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COMPOUNDED LUBRICATING OIL

Robert L. Humphreys and Victor N. Borsoff, Berkeley, Calif., assignors to Standard Oil Company of California, San Francisco, Calif., a corporation of Delaware

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This invention relates to new and useful compositions of the compounded mineral oil class. More particularly, it involves the provision of a lubricating oil containing metal salts of organic acids and an addition agent which inhibits undesirable effects of such compounds, as more particularly pointed out hereinafter, without destroying desired beneficial effects obtained therefrom.

Metal salts of organic acids are known as compounding ingredients for lubricating oils and have been added thereto for various purposes. For example, aluminum oleate is disclosed as a dispersing agent for graphite in the U. S. Patent to Burke No. 1,732,221; and various soaps have been disclosed as pour-point depressing agents.

In its broader aspect this invention is applicable to compounded oils of the above types. However, the present invention is more particularly concerned with oils compounded with certain metal naphthenates such as aluminum or magnesium naphthenates to inhibit piston ring sticking. An important property of lubricating oils is low corrosivity, especially with respect to modern bearing metals such as copper-lead mixtures or cadmium-silver alloy. Some lubricating oils which have been entirely satisfactory from the standpoint of corrosivity to high grade Babbitt bearing metals show a corrosion rate with cadmium-silver and copper-lead bearings which is greater than that permissible. Lubricating oils containing metal soap compounding ingredients have been found in general to show undesirable corrosive effects on such bearing materials. However, these metal soap compounding ingredients are highly desirable or even necessary for other purposes, such as inhibitors for piston ring sticking.

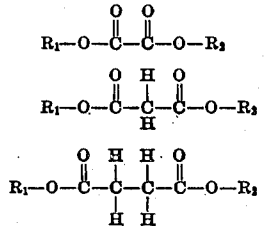
Accordingly, it is an object of the invention to solve the above difficulties by providing an improved compounded mineral oil having little or no corrosive action to machine parts and yet containing metal salts of organic acids.

Another object of the invention is to inhibit corrosive effects of compounded lubricating oils containing metal salts of organic acids such as metal naphthenates.

A still further object of the invention is to improve the wear reducing value of mineral oils compounded with metal salts such as naphthenates.

Another object of the invention is to increase the resistance to oxidation and discoloration of oils compounded with metal soaps.

In the investigation of lubricating oils containing metal salts of organic acids such as metal naphthenates, it has been found that oil-soluble organic compounds comprising an ester of a polycarboxylic acid with two carboxyl groups no more than two carbon atoms apart materially improve various properties of the compounded oils. These types of compounds may be represented generically by the following structural formulae:



in which formulae R_1 and R_2 represent an alkyl, aryl, aralkyl, or cyclic non-benzenoid group and may contain other active groups.

Specific examples of esters which are effective for reducing corrosive effects of mineral lubricating oils containing metal naphthenates, comprise oxalates, malonates and succinates of ethyl, propyl, butyl, amyl alcohols. The neutral esters of these polycarboxylic acids are preferred for our purposes.

To illustrate the effect of these esters as corrosion inhibitors, strip corrosion test data were obtained on mineral oils containing various percentages of a metal naphthenate to which had been added esters as taught in this invention. A basic aluminum naphthenate containing 3 equivalents of aluminum to 2 equivalent weights of petroleum naphthenic acids, and a magnesium naphthenate, were used as the metal naphthenate addition agents in these tests.

The strip corrosion test was performed as follows: Glass tubes 2 inches in diameter and 20 inches long were immersed in an oil bath, the temperature of which was automatically controlled to within ±1° F. of the test temperature. Test temperatures were 200° F. and 300° F. Approximately 300 c. c. of oil under the test was placed in each tube and air was bubbled through it at the rate of 10 liters per hour. Strips of the different types of bearing metals were cut to size and placed in the oils; in most cases more than one type of metal was tested simultaneously in the same sample of oil. The weight loss of each strip was recorded once every 24 hours. Before weighing, each strip was washed in petroleum ether and carefully wiped with a soft cotton cloth. At the same intervals the oils were tested for viscosity, A. S. T. M. naphtha insolubles, and neutralization number to obtain their oxidation characteristics. The duration of these tests were

from 72 to 224 hours depending upon test temperatures. Summarized results are given in the table.

