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[54] **METHOD FOR LUBRICATING 2-STROKE ENGINES AND ROTARY ENGINES**

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[57] **ABSTRACT**

Method for lubrication two-stroke engines or rotary engines fed with gasoline, comprising introducing thereinto a lubrication composition which consists of a base lubricant and conventional additives and having a viscosity at 98.9°C of at least 6 centistrokes, wherein said base lubricant comprises from 10 to 100% by weight of at least one polyalkyleneglycol derivative selected from the group consisting of ethers, simple esters, complex esters, polyesters and esters of ethers, of polyalkyleneglycol having the formula $HO -\!\!\!+ R-O +\!\!\!-_n H$ in which each radical R is a C_2-C_5 alkylene radical, preferably ethylene or propylene, and n an integer from 2 to 50.

In order to further improve the properties of these lubricating compositions, certain organic compounds, especially C_{10-18} aliphatic monocarboxylic acids, their lower alkyl esters, C_{10-18} aliphatic monoalcohols and C_{10-18} aliphatic primary monoamines, as well as C_{36} aliphatic dicarboxylic acids, C_{54} aliphatic tricarboxylic acids, and their lower alkyl esters, may be added to the base lubricant in proportions from 0.1 to 40 % by weight with respect to said base lubricant.

13 Claims, No Drawings

METHOD FOR LUBRICATING 2-STROKE ENGINES AND ROTARY ENGINES

This invention relates to the lubrication of two-stroke engines and rotary engines.

It is known that the lubricant of two-stroke engines may be carried out, according to the type of engine, either with a lubricant previously admixed with a gasoline or with a lubricant separate from the gasoline, which is then injected into the air-gasoline mixture and conveyed therewith. In the latter case, the bearings may be lubricated either by the lubricant introduced into the engine in this manner, or by a pure lubricant conveyed through an independent circuit provided exclusively for this purpose.

In all cases, the lubricant finally passes to the combustion chamber, where it is burnt and its combustion products are discharged to the engine exhaust.

This also the case of rotary engines in which the lubricant destined to the lubrication of the Apex seals and the bearings is introduced in admixture with the fuel.

It is also known that the properties of the oils commonly used for lubricating two-stroke engines, particularly their action for avoiding the seizing of the piston and the bearings as well as the gripping of the piston in the cylinder, are such that it is necessary, in order to obtain a satisfactory safety of operation, to make use of relatively high oil proportions (generally more than 5% by weight and always more than 2% by weight) with respect to the fuel.

The use of such oil amounts, far higher than those used in the four-stroke engines, suffer from a number of inconveniences:

It results in the discharge to the engine exhaust of large amounts of more or less cracked oil;

It results in a bad combustion of the fuel lubricant mixture and generates a large amount of opaque smokes.

These phenomena are responsible for particularly noxious pollutions, either of air or of water bodies in the case of two-stroke outboard engines.

Another inconvenience consists in the formation of deposits in the combustion chamber and exhaust system which results in power losses and makes it necessary to frequently disassemble the engine.

It is an object of this invention to provide a new method for lubricating two-stroke engines which, while resulting in a safety of operation at least as satisfactory as according to the previous method, provides for a very substantial decrease of the lubricant amount used and accordingly results in a large reduction of the above-mentioned inconveniences.

The invention has the further object of providing new fuel-lubricant compositions with a reduced lubricant content, adapted for feeding two-stroke engines.

Another object of the invention is to provide an advantageous method for lubricating rotary engines.

The invention has also for object to provide improved fuel-lubricant compositions for feeding rotary engines.

In fact, it has been discovered that in the case of the two-stroke engines, particularly of the two-stroke engines fed with gasoline, it was possible to reduce the lubricant amount used, provided that the lubricant contains a sufficient proportion of one or more polyalkyleneglycol derivatives.

The polyalylyleneglycol derivatives which are contemplated according to this invention can be formally defined as resulting from etherification of polyalkyleneglycol, by esterification of polyalkyleneglycols or polyalkyleneglycol ethers or still polyesterification of polyalkyleneglycols.

The basic polyalkyleneglycols have the general formula:

$$HO-(R-O)_n-H$$

in which the radicals R, which are identical to or different from one another, are divalent aliphatic radicals containing for example from 2 to 5 carbon atoms and n is an integer preferably from 2 to 50. They generally have a molecular weight of from about 100 to about 4,500.

The polyethyleneglycols, propyleneglycols or still mixed compounds of ethyleneglycol and propyleneglycol are more particularly contemplated.

