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LUBRICATING OIL

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No Drawing. Original application April 26, 1941, Serial No. 390,541, now Patent No. 2,363,134, dated November 21, 1944. Divided and this application February 23, 1942, Serial No. 432,039

11 Claims. (Cl. 252—42.7)

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This invention relates to an improved lubricating oil adapted for use in internal combustion engines and particularly to a lubricating oil having one or more additive ingredients incorporated therein.

This application is a division of application of Rush F. McCleary, Serial No. 390,541, filed April 26, 1941, for Lubricating oil, now Patent No. 2,363,134, dated November 21, 1944.

It is generally conceded that in the recent development of internal combustion engines, and particularly engines designed for heavy duty service, the increase in operating temperatures, together with the reduction of clearances and the use of hard bearing alloys, such as copper-lead, cadmium-silver, etc., has set up such severe operating conditions as to necessitate an improvement in the highly solvent refined mineral oils refined for use as lubricants. These rigorous operating conditions, which are most prevalent in Diesel and gasoline engines used in heavy duty bus and tractor service, where the piston ring temperatures range from approximately 425 to 650° F. and pressures from the oxidizing combustion gases are as high as 750 to 1150 pounds per square inch, have seriously accentuated such problems as corrosion, oxidation and resin formation in the solvent refined mineral lubricating oils with the resultant deleterious effect on the efficiency of the engines. The nature and extent of these problems depend upon the conditions of operation of the particular engine type, the type and extent of refining of the base oil used, and numerous other factors.

The tendency of mineral lubricating oils to deposit gums, resins, soot, and varnish-like materials about the valves, rings, pistons, cylinders and other engine parts can be largely overcome by the addition of certain types of additive ingredients which possess detergent qualities when dissolved or dispersed in lubricating oils. By detergent property is meant not only that property which aids in dispersing, removing or purging foreign materials which accumulate on the surface of the engine parts but also that property which prevents the accumulation or deposition of such materials as distinguished from solvent action upon those accumulations or deposits.

In addition thereto, the added tendency of these oils to corrode the metal surfaces with which the lubricating oil comes in contact may be overcome or reduced by the addition of additive components which possess anti-oxidant or anti-corrosive properties when dissolved or dispersed in mineral lubricating oils. These anti-oxidants or anti-

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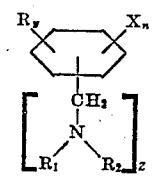
corrosive properties are meant to include all such properties which effect a reduction or elimination of weight loss of the lubricating surfaces, particularly bearing surfaces, which results from the corrosive action of the mineral lubricating oil.

It is the object of the present invention to provide a mineral oil composition which possesses the above-mentioned detergent and anti-oxidant or anti-corrosive properties together with improved stability in service and storage by incorporating in a mineral lubricating oil a novel additive ingredient of multi-functional activity.

A further object of this invention is to provide a mineral oil composition possessing detergent properties and enhanced anti-oxidant or anti-corrosive properties by combining with the above-mentioned multi-functional additive an auxiliary additive ingredient and incorporating in a mineral lubricating oil.

The invention is based upon the discovery of a novel class of multi-functional additives which may be broadly described as oil-soluble or oil-miscible metal derivatives of alkyl substituted aryloxy or aryl thiooxy tertiary amines. It has been found that when small proportions of a compound within the scope of the above general class are blended with a mineral lubricating oil, a mineral oil composition is formed, possessing excellent detergent, anti-oxidants or anti-corrosive, and stabilizing properties.