It has been also found that the color and appearance of the used compounded oils are greatly improved by the presence of the esters. For example straight mineral oils and metal naphthenate compounded oils were dark and dirty after test at 200° F., while oils compounded with esters were perfectly clean with the bloom and transparency preserved. Investigation also shows that addition of esters in accordance with this invention, to oils compounded with aluminum dinaphthenate very materially reduces the amount of wear and friction. Actual engine tests show that the above disclosed beneficial effects are obtained without destroying the ability of oils containing naphthenates to inhibit piston ring sticking in internal combustion engines.

Table

Type of oil	Addition agents: Metal naphthenate	Addition agents: Esters	72 hours @ 300° F.: Weight loss, grams: Copper lead	72 hours @ 300° F.: Weight loss, grams: Cadmium silver	72 hours @ 300° F.: Percent increase in viscosity @ 100° F.	72 hours @ 300° F.: A. S. T. M. naphtha insol.	72 hours @ 300° F.: Neut. No.
Western oil (A) SAE 30	1% Al dinaphth. (340 M. W. acid)	None	.0475	.0001	120	293	3.06
Do	do	1% diethyl oxalate	.0207		83	160	0.25
Blended Penn. and Western. SAE 20.	½% magn. naphth. (270 M. W. acid).	None	.1843	.0070	43	59	2.9
Do	do	1% diamyl oxalate	.0100	.0004	27	34	1.6
Western oil (B) SAE 30	1% magn. naphth. (270 M. W. acid).	None	.2235	.1245	340	710	6.1
Do	½% Mg naphth. (270 M. W. acid)	1% diamyl succinate	.1624	.0036	250	530	6.9
Western oil (A) SAE 30	1% Mg naphth. (340 M. W. acid)	None	.1932	.0040	270	353	8.3
Do	do	1% diamyl succinate	.1426	.0026		410	4.6
224 hours @ 200° F.							
Western oil (A) SAE 30	1% Al dinaphth. (270 M. W. acid)	None	.0733	.0021	10	3	2.10
Do	do	1% diethyl oxalate	.0049	.0012	5	1	1.77
Eastern oil SAE 20	1% Al dinaphth. (270 M. W. acid)	None	.2758	.1389	46	13	4.81
Do	do	1% diethyl oxalate	.0359	.0005	1	3	2.54
Eastern oil SAE 60	1% Al dinaphth. (270 M. W. acid)	None	.1315	.0062	20	2	2.07
Do	do	1% diethyl oxalate	.0044	.0003	2	4	1.60
Western oil (A) SAE 30	1% Mg naphth. (340 M. W. acid)	None	.0948	.0007	29		2.12
Do	do	1% diamyl oxalate	.0017	.0004	3		2.42
Western oil (B) SAE 30	1% Mg naphth. (270 M. W. acid)	None	.0383	.0001	25		1.77
Do	do	1% diamyl succinate	.0098		11		0.44
Western oil (A) SAE 30	1% Mg naphth. (340 M. W. acid)	None	.0948	.0007	29		2.12
Do	do	1% diamyl succinate	.0055	.0004	2		0.99

The chemical mechanism by which the results of this invention are obtained has not been established and is not well understood. Metal naphthenates appear to catalyze corrosive effects in oils. The esters inhibit or offset this catalytic action by a phenomenon which has been discovered by the present inventors but which they are unable, definitely, to explain. The phenomenon of corrosion inhibiting appears to result from some peculiar action which converts the bearing metal to a passive state after an initial induction period. However, such a phenomenon has not been established and is merely suggested as a possible explanation for the corrosion inhibiting effect.

Measurable improvements in the properties of the compounded oil are obtained with as little as 0.1% of the ester, but as much as 1.0% is preferred. More than 10% is regarded as unnecessary.