The polyalkyleneglycol derivatives contemplated in this invention may consist, on the one hand, of ethers of polyalkyleneglycol obtained by etherification of at least one of the two hydroxy functions of a polyalkyleneglycol with at least one monohydroxy compound and/or at least one polyhydroxy compound.

They may thus conform to one of the general formulae:

$$R_1-O\!\!\leftarrow\!\!R-R\!\!\rightarrow_n H \quad (I)$$

and

$$R'_1\,[-O-(R-O\!\!\rightarrow_n H]_m \quad (II)$$

in which R_1 is the hydrocarbon residue of a monohydroxy compound R_1OH, a monoalcohol or a monophenol, and contains for example from 1 to 25 carbon atoms;

R'_1 is a hydrocarbon residue of a polyhydroxy compound $R'_1(OH)_m$ and may be for example an aliphatic radical having from 3 to 20 carbon atoms and whose valency m may have a value from 2 to 4 inclusive.

As examples of such monohydroxy compounds, there can be mentioned: n-butanol, isooctanol, 2-ethylhexanol, isodecanol or still dodecylphenol and as examples of polyhydroxy compounds $R'_1(OH)_m$, there can be mentioned: neopentylglycol, 1,6-hexanediol, glycerol, trimethylolpropane or pentaerythritol.

The polyalkylene-glycol ethers may also have one of the following general formulae:

$$R_1-O\!\!\leftarrow\!\!R-O\!\!\rightarrow_n R_1 \quad (III)$$

and

$$R'_1\,[-O\!\!\leftarrow\!\!R-O\!\!\rightarrow_n R_1]_m \quad (IV)$$

in which R_1 and R'_1 radicals and the integer m are defined as above.

the polyalkyleneglycol derivatives contemplated according to this invention may also consist of polyalkyleneglycol esters or esters of polyalkyleneglycol ethers.

In such a case, they may result from the esterification of a polyalkyleneglycol by a monocarboxylic acid, and they comply with the general formula:

$$R_2-\underset{\underset{O}{\|}}{C}-O-(R-O)_n-\underset{\underset{O}{\|}}{C}-R_2 \qquad \text{(V)}$$

in which the radicals R_2, identical to or different from each other, are hydrocarbon residues of monocarboxylic acids and contain for example from 1 to 25 carbon atoms.

There may also result from the esterification of a polyalkylene glycol ether of the formula (I) above, by monocarboxylic or polycarboxylic acid, for example dicarboxylic, in which case they comply with one of the general formulae:

$$R_2-\underset{\underset{O}{\|}}{C}-O-(R-O)_n-R_1 \qquad \text{(IV)}$$

and

$$R_1-O-(R-O)_n-\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O-(R-O)_n-R_1 \qquad \text{(VII)}$$

in which R_1 and R_2 are defined as above and R_3 is the hydrocarbon residue of a dicarboxylic acid, and contains for example from 1 to 34 carbon atoms.

They may also result from the esterification of a polyalkyleneglycol ether of the general formula (II) above, by means of a monocarboxylic acid, in which case they conform to the general formula:

$$R'_1\left[-O-(R-O)_n-\underset{\underset{O}{\|}}{C}-R_2\right]_m \qquad \text{(VIII)}$$

in which R'_1, R_2 and m are defined as above.

As examples of monocarboxylic acids, there can be mentioned: heptanoic acid, ethyl-hexanoic acid, nananoic acid, dodecanoic acid, tridecanoic acid, tetradecanoic acid, octadecanoic acid or commercial cuts such as the fatty acids from coprah or tallow, or still benzoic acid and, as exaples of dicarboxylic acids, there can be mentioned: adipic acid, azelaic acid, sebacic acid, 2,2,4-trimethyl adipic acid, dodecanedioic acid, isononadecanedioic acid, the acids produced by dimerization of unsaturated fatty acids, for example with 18 carbon atoms, the alkenyl-succinic acids or still the phthalic acids.

Among the polyalkyleneglycol esters and the esters of polyalkyleneglycol ethers such as above defined, there can be mentioned, as particularrly interesting species, by way of examples: the bis-octadecanoates of polyalkyleneglycols having for example an average molecular weight of about 600, the bis-dodecanoates of polypropyleneglycols having for example an average molecular weight of about 1,050 and the bis-heptanoates of polyproplenegIycols having for example an average molecular weight of about 2,000, which conform with the formula (V) above;

the adipate of the ether obtained by condensation of a mixture (50—50 by weight) of ethylene oxide and propylene oxide with n-butanol and containing, for example, about 30 units of alkylene oxide per moles, complying with the general formula (VII) above;

the tris-heptanoate of the ether obtained by condensation of a mixture (50—50 by weight) of ethylene oxide and propylene oxide with trimethylolpropane and containing, for example, about 24 units of alkylene oxide per molecule, complying with the formula (VIII) above.

the polyalkyleneglycol derivatives contemplated according to this invention may also consist of complex esters and polyesters of polyalkyleneglycols.