The compounds of the present invention may be further described as metal derivatives of oil-soluble reaction products of the treatment of any methylol forming aromatic compounds with formaldehyde and any secondary amine. These products may be represented by the following structural formula



in which R may be a hydrogen, alkyl, aryl, aralkyl, cycloalkyl or naphthenyl radical. These radicals may contain further substituents which do not affect the oil solubility of the compounds, as, for example, halogen, sulfur, oxygen, or nitrogen derivatives. R_1 and R_2 may be alkyl, cycloalkyl, aralkyl, naphthenyl radicals or substituted derivatives thereof and they may be combined to form a heterocyclic radical with the nitrogen of the aminomethyl group. Also R_1 and R_2 may be

dissimilar radicals within the scope of the above-mentioned radicals. X may be either an hydroxyl (OH) or sulfhydryl radical (SH) or metal salts thereof, and n, y, z may be integers of 1 or more. y and z may be either 1, 2, 3, or 4, while n may be either 1, 2 or 3, depending upon the valences of the aromatic nucleus not satisfied by other substituents or the residual hydrogen. The aromatic nucleus diagrammatically shown may be substituted by a naphthyl, anthracyl or other condensed aromatic nuclei. The positions of the substituent in the formula are purely diagrammatic and may be connected to any position in the aromatic nucleus. The metal derivatives of this class of compounds which are formed by the substitution of the replaceable hydrogen of the hydroxyl group (OH) or the sulfhydryl group (SH) include any of the following metals: sodium, potassium, calcium, barium, strontium, tin, aluminum, iron, cobalt, nickel, copper, manganese, zinc and magnesium, and chromium.

As illustrating the type of compounds within the scope of the above classification, the following compounds are presented, together with their relationship to the general classification. It is to be understood that the above-mentioned metals should be substituted for the replaceable hydrogen in the following compounds and that the scope of the present invention is not limited to the following specific compounds or their metal salts:

R, R_1 AND R_2=ALKYL

$n, y, z=1$, X=OH

Dimethylaminomethyl octyl phenol

X=SH

Dimethylaminomethyl octyl thiophenol

$n, y=1, z=2$, X=OH

Di (diamylaminomethyl) amyl phenol

X=SH

Di (diamylaminomethyl) amyl thiophenol

$n=1, y=2, z=1$, X=OH

Diamylaminomethyl dioctyl phenol

X=SH

Diamylaminomethyl dioctyl thiophenol

$n=1, y=3, z=1$, X=OH

Dimethylaminomethyl trioctyl phenol

X=SH

Dimethylaminomethyl trioctyl thiophenol

$n=1, y, z=2$, X=OH

Di (dimethylaminomethyl) dioctyl phenol

X=SH

Di (dimethylaminomethyl) dioctyl thiophenol

$n=2, y, z=1$, X=OH

Dimethylaminomethyl amyl resorcinol

$n=2, y=1, z=2$, X=OH

Di (dimethylaminomethyl) octyl hydroquinone

$n, y=2, z=1$, X=OH

Dimethylaminomethyl diamyl resorcinol

In the following compounds X is any hydroxyl radical, although the corresponding thio compounds, e. g., where X is a sulphydryl radical, may also be used:

R=HYDROGEN, R_1 AND R_2=ALKYL

$n=1, y=3, z=2$

Di (dimethylaminomethyl) phenol

$n=1, y=2, z=3$

Tri (diamylaminomethyl) phenol

$n, y, z=2$

Di (dimethylaminomethyl) resorcinol

$n=2, y=1, z=3$

Tri (diamylaminomethyl) hydroquinone

R=ARALKYL, R_1 AND R_2=ALKYL

$n, y, z=1$

Dimethylaminomethyl benzyl phenol

$n, y=1, z=2$

Di (dimethylaminomethyl) benzyl phenol

$n=1, y=2, z=1$

Dimethylaminomethyl dibenzyl phenol

$n=2, y, z=1$

Dimethylaminomethyl benzyl resorcinol

$n=2, y=1, z=2$

Di (dimethylaminomethyl) benzyl resorcinol

$n, y=2, z=1$

Dimethylaminomethyl dibenzyl resorcinol

R=ARYL, R_1 AND R_2=ALKYL

$n, y, z=1$

Diamylaminomethyl phenylphenol

$n, y=1, z=2$

Di (dimethylaminomethyl) phenylphenol

R=CYCLOALKYL, R_1 AND R_2=ALKYL

$n, y, z=1$

Dimethylaminomethyl cyclohexyl naphthol

$n, y=1, z=2$

Di (dimethylaminomethyl) cyclohexyl phenol

$n=1, y=2, z=1$

Dimethylaminomethyl dicyclohexyl naphthol

$n=2, y, z=1$

Dimethylaminomethyl cyclohexyl hydroquinone

$n=2, y=1, z=2$

Di (dimethylaminomethyl) cyclohexyl hydroquinone

R=NAPHTHENYL, R_1 AND R_2=ALKYL

$n, y, z=1$

Dimethylaminomethyl naphthenyl phenol

$n, y=1, z=2$

Di (dimethylaminomethyl) naphthenyl naphthol

$n=2, y, z=1$

Dimethylaminomethyl naphthenyl resorcinol

$n=2, y=1, z=2$

Di (dimethylaminomethyl) naphthenyl resorcinol

R=SUBSTITUTED DERIVATIVES, R_1 AND R_2=ALKYL

$n, y, z=1$

Symmetrical di (dimethylaminomethyl) 4,4'dihydroxy diphenyl propane

$n, y=1, z=2$

Symmetrical tetra (dimethylaminomethyl) 4,4'dihydroxy diphenyl propane

$n, y=1, z=2$

Di (dimethylaminomethyl) chlorophenyl phenol

R=ALKYL, R_1 AND R_2=CYCLOALKYL

$n, y, z=1$

Dicyclohexylaminomethyl undecyl phenol

$n, y=1, z=2$

Di (dicyclohexylaminomethyl) undecyl phenol

$n=1, y=2, z=1$

Dicyclohexylaminomethyl diamyl phenol

$n=1, y, z=2$

Di (dicyclohexylaminomethyl) diamyl phenol

$n=2, y, z=1$

Dicyclohexylaminomethyl undecyl resorcinol

$n=2, y=1, z=2$

Di (dicyclohexylaminomethyl undecyl resorcinol

$n, y=2, z=1$

Dicyclohexylaminomethyl diundecyl resorcinol

R=Hydrogen, R_1 and R_2=Cycloalkyl

$n=1, y=3, z=2$

Di (dicyclohexylaminomethyl) phenol

$n, y, z=2$

Di (dicyclohexylaminomethyl) hydroquinone

R=Alkyl, R_1 and R_2=Aralkyl

$n, y, z=1$

Dibenzylaminomethyl octyl phenol

$n, y=1, z=2$

Di (dibenzylaminomethyl) octyl phenol

$n=1, y=2, z=1$

Dibenzylaminomethyl dioctyl phenol

$n=1, y, z=2$

Di (dibenzylaminomethyl) dioctyl phenol

$n=2, y, z=1$

Dibenzylaminomethyl undecyl hydroquinone

$n=2, y=1, z=2$

Di (dibenzylaminomethyl) undecyl hydroquinone

$n, y=2, z=1$

Dibenzylaminomethyl diundecyl hydroquinone

R=Alkyl, R_1 and R_2=Naphthenyl

$n, y, z=1$

Dinaphthenylaminomethyl octyl naphthol

$n, y=1, z=2$

Di (dinaphthenylaminomethyl) octyl naphthol

$n=1, y=2, z=1$

Dinaphthenylaminomethyl dioctyl naphthol

$n=2, y, z=1$

Dinaphthenylaminomethyl undecyl resorcinol

$n=2, y=1, z=2$

Di (dinaphthenylaminomethyl) undecyl resorcinol

R=Hydrogen, R_1 and R_2=Naphthenyl

$n=1, y=3, z=2$

Di (dinaphthenylaminomethyl) phenol

$n=1, y=2, z=3$

Tri (dinaphthenylaminomethyl) phenol

$n, y, z=2$

Di (dinaphthenylaminomethyl) resorcinol

R=Alkyl, R_1 and R_2=Substituted Derivatives

$n, y, z=1$

Diethanolaminomethyl decyl phenol

$n, y=1, z=2$

Di (diethanolaminomethyl) decyl phenol

$n=1, y=2, z=1$

Diacetonitrileaminomethyl dioctyl phenol

$n=1, y, z=2$

Di (diethanolaminomethyl) didecyl phenol

R=Alkyl, R_1 and R_2, Forming a Heterocyclic Radical With Nitrogen of the Aminomethyl Group