The present invention is applicable in its broader aspects to oils compounded with many oil soluble metal salts of organic acids. The invention appears at present to find its greatest utility in oils containing metal naphthenates capable of inhibiting piston ring sticking. Such metal naphthenates are aluminum, zinc, magnesium, cobalt, cadmium and manganese naphthenates. It is apparent that the particular ester and the particular metal salts must be selected with various factors in mind, such as the service to be encountered and the type of bearings in engines to be lubricated if the maximum benefits of the invention are to be obtained.

While specific examples of the preparation and compositions of the invention have been described, this has been done by way of illustration only and with the intention that no limitation should be imposed upon the invention thereby. Similarly, explanations or theories concerning the reasons for the beneficial effect of the esters of this invention have been submitted merely as possibilities and are not to be regarded as essential to the invention or as limiting it in any respect It will be obvious to those skilled in the art that numerous modifications and variations of the above illustrative examples may be effected in the practice of the invention which is of the scope of the claims appended hereto.

We claim:

1. A compounded mineral oil containing a metal salt of an organic acid in an amount sufficient to render the oil corrosive to bearing metals, such as copper-lead mixtures and cadmium-silver alloys and an organic ester of a polycarboxylic acid having two carboxyl groups no more than two carbon atoms apart, said organic ester being present in an amount sufficient to substantially reduce the corrosivity of said compounded oil.

2. A compounded mineral oil as defined in claim 1 in which the ester is an ester of oxalic acid.

3. A compounded mineral oil as defined in claim 1 in which the ester is an ester of succinic acid.

4. A compounded mineral oil as defined in claim 1 in which the ester is an ester of malonic acid.

5. A compounded mineral oil as defined in claim 1 in which the ester is an ester of an aliphatic acid and an aliphatic alcohol.

6. A compounded lubricating oil containing a metal naphthenate in an amount sufficient to render the oil corrosive to bearing metals, such as copper-lead mixtures and cadmium-silver alloys and an organic ester of a polycarboxylic acid having two carboxyl groups no more than two carbon atoms apart, said ester being present in an amount from approximately 0.1% to 10% of the mineral oil.

7. A compounded lubricating oil as defined in claim 6 in which the ester is an ester of oxalic acid.

8. A compounded lubricating oil as defined in claim 6 in which the ester is an ester of succinic acid.

9. A compounded lubricating oil as defined in claim 6 in which the ester is an ester of malonic acid.

10. A compounded lubricating oil as defined in claim 6 in which the ester is an ester of an aliphatic acid and an aliphatic alcohol.

11. A compounded lubricating oil as defined in claim 6 in which the naphthenate is a basic aluminum naphthenate.

12. A compounded lubricating oil as defined in claim 6 in which the naphthenate is magnesium naphthenate.

13. A compounded lubricating oil containing a small amount of basic aluminum naphthenate and from approximately 0.1% to 10% of diethyl oxalate.

14. A compounded lubricating oil containing a small amount of basic aluminum naphthenate and from approximately 0.1% to 10% of diamyl oxalate.

15. A compounded lubricating oil containing a small amount of magnesium naphthenate and from approximately 0.1% to 10% of diamyl oxalate.

16. In a method of lubricating bearing surfaces which comprises maintaining between the bearing surfaces, one of which is a bearing metal selected from the group consisting of cadmium-silver alloy and copper-lead mixtures, a film of a lubricating oil which initially produces an effective lubricating action but which would normally tend to corrode said bearing metal, the step of inhibiting the corrosive action of the oil on said bearing by incorporating therein from approximately 0.1% to 10% of an organic ester of a poly-carboxylic acid having two carboxyl groups no more than two carbon atoms apart.