The polyesters of polyalkyleneglycols may be produced by esterification of a polyalkyleneglycol by means of a polycarboxylic acid, for example dicarboxylic, optionally in the presence of at least one monocarboxylic acid or at least one monohydroxy compound, which may be a monoalcohol, a monophenol or a monohydroxy ether of a polyalkyleneglycol with a monoalcohol or monophenol.

The polyesters may thus comply with one of the general formulae:

$$HO-\left[\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O-(R-O)_n\right]_p H \qquad \text{(IX)}$$

$$HO-(R-O)_n-\left[\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O-(R-O)_n\right]_p-H \qquad \text{(X)}$$

$$HO-\left[\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O(R-O)_n\right]_p-\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-OH \qquad \text{(XI)}$$

$$R_2-\underset{\underset{O}{\|}}{C}-O-(R-O)_n-\left[\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O-(R-O)_n\right]_p-\underset{\underset{O}{\|}}{C}-R_2 \qquad \text{(XII)}$$

$$R_1O-\left[\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O-(R-O)_n\right]_p-\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-OR_1 \qquad \text{(XIII)}$$

$$R_1O-(R'-O)_n\left[-\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O-(R-O)_n\right]_p-\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O(R'-O)_{n'}-R_1 \qquad \text{(XIV)}$$

and

$$R_1O-(R'-O)_{n'}-\left[\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-O-(R-O)_n\right]_p-\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-OR_1 \qquad \text{(XV)}$$

(In this latter case, it must be understood that the molecules of formulae (XIII) and (XIV) may be present together with the molecules of formula (XV)).

In the formulae (IX) to (XV), R_1, R_2 and R_3 are defined as above, R' is defined as R, *n' as n* and *p*, which is the polycondensation degree of the polyester, has a value greater than 1, for example from 2 to 10, or more.

The complex esters generallly conform with the formulae (XII) to (XV) in which the number p is 1.

Among the complex esters and polyesters of polyalkyleneglycols such as above defined, there can be mentioned as specific examples:

the polyesters of sebasic acid and of a polyethleneglycol having for example an average molecular weight of about 400 they conform, according to the proportions of their components, to one of ghe general formulae (IX), (X) and (XI) above;

the polyester of adipic acid and of a polypropyleneglycol having for example an average about molecular weight of about 400, blocked by dodecanoic acid; they conform to the general formula (XII) above.

The contemplated polyalkyleneglycol derivatives may also consist of complex esters and ppolyesters such as above-defined, blocked or unblocked in which at least a portion of the polyalkyleneglycol is replaced by an ether of polyalkyleneglycol of the formula:

$$R'_1[-O-(R-O)_n-H]_m$$

in which R'_1 and *m* are defined as above.

In this case, a particular attention is paid to the complex esters formed by one mole of dicarboxylic acid

$$HO-\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-OH$$

two moles of polyalkyleneglycol ether $R'_1[-O-(R-O)_n-H]_m$ and (2m -2) moles of monocarboxylic acid

$$R_2-\underset{\underset{O}{\|}}{C}-OH$$

As specific examples of complex esters of this type, there can be mentioned the esters formed by two moles of an ether obtained by condensation of propylene oxide with trimethylol propane, one mole of dimer acid (obtained by thermal dimerization of oleic and linoleic acids) and 4 moles of dodecanoic acid.

There may also be contemplated, as of interest, the polyesters formed for example by two moles of dicarboxylic acid

$$HO-\underset{\underset{O}{\|}}{C}-R_3-\underset{\underset{O}{\|}}{C}-OH$$

3 moles of polyalkyleneglycol ether $R'_1[-O-(R-O)_n-H]_m$ and 3 m-4 moles of monocarboxylic acid

$$R_2-\underset{\underset{O}{\|}}{C}-OH$$

and so on.

More generally, the method for lubricating two-stroke engines according to the invention consists of introducing into the engine, fed in an usual manner with a flue, a proportion of from 0.1 to 2% by weight, with respect to the fuel amount required for the engine operation, of a lubricant which contains from 20 to 100% by weight of one or more polyalkyleneglycol derivatives as above defined.

