

United States Patent [19]
Bosniack et al.

[11] 3,719,600
[45] March 6, 1973

[54] **LUBRICANT COMPOSITION
CONTAINING POLYCARBOXYLIC
ACID**

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[22] Filed: **Feb. 8, 1971**

[21] Appl. No.: **113,741**

[52] U.S. Cl. **252/56 S, 252/56 R, 252/57**

[51] Int. Cl. **C10m 1/26, C10m 1/24**

[58] Field of Search **252/56 D, 56 R, 56 S, 57**

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[57] **ABSTRACT**

This invention is directed towards lubricant compositions comprising a lubricating oil and a corrosion inhibiting amount of a polycarboxylic acid containing at least four non-carboxylic carbon atoms and more than two carboxyl groups. These compositions, when based on synthetic ester oils, exhibit reduced tendencies to corrode metals used in construction of gas turbine engines, particularly, lead.

12 Claims, No Drawings

LUBRICANT COMPOSITION CONTAINING POLYCARBOXYLIC ACID

BACKGROUND OF INVENTION

1. Field of the Invention

This invention relates to lubricant compositions, including those based on synthetic esters. More specifically, it relates to lubricant compositions characterized by reduced corrosivity towards metals, particularly lead, commonly used in the construction of gas turbine engines.

2. Description of Prior Art

The admixture of small amounts of certain materials to natural and synthetic lubricating oils to modify their properties in desirable ways is well known to those skilled in the art. Thus, for example, dispersants have been added to reduce the tendency of an oil to form engine sludge, and antioxidants have been added to improve the resistance of an oil to oxidative deterioration.

Other additives have also been used to reduce the tendency of an oil, during and after prolonged storage, to corrode metals with which it may come in contact, particularly, lead. Many gas turbine engines, such as those used to power modern aircraft, contain bearing cages having lead flashings. Lead corrosion, therefore, must be held to a minimum in such engines. Upon prolonged periods of storage, lubricants undergo deterioration and develop a tendency to corrode metals such as lead. Because of the need to stockpile synthetic lubricating oils around the world in a variety of climates for prolonged periods, the U.S. Air Force has included storage stability requirements in specifications for oils.

While prior art materials have proved useful in lubricating oils meeting these specifications, efforts have continued to find more effective additives which impart improved properties to the oils they are used to treat.

It is an object of this invention to provide a novel lubricant composition. Other objects will be apparent to those skilled in the art from the following description.

SUMMARY OF THE INVENTION

In accordance with certain of its aspects, the lubricant composition of this invention may comprise:

- a lubricating oil; and
- a corrosion-inhibiting amount of a polycarboxylic acid of the formula



wherein R is an acyclic hydrocarbyl nucleus having at least four carbon atoms and x is an integer greater than 2.

Description of the Invention

In accordance with certain of its aspects, the lubricating oils which may be improved by this invention may include various lubricating oils such as naturally-occurring or synthetically prepared lubricating oils.

Natural oils may include minerals oils such as those obtained from petroleum, including distillate and residual lubricating oils. Typical of these latter may be:

- An SAE 10 Mid-continent, solvent refined lubricating oil with the following flow properties:

5	Viscosity at 210°F. SUS Viscosity at 100°F. SUS Viscosity Index	44 168 91
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- An SAE 30 Pennsylvania type lubricating oil with the following flow properties:

10	Viscosity at 210°F. SUS Viscosity at 100°F. SUS Viscosity Index	65 500 103
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- An SAE 30 Naphthenic solvent-refined lubricating oil with the following properties:

15	Viscosity at 210°F. SUS Viscosity at 100°F. SUS Viscosity Index	58 510 62
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Other such oils useful in the practice of this invention are well-known to those skilled in the art.

The synthetic lubricating oils which may be improved by use of this invention may include liquid, high molecular weight esters, fluorocarbons, polyethers, and polysilicones, etc.

