

UNITED STATES PATENT OFFICE

2,366,539

LUBRICANT

Rush F. McCleary and Joseph E. Fields, Beacon,
N. Y., assignors to The Texas Company, New
York, N. Y., a corporation of Delaware

No Drawing. Application August 28, 1942,
Serial No. 456,560

20 Claims. (Cl. 252-47)

This invention relates to a new and improved lubricating composition and particularly to a hydrocarbon lubricating oil containing a new combination of additive ingredients.

The recent developments in the field of internal combustion engines designed for extremely high power outputs for extended periods of time have created such severe and exacting operating conditions as to necessitate an improvement in the refined hydrocarbon lubricating oils used in the lubricating systems thereof. The high engine speeds and high load characteristics of these engines together with the use of new bearing alloys, such as cadmium-silver, copper-lead and silver-coated bearings, have caused a rapid deterioration of the lubricating oils in service which results in a build-up of carbonaceous deposits on the pistons and cylinders, wearing and scratching of the pistons, cylinders, rings and liners, plugging of the oil rings, and corrosive attack on the bearing metals. The deterioration of the lubricating oil is manifested in the performance of the engine by ring-sticking, piston seizure, loss of compression, bearing failure, and in general by a loss of efficiency and a greatly decreased running time.

It has been proposed to eliminate one or more of these undesirable characteristics of the lubricating oil by the incorporation of various chemical compounds possessing certain improving properties. These compounds have been classified according to the properties imparted to the oil as, for example, oiliness agents, V. I. improvers, film strength agents, anti-wear agents, dispersing agents, detergents, oxidation inhibitors, corrosion inhibitors, etc. Although these addition agents improve the lubricating oil in accordance with their particular function when incorporated individually, no prediction can be made as to the degree of improvement, if any, when incorporated in combination.

The present invention is based upon the discovery of a new combination of additive ingredients which, when incorporated in a hydrocarbon lubricating oil, not only improves the oil in accordance with their individual functions but imparts a degree of improvement which is greater than the additive combination of their individual improving properties. The cooperation of the two components of the combination produces an additive composition possessing some improving

qualities which were entirely lacking in either of the components and could not be predicted from the combination thereof.

It has been found that the combination of an oil-miscible metal salt of a carbocyclic alkylol ether and an oil-miscible N-aliphatic dithiocarbamate provides an additive composition which, when incorporated in a hydrocarbon lubricating oil, provides a finished lubricating composition which possesses the improved characteristics necessary for efficient operation of an internal combustion engine. It has been found that this combination of additive ingredients imparts combined extreme pressure properties, oiliness properties, dispersing properties, detergency, oxidation stability and bearing protection to the compounded oil.

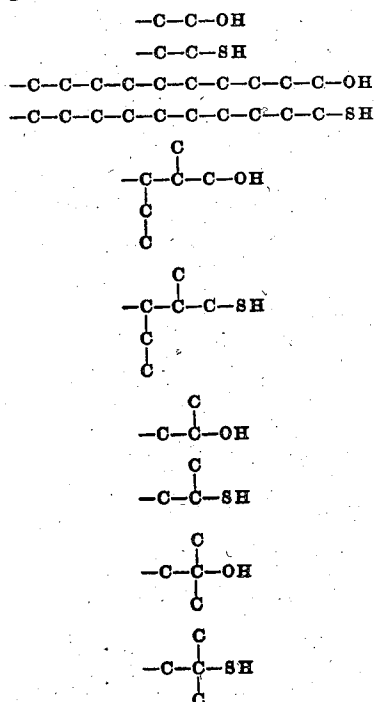
The oil-miscible metal salts of a carbocyclic alkylol ether which constitute one of the components of the combination have been generically disclosed and claimed by Rush F. McCleary in application, Serial No. 411,696, filed September 20, 1941, and application, Serial No. 418,161, filed November 7, 1941. These compounds may be more specifically described by the following type formula:



where R indicates an oil-solubilizing radical which may be an alkyl, aralkyl, cycloalkyl or naphthenyl radical; A represents a carbocyclic radical which may be either an aromatic or aliphatic radical, preferably containing one cyclic nucleus; X may be either oxygen or sulfur; Y represents a metal salt of an alkylol or a thioalkylol radical; and n and m are integers of at least one. The substituent R is preferably an aliphatic-type radical containing a sufficient number of carbon atoms to insure oil-solubility of the compounds and may be further substituted by radicals imparting additional improving qualities thereto, in the form of radicals containing such elements as phosphorus, sulfur, nitrogen, etc.