In admixture with one or more polyalkyleneglycol derivatives, the lubricant may also contain, within the limits of reciprocal miscibility, other components, particularly certain usual lubricants, such as:

lubricating oils of mineral origin;

synthetic lubricating oils, such for example as oligomerization or polymerization products of olefinic hydrocarbons, such as polybutenes optionally after a final hydrogenation treatment thereof, simple esters of ordinary monoalcohols or polyols, such as isodecyl adipate, 2-ethyl-hexyl azelate or trimethylolpropane caprylate, as well as complex esters or polyesters of ordinary monoalcohols or polyols.

It may also contain, if necessary, certain diluents, such as light petroleum cuts, for example white-spirit, kerosene, jet-fuel, certain aromatic solvents consisting, for example, of high boiling petroleum cuts and certain oxygenated solvents such as alcohols (e.g., isononanol), ketones (e.g., cyclohexanone or still certain esters (e.g., acetates or propionates of heavy alcohols).

When a polyalkyleneglycol derivative is to be used in admixture with a mineral oil, it is of course convenient to make use of a polyalkyleneglycol derivative having a sufficient miscibility with the mineral oils, i.e., a sufficient "oleophilic balance." These derivatives are generally those which have a high ratio of the number of carbon atoms of their hydrocarbon groups to the number of alkylene oxide units in their polyalkyleneglycol links. This ratio must, furthermore, be the higher when the basic polyalkyleneglycol contains a greater amount of ethylene oxide with respect to the total alkylene oxides on the one hand, and when the mineral oil has a more paraffinic character and/or a higher viscosity, on the other hand.

Moreover, the lubricant used in the method of the invention must, in any way, have convenient viscosimetric characteristics, particularly a viscosity at 98.9° C greater than about 6 cSt and, preferably, about from 8 to 15 cSt.

In the method for lubricating two-stroke engines according to the invention, it has been observed that the higher the proportion of the polyalkyleneglycol derivative in the lubricant, the lower may be the lubricant amount introduced into the engine with respect to the fuel, amount. Accordingly, whereas the proportion, with respect to the fuel, of a lubricant which contains only a minor amount of polyalkyleneglycol derivative, must be generally from 0.5 to 2 %, more often about 1 % by weight, this proportion may be from 0.1 to 1% by weight only and more often at about 0.5% by weight, when the lubricant contains a major proportion of polyalkyleneglycol derivative.

Besides, it is noticeable that, in the case where the lubricant contains, in admixture with one or more polyalkyleneglycol derivatives, at least another synthetic lubricant, it may happeen that a proportion of the polyalkyleneglycol derivative as low as 10% by weight be satisfactory but, even in this case, a proportion of at least 20% by weight is still preferred.

In the preceding description, the "lubricant" is used to mean the base lubricant used. It must however be understood that, to this base lubricant, it is possible and generally desirable to add, for obtaining the final lubricant, various conventional additives, such as:

antioxidant additives, such phenolic or amine additives, for example in a proportion of 0.1 to 10 % by weight with respect to the lubricant;

organo-salts detergent additives and ashless dispersing agents for example in a proportion of 0.05 to 30% preferably from 5 to 20% by weight with respect to the lubricant.

It is still possible to add to the base lubricant, certain halogenated derivatives, such as for example ethylene dibromide, in order to eliminate the lead compounds which are liable to be formed in the combustion chamber when the fuel which is used contains lead (tetraethyl lead or tetramethyl lead).

In the particular case of two-stroke engines fed with a fuel-lubricant mixture, the fuel-lubricant mixtures of the invention consist of a conventional fuel to which is added an amount of lubricating composition corresponding to an amount of base lubricant, such as hereabove defined, of from 0.1 to 2% by weight with respect to the fuel, e.g. from 0.5 to 2%, more particularly about 1%, when said base lubricant contains a minor proportion of polyalkyleneglycol derivative, and from 0.1 to 1%, more particularly about 0.5%, when said base lubricant contains a major proportion of polyalkyleneglycol derivative.

The lubricating method and the fuel-lubricant compositions hereabove described may be used for two-stroke engines fed with gasoline either for terrestrial or marine used, cooled with air or by water circulation. It has also been discovered that the addition of certain organic compounds, as hereinafter defined, to the base lubricants, results in a substantial improvement of the properties of said lubricants, particularly their resistance to gripping and their efficiency against seezing, as well as in a substantial reduction of the engine fouling.

These organic compounds generally consist of monocarboxylic acids containing ann aliphatic chain of 10–18 carbon atoms, their simple lower alkyl esters (lower alkyl having for example 1–8 carbon atoms), monoalcohols and primary monoamines containing an aliphatic chain of 10–18 atoms of carbon, as well as dicarboxylic acids containing an aliphatic chain of 36 carbon atoms, tricharboxylic acids containing an aliphatic chain of 54 carbon atoms and simple lower alkyl esters of these acids.