Typically, the synthetic oil may be an ester formed by the reaction of (a) a C_5-C_{36} aliphatic acid R' 25 (COOH) $_n$ wherein R' is an aliphatic hydrocarbon (including inertly-substituted hydrocarbon) residue and n is typically 1-3, preferably 1, with (b) a C_4-C_{20} aliphatic alcohol $R''(OH)m$ wherein R'' is an aliphatic hydrocarbon (including inertly-substituted hydrocarbon) residue and m is an integer, preferably 1-6, more 30 preferably 1-4, most preferably 3-4.

The base oil may, in one embodiment, be a liquid ester product of an aliphatic monocarboxylic acid and a polyol. The preferred of these acids may be C_5-C_{36} . Illustrative of such acids may be:

valeric	C_5
pivalic	C_5
dodecanoic	C_{12}
stearic	C_{18}
eicosanoic	C_{20}
triacontanoic	C_{30}
hexatriacontanoic	C_{36}

Preferably C_6-C_{10} acids may be used. Typically of such acid may be:

45	caproic acid caprylic acid capric acid enanthic acid pelargonic acid 2-ethylhexanoic acid	C_6 C_8 C_{10} C_7 C_9 C_8
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The most preferably, however, are enanthic and pelargonic acids.

The polyols which may be reacted with the noted aliphatic monocarboxylic acids, to form esters, may include $R''(OH)m$ wherein R'' is an aliphatic hydrocarbon moiety and m is an integer preferably 2-6, more preferably 2-4. The preferred polyols may be the C_2-C_{10} , say C_2-C_4 polyols. Typical of such polyols 60 may be:

65	neopentyl glycol trimethylol ethane trimethylol propane trimethylol butane pentaerythritol dipentaerythritol	C_5 C_6 C_6 C_7 C_4 C_6
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The preferred glycol may be pentaerythritol.

Typical esters of aliphatic monocarboxylic acids and polyols may be



including the following illustrative examples:

pentaerythritol tetra-valerate
pentaerythritol tetra-caproate
pentaerythritol tetra-pelargonate
pentaerythritol tetra-butylate
dipentaerythritol hexa-valerate
dipentaerythritol hexa-pelargonate
depentaerythritol hexa-caprate
trimethylol propane tri-caproate
trimethylol propane tri-butylate
trimethylol propane tri-valerate
trimethylol propane tri-pelargonate

The preferred esters may be pentaerythritol tetra-caproate.

In another embodiment, the liquid synthetic ester may be the product of reaction of an aliphatic polycarboxylic acid and an aliphatic monohydroxy alcohol.

Preferably, the aliphatic polycarboxylic acid may have the formula $R''(COOH)_n$ wherein n is greater than 1 and preferably 2-3. Typical polycarboxylic acids may include:

adipic acid
azelaic acid
sebacic acid
dodecanedioic acid
succinic acid
1,2,4 butane tricarboxylic acid

Preferred acids may be adipic and azelaic.

Preferably the alcohol may have the formula $R''OH$ where R'' may be a saturated aliphatic group which 35 may be inertly substituted. Typical alcohols may include methanol, n-butanol, 2-ethyl-n-butanol, pentanol, 1-hexanol, 2-ethyl-hexanol, 1-decanol, 2-ethyl-octanol, and 2-ethoxy ethanol.

Specific illustrations of this type of synthetic ester 40 lubricating oils which may be used in this invention are:

TABLE I

di-2-ethylhexyl sebacate
di-2-ethylhexyl azelate
di-2-ethylhexyl adipate
di-n-amyl sebacate
di-2-ethyl octyl succinate
di-2-ethoxyethyl sebacate
di-2-ethyl octyl adipate
di-2-ethyl octyl azelate
tri-pentyl-1,2,4 butane carboxylate

Preferred esters may be di-2-ethylhexyl azelate and di-2-ethylhexyl adipate.

These oils may be blended with other synthetic esters as noted supra or with other oils, such as castor oil; lard oil; polymerized olefins; copolymers of alkylene glycols or aliphatic alcohols with organic acids, etc.

