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COMPOUNDED LUBRICANT

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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.

10 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.

15 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 30 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.

40 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.

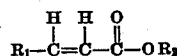
Another object of the invention is to inhibit 45 corrosive effects of compounded lubricating oils containing metal salts of organic acids such as metal naphthenates.

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.

55 In the investigation of lubricating oils con-

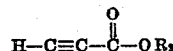
taining metal salts of organic acids such as metal naphthenates it has been found that oil-soluble organic compounds comprising an ester with an unsaturated carbon-to-carbon bond conjugated with the carboxyl group materially improve various properties of the compounded oils. These types of compounds may be represented by the following structural formula:



10 in which formula R_1 and R_2 represent an alkyl, aryl, aralkyl or cyclic non-benzenoid group. R_1 and R_2 may of course contain other active groupings and may be either of the same or different 15 types.

The addition of these types of esters to oils containing metal soaps effectively inhibits the corrosive action of oils so compounded by experiments indicate that where the unsaturated carbon to carbon bond is not conjugated with the carboxyl group and is further removed therefrom the esters do not adequately inhibit the corrosive action of such oils. The decided inferior inhibiting effects obtained from these other types of esters make it necessary to utilize esters of the above represented type in order to obtain the fullest benefits of this discovery and invention.

Specific examples of esters which are effective for reducing corrosiveness of mineral lubricating oils containing metal naphthenates comprise 30 ethyl, propyl, butyl, amyl and octyl esters of maleic, fumaric, acrylic and crotonic acids. Similar acids in which a hydrogen on the unsaturated carbons is substituted by a short chain aliphatic group, for example alpha methyl acrylic acid, may be utilized. Similarly, the unsaturated carbon to carbon bond need not necessarily be an ethylene bond. Esters of propinoic acid having the formula:



are operative.

To illustrate the effect of such esters as corrosion inhibitors strip corrosion test data were obtained on mineral oils containing 1% of a metal naphthenate to which had been added an ester as taught in this invention. A basic aluminum naphthenate containing 3 equivalents of aluminum to 2 equivalents of petroleum naphthenic acids was used as the naphthenate addition agent in this test. Di-isooamyl maleate was used as a corrosion inhibitor.

The strip corrosion test was performed as follows: 300 c. c. of oil are placed in a large test

tube, immersed in an oil bath at a temperature of 300° F. Bearing metal strips of cadmium-silver and copper-lead are suspended in the tube so as to be completely immersed in the oil sample. The samples are blown with air at the rate of 10 liters per hour for 90 hours. The loss of weight in milligrams per square centimeter from the strips is a direct measure of corrosion. The results of such a test are given in table.

TABLE

Strip corrosion test (300° F.—90 hrs.)

Oil	Weight loss mg. per sq. cm.	
	Cadmium-silver	Copper-lead
Western oil SAE 30 (acid refined)	0	0
Western oil SAE 30 (acid refined)+1% Al dinaphthenate	31	123
Western oil SAE 30 (acid refined)+1% Al dinaphthenate+1% amyl maleate	6	35
Western oil SAE 30 (acid refined)+1% Al dinaphthenate+1% amyl fumarate	9.5	20

It has also been observed that the color and appearance of the used compounded oils are greatly improved by the presence of the esters. Investigation indicates that addition of esters in accordance with this invention to oils compounded with aluminum di-naphthenate very materially reduces the amount of wear and friction and engine tests show that the beneficial effects of esters are obtained without destroying the ability of oils containing naphthenates to inhibit piston ring sticking in internal combustion engines.

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 lubricating 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 of certain esters which convert the bearing metal surface to a passive state after an initial induction period. However, this theory has not been established and is merely suggested as a possible explanation for the corrosion inhibiting effect.

Measureable improvements of the properties of the compounded oils are obtained with as little as 0.1% of the ester, but as much as 0.5% is regarded as necessary to obtain the desired effects and approximately 1.0% is preferred. More than 10% is believed at present to be unjustifiable.

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 or the particular metal salt 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.

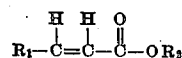
Specific examples of compositions prepared according to the invention have been described. This has been done by way of illustration only and with the intention that no limitation should

be imposed upon the invention thereby. Similarly, the explanation or theory concerning the reasons for the beneficial effect of the esters of this invention has been submitted merely as a possibility and is 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 having an unsaturated carbon to carbon bond conjugated with a carboxyl group of the ester, 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 of the type formula:



in which R₁ and R₂ represent an alkyl, aryl, aralkyl or cyclic nonbenzenoid group.

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

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

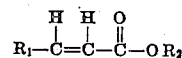
5. A compounded mineral oil as defined in claim 1 in which the ester is di-isoamyl maleate.

6. A compounded mineral oil as defined in claim 1 in which the metal salt is an aluminum salt of a fatty acid.

7. A compounded mineral oil as defined in claim 1 in which said metal salt is a metal naphthenate.

8. A compounded lubricating oil containing a small amount of a naphthenate selected from the group consisting of aluminum, zinc, magnesium, cobalt, cadmium and manganese naphthenates and an organic ester having an unsaturated carbon to carbon bond conjugated with a carboxyl group of said ester, said ester being present in an amount from approximately 0.1% to 10% of the mineral oil.

9. A compounded lubricating oil as defined in claim 8 in which the ester is of the type formula:



in which R₁ and R₂ represent an alkyl, aryl, aralkyl or cyclic nonbenzenoid group.

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

11. A compounded lubricating oil as defined in claim 8 in which the ester is an ester of maleic acid and an aliphatic alcohol.

12. A compounded lubricating oil as defined in claim 8 in which the ester is di-isoamyl maleate.

13. A compounded lubricating oil as defined in claim 8 in which said naphthenate is a basic aluminum naphthenate and said ester is an ester of maleic acid.

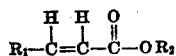
14. A compounded lubricating oil as defined in claim 8 in which said naphthenate is magnesium naphthenate and said ester is an ester of maleic acid.

15. 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 having an unsaturated carbon to carbon bond conjugated with a carboxyl group of the ester.

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 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 having an unsaturated carbon to carbon bond conjugated with a carboxyl group of the ester.

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 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 having an unsaturated carbon to carbon bond conjugated with a carboxyl group of the ester.

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 metal by incorporating therein from approximately 0.1% to 10% of an organic ester of the type formula:



in which R₁ and R₂ represent an alkyl, aryl, aralkyl or cyclic non-benzenoid group.

19. In a method of lubricating bearing surfaces which comprises maintaining between the bear-

ing 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 compounded oil on said bearing metal by incorporating therein a minor proportion of an organic ester having an unsaturated carbon-to-carbon bond conjugated with a carboxyl group of the ester.

20. 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 having an unsaturated carbon-to-carbon bond conjugated with a carboxyl group of the ester.

21. 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 having an unsaturated carbon-to-carbon bond conjugated with a carboxyl group of the ester.

22. 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 having an unsaturated carbon-to-carbon bond conjugated with a carboxyl group of the ester, said ester being present in an amount sufficient substantially to reduce the corrosivity of said compounded lubricant.

23. 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 having an unsaturated carbon-to-carbon bond conjugated with a carboxyl group of the ester.

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