More particularly, the following compounds can be cited:

monocarboxylic acids having a saturated or unsaturated C_{10-18} aliphatic chain, such as decanoic, dodecanoic, tetradecanoic, hexadecanoic, octadecanoic and octadecanoic (e.g., oleic) acids, as well as natural fractions consisting of mixtures of such acids;

lower alkyl esters of said acids or mixtures of acids, such as their methyl, ethyl, propyl, isopropyl, butyl, isobutyl, pentyl, hexyl, heptyl, or 2-ethylhexyl esters;

C_{10-18} aliphatic monoalcohols, such as decanol, dodecanol, tridecanol, as well as fractions of straight-chain C_{10-18} aliphatic monoalcohols obtained by the reduction of mixtures of the corresponding monocarboxylic acids or by methods of synthesis, such as the polymerization of ethylene in the presence of an alkyl aluminum catalyst followed with an oxidation step; primary C_{10-18} aliphatic monoamines, such as decylamine or dodecylamine;

as well as the di- (or tri-) carboxylic acids containing a saturated or unsaturated C_{36} (or C_{54}) aliphatic chain, obtained by dimerization (or trimerization) of monocarboxylic acids having an unsaturated C_{18} aliphatic chain, such as octadecenoic acid (oleic acid), either alone or in admixture with octadecadienoic acid (linoleic acid) and/or with octadecatrienoic acid (linolenic acid), said dimerization (or trimerization) being optionally followed with a hydrogenation step;

and lower alkyl esters of said acids. According to this invention, the organic compounds as defined hereinabove are added to the base lubricants, in proportions amounting to 0.1 – 40%, preferably 5-25%, by weight with respect to said base lubricant.

Compounds having an aliphatic chain of 12 carbon atoms, e.g., dodecanoic acid and its lower alkyl esters, dodecanol and dodecylamine, are preferred.

The invention also relates to the lubrication of rotary engines by a lubricating method similar to that used for the two-stroke engines, but in which the relative amount of lubricant, with respect to the fuel, is generally from 50 parts per million of parts by weight to 2% by weight.

Similarly, for the rotary engines fed with a fuel-lubricant mixture, the fuel-lubricant compositions according to the invention are constituted of a conventional fuel, to which is added an amount of lubricating composition corresponding to an amount of base lubricant defined in the same way as for the two-stroke engines, from 50 ppm to 2% by weight with respect to said fuel.

The following examples illustrate the invention.

PREPARATIONS

There are prepared, according to usual esterification techniques, the following polyalkyleneglycol derivatives:

Product I: Bis-octadecenoate of a polyethyleneglycol having a molecular weight of 600

Viscosity at 37.8°C	66.9	cSt
at 98.9°C	12.7	cSt
Viscosity index (VI_E)	205	
Acid number	1.2	mg/g
Soluble in gasoline		

Product II: Bis-dodecanoate of a polypropyleneglycol of molecular weight 1050

Viscosity at 37.8°C	71.0	cSt
at 98.9°C	13.27	cSt
Viscosity index (VI_E)	201	
Acid number	1	mg/g
Pour point	<-30°	
Miscible with mineral oils and gasoline.		

Product III:

Adipate of an ether obtained by condensation of a mixture (50/50 by weight) of ethylene oxide and propylene oxide with n-butanol (the ether contains, as an average, 30 alkylene oxide units per molecule).

Viscosity at 37.8°C	352	cSt
at 98.9°C	61.3	cSt
Not miscible with mineral oils		
Soluble in the esters of dicarboxylic acids (for example isodecyl adipate) and gasoline.		

Product IV:

Tris-heptanoate of an ether obtained by condensation of a mixture (50/50 by weight) of ethylene oxide and propylene loxide with trimethylolpropane (the ether contains, as an average, 24 alkylene oxide groups per molecule).

Viscosity at 98.9°C	14.3 cSt
Not miscible with mineral oils	
Soluble in gasoline.	

Product V:

Ester formed by 2 moles of an ether obtained by condensation of propylene oxide with trimethylolpropane and a mixture of dodecanoic acid (4 moles) and "dimer acid" (1 mole).

(The "dimer acid" consists of a mixture of dicarboxylic acids obtained by thermal dimerization of oleic and linoleic acids).

The ether contains, as an average, 22 propylene oxide units per molecule.