$n, y, z=1$

Piperazinomethyl amylphenol

$n, y=1, z=2$

Di (piperidinomethyl) undecyl phenol

$n=1, y=2, z=1$

Di (diamyl hydroxybenzyl) piperazine

$n=1, y, z=2$

Di (morpholinomethyl) dioctyl phenol

$n=2, y, z=1$

Morpholinomethyl octadecyl resorcinol

$n=2, y=1, z=2$

Di (morpholinomethyl) octyl resorcinol

$n, y=2, z=1$

Morpholinomethyl dioctyl resorcinol

R=Hydrogen, R_1 and R_2 Forming a Heterocyclic Radical With Nitrogen of the Aminomethyl Group

$n=1, y=4, z=1$

Piperazinomethyl phenol

$n=1, y=3, z=2$

Di (morpholinomethyl) phenol

$n=1, y=2, z=3$

Tri (morpholinomethyl) phenol

$n, y, z=2$

Di (piperidinomethyl) resorcinol

R=Alkyl, R_1 and R_2 Are Dissimilar Radicals

$n, y, z=1$

Methylethylaminomethyl octyl phenol

$n, y=1, z=2$

Di (methylethylaminomethyl) octyl phenol

R=Cycloalkyl, R_1 and R_2 Are Dissimilar Radicals

$n, y, z=1$

Methylethylaminomethyl cyclohexyl naphthol

$n, y=1, z=2$

Di (methylethylaminomethyl) cyclohexyl naphthol

R=Hydrogen, R_1 and R_2 Are Dissimilar Radicals

$n=1, y=2, z=3$

Tri (methylethylaminomethyl) phenol

R=Aryl, R_1 and R_2 Are Dissimilar Radicals

$n, y, z=1$

Methylethylaminomethyl p-phenyl phenol

This general class of compounds may be prepared by any of the classical methods of synthesis and the following examples are mentioned as illustrating one method of preparation:

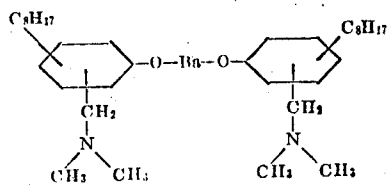
Example I

256 grams (1.0 mol) of tridecylphenol and 180 grams (1.0 mol) of a 25% aqueous solution of dimethylamine were stirred together and sufficient methyl alcohol added to give a clear solution, then 200 cc. more of methyl alcohol were added. To this clear solution was added, with stirring, one mol (120 grams) of 25% aqueous formaldehyde solution. The formaldehyde was added slowly and the temperature maintained at 25–30° C. for one hour during the addition of the formaldehyde. After the addition was complete the temperature was increased to 70–75° C. for one hour. The product separated out as an oil and was washed well with water and then dried by warming to 75–80° C. in vacuo. The dimethylaminomethyl tridecylphenol was a light brown colored oil with a slight amine odor.

Example II

200 grams (0.76 mol) of a dimethylaminomethyl octyl phenol, prepared in accordance with the procedure given in Example I, were dissolved in 250 cc. of benzene and 65 grams (0.38 mol) of anhydrous barium hydroxide were added with stirring. The solution was heated to reflux under an automatic water separator until no more water was evolved. Filter-cel and additional benzene were added and the excess barium hy-

droxide filtered out. The clear filtrate was freed of solvent by heating to 75–85° C. in vacuo. The resulting barium dimethylaminomethyl octylphenolate, represented by the formula



appeared as a dark brown, oily residue which solidified to a pasty solid on cooling which was very soluble in oil and gave the following analysis: ash, 23.5%; ash (theoretical) 23.3%.

The proportions of these multifunctional additives added to a mineral lubricating oil may vary between 0.1 and 5.0% by weight, depending upon the particular base oil used and the type of engine and service involved. However, the range of proportions between 0.25 and 2.0% by weight has been found to be particularly effective in imparting excellent detergent and anti-corrosive properties to the mineral lubricating oil.

