 9 |
| Coefficient of friction steel/diamond | 0.070 | 0.080 | 0.070 |

[0234] These results show that the lubricant composition according to the invention No. 9 has improved friction properties for DLC/steel contacts, relative to a lubricant composition comprising an organomolybdenum compound according to the invention and a compound comprising a dithiophosphate group according to the invention but comprising no fatty triamine according to the invention (composition No. 8).

[0235] Thus, all of the above examples and tests demonstrate that the presence of a combination of an organomolybdenum compound according to the invention, a compound comprising a dithiophosphate group according to the invention and a fatty triamine according to the invention in a lubricant composition makes it possible to give this composition friction properties that are equivalent, or even improved both on steel/steel contacts and on steel/carbon coating contacts, in particular on steel/nanodiamond contacts but also steel/DLC contacts. The presence of such a combination in a lubricant composition also allows the lubricant composition to retain good anti-wear properties, both on steel/steel contacts and on steel/carbon coating contacts, in particular on steel/nanodiamond contacts but also on steel/DLC contacts.

1. A lubricant composition comprising:
   at least one base oil,
   at least one organomolybdenum compound,
   at least one compound comprising a dithiophosphate group, and
   at least one fatty triamine.
2. The lubricant composition according to claim 1 in which the organomolybdenum compound is a molybdenum dithiocarbamate compound.
3. The lubricant composition according to claim 1 in which the organomolybdenum compound is a molybdenum complex comprising at least one compound selected from:
   (a) the compounds of formula (I)

\[
\begin{align*}
R_1 & = \text{O} \\
N & \quad \text{M} \\
R_2 & = \text{SO}_2 \text{N} \\
X^1 & \quad \text{X}^2 \\
& \quad \text{X}^3 \\
\end{align*}
\]

in which:

- \(X^1\) represents an oxygen atom or a nitrogen atom;
- \(X^2\) represents an oxygen atom or a nitrogen atom;
in which: X represents a carbon atom; R represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms.

6. The lubricant composition according to claim 1 in which the content by weight of organomolybdenum compound ranges from 0.05% to 3% with respect to the total weight of the lubricant composition.

7. The lubricant composition according to claim 1 in which the compound comprising a dithiophosphate group is selected from the group constituted by the ammonium dithiophosphates, amine dithiophosphates, ester dithiophosphates and metal dithiophosphates, alone or in a mixture.

8. The lubricant composition according to claim 1 in which the compound comprising a dithiophosphate group is a compound of formula (VII)

in which:

(a) a mixture of at least one compound of formula (I) and at least one compound of formula (II).

4. The lubricant composition according to claim 3 in which the molybdenum complex comprises at least one compound of formula (I-a)

in which R represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms.

5. The lubricant composition according to claim 3 in which the molybdenum complex comprises at least one compound of formula (II-a)

in which R represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms.

9. The lubricant composition according to any claim 1 in which the compound comprising a dithiophosphate group is a compound of formula (VII-a) or formula (VII-b):

in which:

(a) a mixture of at least one compound of formula (I) and at least one compound of formula (II).

4. The lubricant composition according to claim 3 in which the molybdenum complex comprises at least one compound of formula (I-a)

in which R represents a linear or branched, saturated or unsaturated alkyl group, comprising from 3 to 30 carbon atoms.

5. The lubricant composition according to claim 3 in which the molybdenum complex comprises at least one compound of formula (II-a)
11. The lubricant composition according to claim 1 in which the fatty triamine is selected from:
the compounds of formula (VIII)
\[ R_{20} - \text{N} \cdots [(\text{CH}_2)_2] - \text{NH}_3 \]  
(VIII)
in which \( R_{20} \) represents a linear or branched, saturated or unsaturated alkyl group, comprising at least 10 carbon atoms; and
the compounds of formula (IX)
\[ R_{21} - \text{NH} \cdots (\text{CH}_2)_2 - \text{CH}_2 - \text{CH}_2 - \text{NH}_2 - \text{H} \]  
(IX)
in which \( R_{21} \) represents a linear or branched, saturated or unsaturated alkyl group, comprising at least 10 carbon atoms.

12. The lubricant composition according to claim 1 in which the content by weight of fatty triamine ranges from 0.1 to 5% with respect to the total weight of the lubricant composition.

13. The lubricant composition according to claim 1 in which the mass ratio (organomolybdenum compound/fatty triamine) ranges from 1/10 to 1.

14. The lubricant composition according to claim 1 in which the mass ratio (organomolybdenum compound/compound comprising a dithiophosphate group/fatty triamine) ranges from 1/10/10 to 1/1/1.

15. The lubricant composition according to claim 1 further comprising at least one additive selected from the detergents, anti-wear additives different from ammonium dithiophosphates, amine dithiophosphates, ester dithiophosphates and metal dithiophosphates, extreme pressure additives, dispersants, pour-point improvers, anti-foaming agents, thickeners and mixtures thereof.

16. A method comprising reducing friction between two steel surfaces, between two carbon-covered surfaces or between a steel surface and a carbon-covered surface in a vehicle engine, the method further comprising bringing the surfaces into contact with a lubricant composition comprising:
- at least one base oil,
- at least one organomolybdenum compound,
- at least one compound comprising a dithiophosphate group, and
- at least one fatty triamine.

17-18. (canceled)

19. A method comprising bringing a mechanical part of a vehicle engine into contact with a lubricant composition, and reducing fuel consumption of vehicles, the lubricant composition comprising:
- at least one base oil,
- at least one organomolybdenum compound,
- at least one compound comprising a dithiophosphate group, and
- at least one fatty triamine.

20. A composition of additives concentrate comprising:
- at least one organomolybdenum compound,
- at least one compound comprising a dithiophosphate group, and
- at least one fatty triamine.

* * * *