The lubricant compositions of the present invention may preferably contain other additives, typically present in amount of 0.001 - 10 wt. %, including:

- a. oxidation inhibitors such as aromatic amines e.g. phenothiazine;
- b. metal corrosion inhibitors such as benzo-triazole;
- c. metal passivating and load-carrying agents, such as tricresyl phosphate;
- d. anti-foamants such as a silicone;

e. dispersants such as the polymethacrylates.

In the practice of this invention, according to certain of its aspects, there may be added to said lubricating oil a corrosion-inhibiting amount of a polycarboxylic acid 5 of the formula:



(I)

wherein R is an acyclic hydrocarbyl nucleus having at least four carbon atoms and x is an integer greater than 10 2.

The corrosion-inhibiting amount of polycarboxylic acid may be sufficient to decrease corrosion, and particularly corrosion of lead, by the lubricant composition to a satisfactory level. Commonly, this may mean a reduction in lead corrosion to a point at which the lubricant composition satisfies specifications such as those set by the U.S. Air Force as for example in MIL-L-7808G. There may be present 0.01 to 1.0 parts, preferably 0.015 to 0.5 parts, most preferably 20 0.02-0.05 parts of polycarboxylic acid per 100 parts of lubricating oil.

In the formula (I), R(COOH)_x, x may be an integer greater than 2, typically 3-7, preferably 3-4, say 3; R may be a hydrocarbyl moiety containing at least four carbon atoms, typically an alkyl group. R may be n-butyl, isobutyl, t-butyl, pentyl, neo-pentyl, hexyl, isodecyl, n-octadecyl, 3-ethyl-nonadecyl, etc. The R group may contain inert sub-stituents which are inert under the conditions of operation of the invention, such as aryl, 25 alkaryl, aralkyl, alkoxy, etc. substituents.

In the preferred embodiment of this invention, R of Formula I may be:



(II)

wherein n is an integer at least four.

In Formula x may be an integer greater than 2, typically 3-6, say 3. If x be, e.g. 4, the acid may be, inter alia,

n-octane-1,2,4,6-tetracarboxylic acid
n-decane-1,2,3,4-tetracarboxylic acid
n-heptane-4-phenyl-1,4,6,7-tetracarboxylic acid
n-pentane-3-ethyl-1,2,4,5-tetracarboxylic acid, etc.
If x be, e.g. 5 the acid may be, inter alia,
n-pentane-3(n-pentyl)-1,1,3,5,5-pentacarboxylic acid
45 n-decane-2,4,6-methyl-1,1,5,7,9-penta-carboxylic acid
n-nonane-5-phenyl-1,2,5,8,9-pentacarboxylic acid, etc.

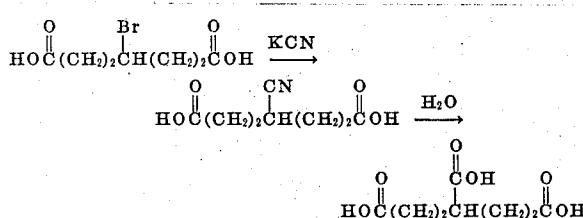
In a typical preferred embodiment of this invention, x of Formula I may be 3 and the acid may be tricarboxylic acids such as:

n-butane-1,2,4-tricarboxylic acid
n-pentane-1,2,3-tricarboxylic acid
n-pentane-1,3,5-tricarboxylic acid
n-pentane-1,3,3-tricarboxylic acid
n-butane-1,1,4-tricarboxylic acid
3-methyl-n-pentane-1,3,5-tricarboxylic acid
5-phenyl-n-pentane-1,3,5-tricarboxylic acid
n-nonane-1,5,9-tricarboxylic acid
n-nonane-1,2,3-tricarboxylic acid
5-methyl-nonane-1,5,9-tricarboxylic acid

Preferably the R of formula I contains four to six carbon atoms making the acid for example n-butane-1,2,3-tricarboxylic acid, n-pentane-2,3,4-tricarboxylic acid, n-hexane-1,3,6-tricarboxylic acid. Most preferably, however, the acid is n-pentane-1,3,5-tricarboxylic acid, (i.e. octric acid).