An additional feature of the present invention is a combination of the foregoing multifunctional additives with an auxiliary additive to further enhance the anti-oxidant or anti-corrosive properties of the mineral oil composition with which the additives are used in certain Diesel and gasoline engines designed for heavy duty service. A higher degree of anti-oxidant or anti-corrosive properties is desired and it is for this purpose that an auxiliary additive ingredient is added to the compounds aforementioned.

The class of compounds which may be used to impart the additional anti-corrosive properties may be any one of the generally accepted sulfurized anti-corrosives. Among the particularly effective sulfurized anti-corrosive compounds found suitable for purposes of the invention are the sulfurized esters of oleic acid, such as sulfurized ethyl oleate; sulfurized high-boiling gasoline polymers, such as the sulfurized clay tower polymers; sulfurized fatty oils, such as sulfurized sperm oil; sulfurized wax compounds, such as sulfurized paraffin wax; sulfurized resins, such as sulfurized abietene; sulfurized tall oil and sulfurized terpene hydrocarbons, such as the sulfurized terpinolenes and isomers thereof which are disclosed and claimed in the copending application of Knowles et al., Serial No. 391,468, filed May 2, 1941. The amount of sulfurized compound added to the mineral lubricating oil in combination with the multifunctional additive is usually within the proportion range of 0.5 and 5.0% by weight and preferably between 1.0% and 3.0%, depending upon the type of lubricating oil used.

These sulfurized auxiliary additives may be prepared in accordance with the copending applications of Knowles et al., Serial Nos. 358,876, 358,877 and 358,878, respectively, all filed September 28, 1940, now Patents Nos. 2,289,437, 2,289,438 and 2,337,473, respectively, wherein a light-colored sulfurized material is prepared by the direct action of sulfur to the material to be sulfurized at approximately 300° F. in the presence of water and under pressure of hydrogen sulfide. This pressure which is at least 50 pounds per square inch, is maintained until all the free sulfur has entered into combination and lasts usually from one-half to three hours. The sulfurized products formed by this process are directly soluble in a mineral oil and possess the added advantage in that the reaction product is a light-colored compound as against the usually dark-colored sulfurized compounds.

As illustrative of the anti-corrosive properties of a lubricating oil containing either or both of the aforementioned class of compounds, the results of the following empirical tests are presented: A copper-lead bearing specimen, encased in a special non-wear bushing and rotatably mounted on a stainless steel shaft, was immersed in a glass pot of the oil to be tested. The tested oil was heated to a controlled temperature of either 250° F. or 350° F. and continuously circulated between the bearing specimen and the shaft for ten hours. The bearing specimen was weighed before the test and after the ten hour period and the loss in weight recorded in milligrams. The reference oil used was a solvent-refined, dewaxed Mid-Continent lubricating oil distillate of an SAE 30 grade. To this reference oil was added varying proportions of the additives of the present invention taken individually and in combination and the results compared. The results of two runs at both 250° F. and 350° F. are presented:

BEARING CORROSION, COPPER-LEAD (10 HOURS)

Loss of weight in mgs.

Oil Tested	250° F.	350° F.
Reference Oil	4.6	142, 177
Reference Oil plus 0.5% Barium Dimethylaminomethyl octylphenolate	0.1	
Reference oil plus 0.5% Barium Dimethylaminomethyl octylphenolate plus 3.0% sulfurized sperm oil	1.1	46, 47
Reference oil plus 0.5% Barium Dimethylaminomethyl octylphenolate plus 1.0% sulfurized terpinolene	0.0	2.2
Reference oil plus 0.5% Barium Dimethylaminomethyl octylphenolate plus 2.0% sulfurized ethyl oleate	1.0	10.8
Reference oil plus 0.5% Barium Dimethylaminomethyl octylphenolate plus 3.0% sulfurized clay tower polymers	1.0	2.2