Viscosity at 98.9°C	32	cSt
Residual acid number	1.4	mg/g
Soluble in light mineral oils		
Miscible with gasoline		

Products I to V described hereinabove have been used for the manufacture of basic libricants A to E whose composition is given in the following table:

TABLE I

Lubricant	Composition				
	Polyalkylene-glycol derivative Name	% b.w.	Mineral oil 150 neutral % b.w.	Isodecyl adipate % b.w.	Viscosity at 98.9°C (cSt)
A	Product I	100	—	—	12.7
B	Product II	100	—	—	13.2
C	Product III	40	—	60	12.8
D	Product IV	80	—	20	11.1
E	Product V	45	55	—	12.3

(1) 150 Neutral is a paraffinic mineral oil having a viscosity of about 150 SUS at 37.8°C.

EXAMPLE 1 — Gripping tests on a Motobecane motor AV 7L

(Prevention of seizing)

The lubricants A to E indicate in table I have been tested in fuel-lubricant mixtures having a 1% by weight and, for some of them, a 0.5% by weight lubricant content, by reference with a commercial oil, called X, used in a proportion of 5% b.w. (Oil X mainly consists of a mineral oil).

There have also been tested: the same commercial oil X in mixtures at 3% and 1% by weight, another commercial oil, called Y, in a mixture at 1% by weight and a third commercial oil, called Z, in a mixture at 5% by weight. (Oil Y mainly consists of a polybutene and Oil Z of a mineral oil).

The test consists of measuring the temperature increase of the spark plug joint corresponding to a decrease of the motor running speed by 400 runs/minute, produced by the gripping of the piston in the cylinder, which occurs when the cooling of the engine is discontinued.

The higher is the temperature increase permitted, the better is the lubricant.

The results reported in Table II below have been expressed as a gain percentage with respect to the reference, as follows:

$$\% \text{ gain} = (\Delta\theta_1 - \Delta\theta_o/\Delta\theta_o) \times 100$$

in which $\Delta\theta_1$ and $\Delta\theta_o$ respectively indicate the temperature increase for the tested product and for the reference product.

TABLE II

Lubricant	Proportion in the gasoline (% b.w.)	gain/reference (%)
commercial oil X	5 (reference)	0
do.	3	− 4.3
do.	1	−15
commercial oil Y	1	−20
commercial oil Z	5	+ 1.2
lubricant A	1	+ 6.1
lubricant B	1	+29.1
do.	0.5	+ 7.2
lubricant C	1	+ 3.2
lubricant D	1	+ 9.0
lubricant E	1	+19.7
do.	0.5	+ 2.4

Lubricants referred to as F and G, have also been tested under gripping conditions, said lubricants consisting of mixtures of polyesters of polypropyleneglycol (Products VI and VII) and isodecyl adipate.

Product VI is obtained from polypropyleneglycol having a molecular weight of 400 and sebacic acid. It has a viscosity, at 98.9°C of 850 cSt and an acid number of 7.5 mg/g.

Product VII is obtained from polypropyleneglycol having a molecular weight of 400 and adipic acid. It is blocked by dodecanoic acid. Its viscosity at 98.9°C is 88 cSt and its acid number is 1.4 mg/g.

Mixtures F and G respectively contain 14% by weight of Product VI and 40% by weight of Product VII, the remaining portion to 100% consisting, in both cases, of isodecyl adipate.

The gripping tests carried out with lubricants F and G, admixed in a proportion of 1% b.w. to the fuel, have given results similar to those obtained with the above mentioned lubricants A to E.

The gripping tests reported above show that, by the method of the invention, there can be used a proportion of 1% and, even in some times, 0.5% by weight of lubricant with respect to the gasoline, while obtaining a protection against seizing which is as good as, or even better than, with conventional lubricants.

It might be expected that the use of a reduced amount of lubricant would result in a reduced clogging of the engine. This is confirmed by the results of the clogging tests which are reported herebelow.

EXAMPLE 2: Clogging Tests

Lubricating compositions (B' and E') obtained by adding, to each of the basic lubricants B and E, 20% by weight of a multifunctinal additive (detergent, antioxidant and antirust) known under the trade name of "Oloa 340 D," have been tested. The mixtures "fuel-lubricant" each contains 0.5% b.w. of lubricants B' and E' respectively, in a gasoline without lead having an octane number (Research method) of 94.

By way of comparison, two conventional lubricants for two-stroke engines in admixture with the same fuel in a proportion of 4 and 5% b.w., have been tested.

The clogging test carried out according to the method CEC 1 402 T 68, was carried out over 100 hours. It comprises various working phases, including an idle-running period. It represents a running period, under actual running conditions, of a longer duration.

The results are given in Table III, below.