This invention may be practiced using mixtures of the above described acids. For example a mixture of 1-10 parts of octric acid per 1 part of n-heptane-1,4,7-tricarboxylic acid may be employed. Other such mixtures will be obvious to those skilled in the art.

The acids which may be used in the practice of this invention may be readily available from natural or commercial sources or they may be synthesized by well-known procedures such as hydrolysis of nitriles derived from appropriately substituted halogenated starting materials. For example, octric acid may be prepared from 4-bromo pimelic acid according to the following scheme:



Other such synthetic routes will be apparent to those skilled in the art.

skilled in the art.

Practice of the process of this invention, in accordance with certain of its aspects, may be effected by adding a corrosion inhibiting amount of said polycarboxylic acid to said lubricating oil and mixing the two, 30 thereby forming a lubricant composition. Mixing may be carried out continuously or in a batchwise fashion. Typically, such formulations may be prepared by adding the corrosion inhibiting amount of said acid to a body of said lubricating oil at a temperature of 180°-22 35 0°F., preferably 200°-220°F. Mixing may be continued over a period of 5 to 120 minutes, preferably 20 to 60 minutes, say 30 minutes.

It is a feature of this invention that the lubricant composition may be formulated from a concentrate of the polycarboxylic acid. Typically, such concentrates may contain 0.1 to 50 parts, preferably 0.1-10 parts, say 0.5 to 5 parts of acid in 100 parts of lubricant-composition soluble diluent solvent.

The diluent-solvent may be an inert liquid in which the acid may be soluble or dispersible. Commonly, the solvent may be an inert liquid having a boiling point of about 50°–250°C., say 75°–150°C.

The diluent-solvent may be characterized by its solubility or dispersability in lubricants. Typically, the diluent-solvent may be a low molecular weight mineral oil, polyether, a fluorocarbon, or preferably, a lubricating oil.

The diluent-solvent may include low molecular weight mineral oils such as solvent 150 neutral oil, solvent 325 neutral oil, and bright stock. Polyethers which may be employed as diluent-solvent include 1,2-dimethoxy ethane; 1,5-diethoxy-3-oxa-pentane; and 1,8-diethoxy-3,5-dioxa-octane. Fluorocarbon liquids which may be used as diluent solvents include perfluorooctane, perfluorotetradecane, perfluoro-octadecane and perfluorobenzene.

In a preferred embodiment, the diluent solvent may be a lubricating oil and most preferably it may be the oil forming the base of the lubricant composition.

Thus, the concentrates prepared in accordance with this invention may typically contain the following:

TABLE II

	Broad Range	Preferred Range	Typical
Acid	0.1-50	0.1-10	0.5-5
Diluent-solvent	1-100	1-50	10-50

A preferred concentrate may contain 4 parts acid in 100 parts diluent-solvent. Typically such concentrates may include:

10 1. 1.0 part octric acid, 100 parts pentaerythritol tetracaprate
2. 1.0 part octric acid, 100 parts di-(2-ethylhexyl) adipate
15 3. 1.0 part octric acid, 100 parts di-(2-ethylhexyl) sebacate
4. 1.2 parts octric acid, 100 parts di-(2-ethylhexyl)adipate.

The novel process of this invention permits attainment of outstanding results in lubricant compositions such as the following illustrative formulations

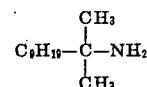
FORMULATION A

Component	Parts
Di(2-ethylhexyl) azelate	100
Di-(octylphenyl) amine	1.0
Phenyl alpha naphthyl amine	0.8
Tricresyl phosphate	0.6
Hydroxy terminated ester of linoleic acid dimer	0.5
Alkyl methacrylate-n-vinyl pyrrolidone copolymer (Mol. Wt. 850,000)	0.5