In order to illustrate the aforementioned detergent properties of the additives of the present invention an empirical test was devised which would illustrate the ability of the multifunctional additives to disperse, remove or purge carbonaceous deposits from the engine surface of a heavily varnished engine. A heavy varnish deposit was obtained upon the piston of a single cylinder standard Lauson engine by utilizing a solvent refined dewaxed Mid-Continent lubricating oil of an SAE 10 grade and running the engine at 1800 R. P. M. with a jacket temperature of 212° F., a crankcase temperature of 300° F. and with a crankcase ventilation of 0.4 cubic feet of air per minute for 24 hours. Then, without cleaning the piston the oil was changed to the compounded oil containing the proposed additives and the engine operated at 1800 R. P. M. with a jacket temperature of 315° F., a crankcase temperature of 200° F., and with no crankcase ventilation for 20 hours. At the end of the 24 hour period the engine was dismantled, the condition of the piston noted and the oil classified according to a visual inspection of bad, fair and good. The following results were obtained with a solvent-refined, dewaxed Mid-Continent lubricating oil of an SAE 30 grade as reference oil, together with this reference oil compounded with the proposed multi-functional additives:

LAUSON DETERGENCY TEST

Oil Tested	Rating
Reference Oil	Bad.
Reference oil plus 0.6% Barium Dimethylaminomethyl octylphenolate	Fair plus.

A further illustration of the detergent properties of the multifunctional additives may be shown by the results of an empirical test which was designed to indicate the performance of the additives in preventing the accumulation or deposition of varnish or lacquer deposits on the engine parts. This test is carried out in a single cylinder standard Lauson engine by operating with the compounded oil of the present invention under extremely severe conditions for the purpose of developing varnish and lacquer. The conditions of operation attempt to simulate the severe operating conditions encountered in the field by running the engine continuously at 1800 R. P. M. for 24 hours, with the jacket temperature at 212° F., the crankcase temperature at 300° F., fuel fed at 10 cc. per 30 seconds, and a crankcase ventilation of 0.4 cubic feet air per minute. At the end of this period the engine was dismantled, the condition of the piston noted, and the oil classified according to a visual classification of A, B, C, D, and E (A=clean; B=light varnish; C=medium varnish; D=heavy varnish; and E=very heavy varnish). The following results were obtained with a solvent-refined, dewaxed Mid-Continent lubricating oil of an SAE 20 grade as the reference oil and compared with the reference oils containing a multifunctional additive.

LAUSON VARNISH TEST

Oil tested	Rating
Reference oil	E
Reference oil+0.6% Barium Dimethylaminomethyl octylphenolate	C

The multifunctional additives of the present invention may further be used in combination with other additive ingredients such as pour point depressors, oiliness agents, extreme pressure agents, blooming agents, viscosity index improving agents, color stabilizers, etc.

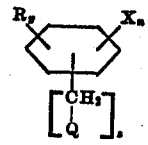
Obviously many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

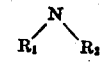
1. An improved lubricating oil comprising a mineral lubricating oil having incorporated therein a small proportion of an oil-soluble metal salt of a compound which is the reaction product of a methylol-forming aromatic compound with equimolecular quantities of formaldehyde and a secondary amine.

2. An improved lubricating oil comprising a major proportion of a mineral lubricating oil and a minor proportion of an aromatic compound containing at least one tertiary aminomethyl radical linked to the aromatic nucleus through the methylene group and at least one substituent selected from the group consisting of metal oxides and metal sulfides.

3. An improved lubricating oil adapted for use in internal combustion engines, comprising a mineral lubricating oil containing a small amount of a compound of the following general formula

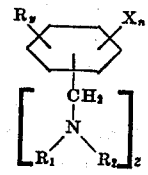


wherein R is a radical selected from the group consisting of hydrogen, alkyl, aryl, aralkyl, cycloalkyl, and naphthenyl radicals, Q is a radical selected from the group consisting of



and N-heterocyclic radicals which are bound to the methylene group through the nitrogen atom, R_1 and R_2 are selected from the group consisting of alkyl, cycloalkyl, aralkyl and naphthenyl radicals, X is a substituent selected from the group consisting of metal oxides and metal sulfides, and n, y and z are integers of at least 1.