17. In a method of lubricating bearing surfaces which comprises maintaining between the bearing surfaces, one of which is a bearing metal selected from the group consisting of cadmium-silver alloy and copper-lead mixtures, a film of a compounded lubricating oil containing a metal naphthenate in an amount which would normally increase the corrosivity of said oil to said bearing metal, the step of inhibiting the corrosive action of the oil on said bearing by incorporating therein from approximately 0.1% to 10% of an organic ester of a poly-carboxylic acid having two carboxyl groups no more than two carbon atoms apart.

18. In a method of lubricating bearing surfaces which comprises maintaining between the bearing surfaces, one of which is a bearing metal selected from the group consisting of cadmium-silver alloy and copper-lead mixtures, a film of a compounded lubricating oil containing a small amount of a metal naphthenate selected from the group consisting of aluminum, zinc, magnesium, cobalt, cadmium and manganese naphthenates which oil would normally tend to corrode said bearing metal, the step of inhibiting the corrosive action of the oil on said bearing by incorporating therein from approximately 0.1% to 10% of an organic ester of a poly-carboxylic acid having two carboxyl groups no more than two carbon atoms apart.

19. In a method of lubricating bearing surfaces which comprises maintaining between the bearing surfaces, one of which is a bearing metal selected from the group consisting of cadmium-silver alloy and copper-lead mixtures, a film of a compounded lubricating oil containing a small amount of a metal naphthenate selected from the group consisting of aluminum, zinc, magnesium, cobalt, cadmium and manganese naphthenate which oil would normally tend to corrode said bearing metal, the step of inhibiting the corrosive action of the oil on said bearing metal by incorporating therein from approximately 0.1% to 10% of an organic ester of an aliphatic alcohol and a poly-carboxylic acid having two carboxyl groups no more than two carbon atoms apart.

20. In a method of lubricating bearing surfaces which comprises maintaining between the bearing surfaces, one of which is a bearing metal selected from the group consisting of cadmium-silver alloys and copper-lead mixtures, a film of a compounded lubricating oil normally tending to corrode said bearing metal and containing an addition agent selected from the group of metal salts of an organic acid which substantially increase the corrosivity of said oil to said bearing metal, the step of inhibiting the corrosive action of the oil on said bearing metal by incorporating therein a minor proportion of an organic ester of a polycarboxylic acid having two carboxyl groups no more than two carbon atoms apart.

21. A compounded mineral oil containing an addition agent in an amount normally sufficient to substantially increase the corrosivity of the mineral oil, said addition agent being a metal salt of an organic acid and selected from the group of compounds which increase the corrosivity of hydrocarbon oils to bearing metals, such as copper-lead mixtures and cadmium-silver alloys, and from approximately 0.1% to 10% of an organic ester of a polycarboxylic acid having two carboxyl groups no more than two carbon atoms apart.

22. A compounded liquid lubricant comprising a mineral oil containing a metal salt of an organic acid in an amount sufficient substantially to increase the corrosivity of the lubricant to bearing metals, such as copper-lead mixtures and cadmium-silver alloys, and approximately 1% of an ester of a polycarboxylic acid having two carboxyl groups no more than two carbon atoms apart.

23. A compounded liquid lubricant comprising a mineral oil containing an oil-soluble metal salt of an organic carboxylic acid in an amount sufficient substantially to increase the corrosivity of the lubricant to bearing metals, such as copper-lead mixtures and cadmium-silver alloys, and an ester of a polycarboxylic acid having two carboxyl groups no more than two carbon atoms apart, said ester being present in an amount sufficient substantially to reduce the corrosivity of said compounded lubricant.

24. In a method of lubricating bearing surfaces which comprises maintaining between the bearing surfaces, one of which is a bearing metal selected from the group consisting of cadmium-

silver alloys and copper-lead mixtures, a film of a compounded lubricating oil containing an oil-soluble metal salt of an organic carboxylic acid in an amount which would normally increase the corrosivity of said oil to said bearing metal, the step of inhibiting the corrosive action of the oil on said bearing by incorporating therein from approximately 0.1% to approximately 10% of an ester of a polycarboxylic acid having two carboxyl groups no more than two carbon atoms apart.

ROBERT L. HUMPHREYS.
VICTOR N. BORSOFF.