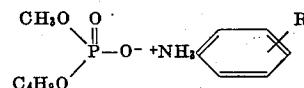
FORMULATION B

Component	Parts
di-2-ethylhexyl adipate	70
di-isodecyl adipate	30
di(octylphenyl)amine	1.0
phenyl alpha naphthyl amine	0.8
tricresyl phosphate	0.6
hydroxy terminated ester of linoleic acid dimer	0.5
alkyl methacrylate n-vinyl pyrrolidone copolymer (Mol.wt. 500,000)	1.0

To such formulations as A and B may also be added various additives such as a primary amine of a C₁₂₋₁₄ tertiary alkyl group, e.g.



hereafter referred to as Additive B or a mixed methyl, butyl phosphate ester salt of an alkylated aryl amine, e.g.



55 hereafter referred to as Additive A, a load carrying agent.

It is a particular feature of this invention that its practice reduces the tendency of oil compositions containing such load-carrying additives to corrode metals, especially lead.

especially lead.

It may be found that practice of this invention permits attainment of improved (i.e. decreased) corrosivity toward metal including lead by the treated oil. Such corrosivity may be determined in a standard manner by Federal Test Method Standard No. 791, Procedure No. 5321 prescribed in the U.S. Air Force's MIL-L-7808 storage stability specification. This test is conducted as

follows: two 1-gallon cans of test oil are placed in an unvented oven maintained at $230^{\circ}\pm 2^{\circ}\text{F}$. (110°C .) throughout the test. A 500 cc sample is removed from each can after 48 and 168 hours of storage respectively, and a lead corrosion test is carried out on each sample. In the lead corrosion test a sample of oil is agitated while in contact with copper and lead plates for 60 minutes at 325°F . while air is bubbled through the oil. At the end of the test, the loss in weight of the lead plate is determined.

Results are reported as milligrams lost (or gained) per square inch of exposed plate. The specification requires that an acceptable formulation exhibit a maximum of 25 mg/in² LOSS (or gain) after 48 hrs. Storage. The novel compositions of this invention permit attainment of outstanding results when subjected to this test.

It is a feature of this invention according to one of its aspects, that the lubricant composition permits lubrication or rubbing parts by contacting a first part to be lubricated with said lubricant composition, and rubbing said part against a second part.

Description of Preferred Embodiment

Practice of this invention will be apparent to those skilled in the art from the following examples, wherein, as elsewhere in this specification and claims, all parts are parts by weight unless otherwise specified.

In a first series of examples, a standard formulation of lubricating oil (Formulation C) was prepared:

FORMULATION C

Component	Parts
Adipic Acid coester of C ₈ oxo, C ₁₀ oxo alcohols	100.0
di(octylphenyl) amine	1.0
phenyl alpha naphthyl amine	0.8
tricresyl phosphate	0.6
hydroxy terminated ester of linoleic acid dimer	0.5
octyl methacrylate-n-vinyl pyrrolidone copolymer (Mol. Wt. 850,000)	0.5
benzotriazole	0.02
Additive A	0.05

In each of the Examples 1 through 8, there was added to Formulation C, a corrosion inhibiting amount of a polycarboxylic acid (according to this invention) or as a control, a comparable amount of an acid used in the prior art for lead corrosion inhibition but falling outside the scope of this invention. These lubricant compositions were then evaluated in a standard test, MIL-L-7808, as described above.

The following Table summarizes the acids used and their amount and the change in weight of the lead recorded during the test:

TABLE III

ex.	Purpose	Acid	Amount	Lead Wt. Loss After 48 Hrs.	Lead Wt. Loss After 168 Hrs.	Storage *
1	base	none	—	39.5	—	—
2	control	sebacic	0.02	47.9	952.6	—
3	control	sebacic	0.03	65.8	—	65
4	control	azelaic	0.025	48.9	—	—
5	control	adipic	0.025	33.8	—	—

6	example	oetric	0.025	0.89	—
7	example	oetric	0.02	0.04	3.06
8	example	oetric	0.02	0.02	—
9	example	oetric	0.05	0.05	—

* In mg. per square inch of coupon exposed.