TABLE III

Lubricating composition	X	Z	B'	E'
Lubricant in the fuel (% b.w.)	4	5	0.5	0.5
Obstruction of the exhaust muffler (%)	71	36.6	16.1	19.2
Obstruction of the exhaust port (%)	5	10	0	0
Weight of the deposits in the exhaust muffler (g)	70	35	17	21
Spark plug misfirings	1	0	0	0
Valuation mark of the piston-Merit/10				
Freedom of the piston rings				
1st ring	9.5	0	10	10
2d ring	5	0	10	10
Varnish on the piston skirt	7.9	7.1	9.8	9.8
Carbon deposit in the grooves :				
1st groove	0	0	9.8	9.0
2d groove	0	0	10	8.8
Varnish in the grooves				
1st groove	0	0	8.5	6.8
2d groove	0	0	10	8.6
Varnish in the piston bottom	0.25	2	9.6	9.1
Varnish on the internal wall of the piston	2.5	9.6	10	10
Carbon deposit on the area above the ring	9.3	6.2	7.1	5.4
Scratching on the area above the ring	9	8.2	9.2	8.6
Varnish on the piston land	0	0	9.7	8.2
Varnish on the cylinder walls	9.4	7.3	10	10

These results show that the products according to the invention are advantageous in substantially every respect as compared to the tested commercial oils.

In addition to these results, it must be observed that substantially no oil is discharged to the engine exhaust, and that no visible smoke is observed.

EXAMPLE 3: Gripping Test

Further base lubricants have been prepared from Product I and from a Product VIII consisting of the bis-heptanoate of a propyleneglycol of molecular weight 2,000. The viscosimetric properties of which are the following:

Viscosity	at 98.9°C	19.1 cSt
do.	at 37.8°C	118.0 cSt
Viscosity	index (VI_E)	192

The composition of said lubricants is given in the following table.

TABLE IV

Base lubricant	Composition: Polyalkylene glycol derivative Nature	% b.w.	Additive Nature	% b.w.
A	Product I	100	—	—
H	do.	95	Dodecanoic acid	5
J	do.	95	Isopropyl dodecanoate	5
K	Product VIII	100	—	—
L	do.	95	Dodecanoic acid	5
M	do.	95	Methyl dodecanoate	5
N	do.	95	Dodecanol	5
P	do.	95	Dodecylamine	5

These base lubricants have been tested for gripping on a 2-stroke engine of the Motorbecane AV 7 L type in fuel-lubricant mitures containing 1% b.w. of lubricant in lead-free normal gasoline of 94 Research O.N.

The gripping properties of the tested mixtures have been ESTIMATED in the same manner as described in Example 1.

The results given in Table V below are expressed as the % increase with respect to the reference product (product I alone for lubricants H and J and product VIII alone for lubricants L - P), according to the following relationship:

$$\% \text{ increase} =)\Delta\theta_1 - \Delta\theta_o/\Delta\theta_o) \times 100$$

in which $\Delta\theta_1$ and $\Delta\theta_o$ are the respective temperature increases of the tested mixture of the reference product.

TABLE V

Tested lubricant	Proportion in gasoline % by weight	% Gain
A (reference)	1	0
H	1	9
J	1	7
K (reference)	1	0
L	1	7
M	1	9
N	1	3
P	1	8

These results show the advantage of adding C_{12} organic compounds to the base lubricant.

EXAMPLE 4: Clogging test

The following compositions have been prepared:

Composition R	% by weight
bis-dodecanoate of polypropylene glycol of molecular weight 1 200	76
ash-less detergent-dispersant	16
p.p dioctyldiphenylamine	6
phenyl β-naphthylamine	2

Composition S

The preparation of composition R has been repeated, except that a portion of polypropyleneglycol bis-dodecanoate has been replaced by methyl dodecanoate, in a proportion of 10% by weight of the total composition.

The tested fuel-lubricant mixtures each contain 0.5% by weight of the compositions R and S in lead-free normal gasoline of 94 R.O.N.

The clogging test has been carried out for 100 hours, according to the method CEC 1 402 T 68, on an AV 7 L Motobecane 2-stroke engine, as described in Example 2.

The % clogging of the engine and the % piston-cylinder merit have been determined, the results are given in Table VI.

TABLE VI

	% Clogging	% Piston-cylinder merit
Composition R	44.2	61.9
Composition S	18.0	94.7

These results show the beneficial effect on the engine clogging of adding a C_{12} organic compound to the base lubricant.