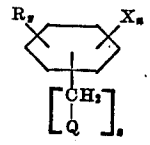
4. An improved lubricating oil adapted for use in internal combustion engines, comprising a mineral lubricating oil having incorporated therein a small proportion of a compound of the following general formula



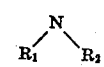
wherein R is a radical selected from the group consisting of hydrogen, alkyl, aryl, aralkyl, cycloalkyl, and naphthenyl radicals, R_1 and R_2 are selected from the group consisting of alkyl, cycloalkyl, aralkyl and naphthenyl radicals, X is a substituent selected from the group consisting of metal oxides and metal sulfides, and n, y and z are integers of at least 1.

5. An improved lubricating oil adapted for lubrication of internal combustion engines, comprising a major proportion of a mineral lubricating oil and a minor proportion of an aryl compound containing at least one tertiary amine substituent which is linked to said aryl compound through a methylene radical, and at least one substituent selected from the group consisting of metal oxides and metal sulfides.

6. An improved lubricating oil adapted for use in internal combustion engines, comprising a mineral lubricating oil containing 0.1 to 5.0% by weight of a compound of the following general formula



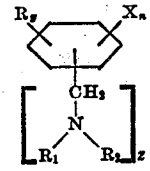
wherein R is a radical selected from the group consisting of hydrogen, alkyl, aryl, aralkyl, cycloalkyl, and naphthenyl radicals, Q is a radical selected from the group consisting of



and N-heterocyclic radicals which are bound to the methylene group through the nitrogen atom, R_1 and R_2 are selected from the group consisting of alkyl, cycloalkyl, aralkyl, and naphthenyl radicals, X is a substituent selected from the

group consisting of metal oxides and metal sulfides, and n, y and z are integers of at least 1.

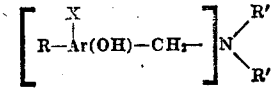
7. An improved lubricating oil adapted for use in internal combustion engines, comprising a mineral lubricating oil having incorporated therein between 0.25 and 2.0% by weight of a compound of the following general formula



wherein R is a radical selected from the group consisting of hydrogen, alkyl, aryl, aralkyl, cycloalkyl, and naphthenyl radicals, R_1 and R_2 are selected from the group consisting of alkyl, cycloalkyl, aralkyl and naphthenyl radicals, X is a substituent selected from the group consisting of metal oxides and metal sulfides, and n, y and z are integers of at least 1.

8. An improved lubricating oil composition comprising a mineral lubricating oil having admixed therewith a minor proportion of an oil soluble metal salt of an auto-condensation product obtained by reacting a secondary amine, formaldehyde, and an alkyl substituted monocyclic hydroxyaromatic compound, and then substituting the hydroxyl hydrogen in the condensed product with a metal.

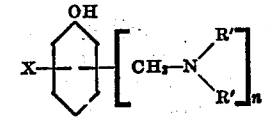
9. An improved lubricant composition comprising a mineral lubricating oil and a small proportion of an oil-soluble metal salt of a compound containing the following characteristic group:



in which R—Ar(OH) is an alkyl phenol group, X is selected from the group consisting of hydrogen

and an organic radical, and R′ is a radical selected from the group consisting of alkyl and cycloalkyl radicals.

10. An improved lubricant composition comprising a mineral lubricating oil and a small proportion of an oil-soluble metal salt of a compound containing the characteristic structure:



in which X is selected from the group consisting of hydrogen and an organic radical, R′ is selected from the group consisting of alkyl and substituted alkyl radicals, and n is a small whole number.

11. An improved lubricating oil composition comprising a mineral lubricating oil having admixed therewith a minor proportion of an oil-soluble metal salt of an auto-condensation product obtained by reacting a secondary amine, formaldehyde, and an alkyl substituted hydroxy aromatic compound, and then substituting the hydroxyl hydrogen in the condensed product with a metal.

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