From the results summarized in this Table, it can be seen that when the oil is treated in accordance with this invention as in Examples 6-9, corrosion of lead falls within the range of 0.89 mg/in² (Example 6) to 0.02 mg/in² (Example 8), a decrease of 40-200 fold. In base Example 1, the corrosion was 39.5 mg/in². Furthermore, storage of the oil for a longer time before test, i.e. 168 hours, produces even more dramatic evidence of the utility of this invention. Under these conditions, the corrosivity of the oil is reduced by a factor of 300 when treated in accordance with this invention (Example 2 versus Example 7).

In second series of examples the effect of the 0.02 part of preferred oetric acid on Formulation A, so described above, was determined. The results are summarized in the following Table:

TABLE IV

Example	Purpose	Oetric Acid	Lead Wt. Loss, mg/in ² 168 Hrs. Storage
10	base	none	6.56
11	example	0.02	0.036

As can be seen the addition of 0.02 part of oetric acid to Formulation A desirably reduces its lead corrosivity by a factor of about 200-fold.

In a third series of examples, Formulation A as described above was used as a base stock. Added to this base stock were 0.02 part per 100 parts of base ester of various acids, some within the scope of this invention and others without the scope of this invention. Also added to these experiments was an additive to improve the load carrying properties of the oil. This additive was that described above as Additive A and present in a concentration 0.05 part per 100 parts of base azelate ester. The results of these tests are summarized in the following table.

TABLE V

ex.	Purpose	Acid	Additive A	Lead Wt. Loss, mg/in ²
				48 Hrs. Stg. 168 Hrs. Stg.
12	base	—	yes	33.79 69.40
13	example	oetric	yes	0.042 29.1
14	control	citric	yes	16.2 171.8
15	control	NTA ^a	yes	54.3 89.2
16	control	TCA ^b	yes	8.77 108.6

(a) NTA = nitrilotriacetic acid; (b) tricarballylic acid

From comparison of Examples 12 and 13, it can be seen that 0.02 part of oetric desirably reduced the oil's tendency to corrode lead after 168 hours storage by a factor of 2-fold. Comparison of Examples 10 and 12 shows the undesirable effect of the Additive A while Example 13 shows that addition of oetric acid yields results superior to those achieved when Additive A is employed alone. Example 14, 15 and 16 when com-

pared with base Example 12 demonstrate that tricarboxylic acids not within the scope of this invention fail to reduce the corrosivity of an oil towards lead after 168 hours storage.

In a fourth series of examples (Examples 17-24), Formulation A as described above was blended with varying amounts of the two additive, Additive B, as described above, and Additive A, as described above. Then 0.02 part of either octric acid (Examples 18, 19, 22, and 24) or sebacic acid (Example 20) was added to certain formulations. As can be seen from inspection of the following Table in every instance where the preferred octric acid was used, corrosivity of the oil toward lead was markedly reduced while when sebacic acid was used (Example 20) no such effect was observed.

TABLE VI

ex.	Purpose	Amount Additive B	Amount Additive A	Acid	Lead Wt. Loss, mg.	
					After 48 Hrs. Storage	After 168 Hrs. Storage
17	Base	0.0175	0.05	—	41.1	105.1
18	Example	0.0175	0.05	Octric	0.00	16.2
19	Example	0.012	0.034	Octric	4.23	49.47
20	Control	0.012	0.034	Sebacic	6.04	88.4
21	Base	0.014	0.04	—	24.6	—
22	Example	0.014	0.04	Octric	0.012	—
23	Base	0.01	0.028	—	29.2	—
24	Example	0.01	0.028	Octric	0.042	—

As can be seen from comparison of Example 17 with Example 18, Example 21 with Example 22 and Example 23 with Example 24, the addition of octric acid to an oil desirably reduces its corrosivity towards lead by as much as a factor of 2000-fold. Use of sebacic acid on the other hand (Example 20) was found to be less than half as effective as octric acid (Example 19).