EXAMPLE 5

LONG RUN TEST ON A ROTARY ENGINE

A vehicle of NSU mark, of Ro 80 type, with a bi-rotor WANKEL Engine of the KKM 616 type, has been in operation over 20,000 km under various running condition: in town, on the roads, on express way. The oil circulating in the main lubricating circuit and feeding of the device for injection oil into the fuel at the level of the gasoline pump was constituted of the lubricating composition E described in example 1, having added thereto a convenient amount of multifunctional detergent, antioxidant, anti-rust and anti-foam additive. The fuel was an ordinary gasoline as available on the market.

During this test, no defect of the engine was observed. After disassembling, a particularly small wear of the Apex seals was observed as well as the total absence of the characteristic wear marks, parallel to the

axis of the rotor which usually result from a chattering effect on the stator walls. Moreover, no anomalous deposits have been observed in the combination chambers or in the ports.

From the foregoing description, on skilled in the art cas easily ascertain the essential characteristics of this invention, and without departing from the spirit and scope thereof, can make various changes and modifications of the invention to adapt it to various usages and conditions.

What we claim is:

1. A method for lubricating a two-stroke engine fed with gasoline, comprising introducing into the engine a lubricating composition having a viscosity at 98.9°C of at least 6 centistokes, the base lubricant of which contains from 10 to 100% by weight of at least one polyalkyleneglycol derivative being bis octadecanoate or bis dodecanoate of a C_2–C_5 polyoxyalkylene glycol containing 2–50 oxyalkylene units.

2. A method according to claim **1**, in which the base lubricant contains from 20 to 100% by weight of said at least one polyalkyleneglycol derivative.

3. A method according to claim **1**, for lubricating a two-stroke gasoline engine, in which the lubricating composition is introduced into the engine in a proportion corresponding to an amount of base lubricant of from 0.1 to 2% by weight with respect to the fuel amount required for the operation of said engine.

4. A method according to claim **3**, in which the base lubricant contains a minor proportion of said polyalkyleneglycol derivative and the lubricating composition is introduced into the engine in a proportion corresponding to an amount of said base lubricant of from 0.5 to 2% by weight with respect to the fuel amount required for the operation of the engine.

5. A method according to claim **3**, in which the base lubricant contains a major proportion of said polyalkyleneglycol derivative and the lubricating composition introduced into the engine in a proportion corresponding to an amount of said base lubricant of from 0.1 to 1% by weight with respect to the fuel amount required for the operation of the engine.

6. A method according to claim **1** futher comprising adding to the base lubricant from 0.1 to 40% by weight of at least one organic compound selected from monocarboxylic acids containing an aliphatic chain of 10–18 carbon atoms, their lower alkyl esters; monoalcohols and primary monoamines containing an aliphatic chain of 10–18 carbon atoms; dicarboxylic acids containing an aliphatic chain of 36 atoms; and tricarboxylic acids containing an aliphatic chain of 54 carbon latoms and their lower alkyl esters.

7. A method according to claim **6**, wherein said organic compound amounts to 5–25% by weight of the base lubricant.

8. A method according to claim **6**, wherein said organic compound is selected from dodecanoic acid, its lower alkyl esters, dodecanol and dodecylamine.

9. A method according to claim **6**, wherein the base lubricant consists essentially of said at least one polyalkyleneglycol derivative.

10. A method according to claim **7**, wherein the base lubricant consists essentially of said at least one polyalkyleneglycol derivative.

11. A method according to claim **6**, for lubricating a two-stroke gasoline engine, in which the lubricating composition is introduced into the engine in a proportion corresponding to an amount of base lubricant of from 0.1 to 2% by weight with respect to the fuel amount required for the operation of said engine.

12. In a method of lublicating a two-cycle or rotary engine wherein the combustion mixture fed to the combustion chamber contains a mixture of gasoline and a lubricating compositions,

the improvement wherein the weight percent proportion of the lubricating composition to the gasoline is 0.1 –1% and said lubricating composition contains a base lubricant having a major porition of at at least one polyalkyleneglycol deravitive being bis octadecanoate or bis dodecanoate of a C_2–C_5 poly-

oxyalkylene glycol containing 2–50 oxyalkylene units.

13. A fuel-lubricant mixture comprising gasoline and a lubricating composition comprising a lubricating amount of a base lubricant having a viscosity at 98.9°C of at least 6 centistokes, in which the proportion of the lubricating composition corresponds to an amount of base lubricant of from 50 ppm to 2% by weight with respect to said gasoline, said base lubricant containing from 10 to 100% bis octadecanoate or bis dodecanoate of a C_2–C_5 polyoxyalkylene glycol containing 2–50 oxyalkylene units.

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