In a further series of experiments (Examples 25-28) the relative effectiveness of octric acid and sebacic acid were evaluated in oils based on Formulation B, as described above, having varying amounts of the above described Additive B and Additive A. The results of these tests are summarized in the following Table.

TABLE VII

ex.	Purpose	Amount Additive B	Amount Additive A	Acid*	Lead Wt. Loss, mg.	
					After 48 Hrs. Storage	After 168 Hrs. Storage
25	Base	0.0175	0.05	—	30.8	—
26	Example	0.0175	0.05	Octric	0.021	0.104
27	Example	0.012	0.034	Octric	4.77	2.50
28	Control	0.012	0.034	Sebacic	19.8	58.2

* Concentration 0.02 part.

Comparison of Examples 25 and 26 again shows that addition of octric acid to an oil desirably reduces its ability to corrode lead by a factor of 1000-fold. In con-

trast, addition of sebacic acid is found to be undesirably less effective by a factor of as much as 20-fold (Examples 27 and 28).

Similar improved results may be obtained by practice of this invention by use of the following specific acids:

Example	Acid
29	n-butane-1,2,3-tricarboxylic acid
30	3-methyl-pentane 1,3,5-tricarboxylic acid
31	n-heptane-1,4,7-tricarboxylic acid
32	5-phenyl-n-nonane 1,5,9-tricarboxylic acid

Example 33

A concentrate prepared in accordance with this invention may be prepared by adding 0.1 - 2.0 parts of octric acid to 100 parts of di-(2-ethyl hexyl) azelate and adding 0.01 to 0.2 part of this concentrate to the Formulation A described above.

Although this invention has been illustrated by description of specific embodiments, it will be apparent to those skilled in the art that many changes and variations can be made which clearly fall within the scope of this invention.

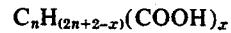
What is claimed is:

1. A lubricant composition comprising:
 - a major amount of a lubricating oil; and
 - a minor but corrosion inhibiting amount of a polycarboxylic acid of the formula



wherein R is an acyclic hydrocarbyl nucleus having four to 21 carbon atoms, and x is an integer between 3 and 7.

2. A lubricant composition as claimed in claim 1 wherein said acid is of the formula



wherein n is an integer between 4 and 21.

3. A lubricant composition as claimed in claim 1 wherein said oil is a synthetic ester lubricating oil.

4. A lubricant composition as claimed in claim 1 wherein said acid is pentane-1,3,5-tricarboxylic acid.

5. A lubricant composition as claimed in claim 1 wherein said acid is present in the amount of about 0.01-1.0 part per 100 parts of said oil.

6. A lubricant composition comprising:

- a. about 99.9 - 99.98 parts of a synthetic ester lubricating oil, and
- b. about 0.1 - 0.02 parts of pentane 1,3,5-tricarboxylic acid.

7. A concentrate for treating lubricant compositions which comprises

- a. 1 to 100 parts of a lubricating oil, and
- b. 0.1 to 50 parts of a polycarboxylic acid of the formula



wherein R is an acyclic hydrocarbyl nucleus having four to 21 carbon atoms x is an integer between 3 and 7, and the lubricating oil is present in lubricating amounts.

8. A concentrate as claimed in claim 7 wherein the lubricating oil is synthetic ester lubricating oil.

9. A concentrate as claimed in claim 8 wherein the lubricating oil is present in 99.8 parts.

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10. A concentrate as claimed in claim 7 wherein the acid is pentane 1,3,5-carboxylic acid.

11. A concentrate for treating lubricant compositions comprising

a. about 95.0 - 99.9 parts of a synthetic ester lubricating oil, and

b. about 0.1 - 5.0 parts of a polycarboxylic acid of the formula

$R(COOH)_x$

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wherein R is an acyclic hydrocarbyl nucleus having between four and ten carbon atoms and x is an integer between three and six.

12. A concentrate for treating lubricant compositions comprising

a. about 99.8 parts of di(2-ethyl hexyl) azelate, and

b. about 0.2 part of n-pentane-1,3,5-tricarboxylic acid.

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