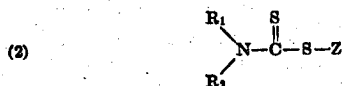
The metal salts of the alkylol radicals represented by Y comprise the salts of metals selected from groups I, II, IV and VIII of the periodic table of elements and include such metals as copper, calcium, strontium, barium, magnesium, zinc, tin, lead, iron, cobalt and nickel with preference

given to the alkaline earth metals. The alkylol and thio-alkylol radicals within the designation Y are preferably those containing from one to ten carbon atoms which may be either straight or branch chain radicals as illustrated by the following:



Among the specific compounds included in the above category which have been found to be exceptionally effective for the purposes of the present invention are calcium diamyl phenoxy ethylate, calcium diamyl cyclohexoxy ethylate, calcium cardanox ethylate (derived from cardanol $\text{C}_{20}\text{H}_{32}\text{O}$), calcium capryl phenoxy ethylate, tin diamyl phenoxy ethylate, barium diamyl phenoxy ethylate and calcium keryl phenoxy ethylate (derived from phenol alkylated with kerosene).

The other additive component, namely an oil miscible N-aliphatic dithiocarbamate, has previously been proposed as a lubricating oil additive in Patents Nos. 2,160,880 and 2,265,851. The inventions described therein embrace a broader class of compounds than is contemplated by the present invention and those included within the classification of N-aliphatic dithiocarbamates. The particular class of compounds with which the present invention is concerned are those dithiocarbamates which may be illustrated by the following type formula:



in which R_1 and R_2 are aliphatic radicals and Z represents either an ester radical such as an alkyl, aryl, aralkyl, cycloalkyl or a naphthyl radical or a metal selected from groups I, II, III, IV and VIII of the periodic table of elements. Specific examples of the metals contemplated within this classification are copper, magnesium, zinc, cadmium, aluminum, tin, lead, chromium, iron, cobalt and nickel, with preference given to tin, zinc and the iron sub-group metals.

The dithiocarbamates which have been found to be especially desirable are the metal salts

which are illustrated by Formula 2 when Z represents a metal. The metal salts are less oil-soluble than the esters and, in order to insure the oil-miscibility of the metal salts it is preferable to limit the aliphatic radicals R_1 and R_2 to such radicals whose sum ($\text{R}_1 + \text{R}_2$) contains at least six carbon atoms. This limitation, however, does not apply when Z is an ester radical and probably because sufficient oil-solubility is imparted to the compound by the ester radical itself. Among the specific compounds within this classification found to be particularly effective as a component of this additive combination are tin diamyl dithiocarbamate, zinc di (2-ethylhexyl) dithiocarbamate, zinc dibutyl dithiocarbamate, zinc octyl-butyl dithiocarbamate, zinc iso-amyl-n-amyl dithiocarbamate and benzyl diethyl dithiocarbamate.

The components of the aforementioned additive combination may be incorporated in a hydrocarbon lubricating oil in varying ratios, depending upon the type of service for which the lubricant is intended and the degree of improvement desired. For all practical purposes the amount of either component added to the hydrocarbon oil will lie within the range of 0.01-5.0% by weight of the finished lubricant. The specific range of proportions, together with the preferred range which has been found to give the maximum improvement in a few of the more important types of services, is indicated in the following table. For simplicity, the oil-miscible metal salt of a carbocyclic alkylol ether component will be represented by A, and the oil-miscible N-aliphatic dithiocarbamate component will be represented by B:

	A	B
	Per cent by weight	Per cent by weight
Heavy duty Diesel and motor oils.....	0.25-3.0 (0.75-1.0)	0.25-5.0 (0.5-0.75)
Motor oils.....	0.1-1.0 (0.2-0.5)	0.25-2.0 (0.25-1.0)
Aircraft engine oils.....	0.1-1.0 (0.2-0.5)	0.25-1.5 (0.25-0.75)

The improving qualities of this combination of additives when incorporated in a hydrocarbon oil, and particularly in a mineral lubricating oil, are apparently due to some interaction between the two component molecules which alters the chemical activity of the individual component when incorporated in a hydrocarbon lubricating oil. This has been substantiated by the behavior of these additive components in numerous tests designed to predict the degree of improvement imparted by these additives to hydrocarbon lubricating oils under actual operating conditions.

One of these tests which is called a bearing stain test, is used to determine the amount and type of film which a compounded oil will leave on the bearing surface. This type of test when used in conjunction with a corrosion test tends to indicate the behavior of the additive with respect to bearing protection in an engine. According to the procedure of this test, a $1\frac{1}{4}'' \times \frac{1}{4}''$ section was cut from a copper-lead bearing, cleaned, polished and placed in a four-ounce bottle. A sufficient amount of the test oil necessary to cover the bearing was added and the stopped bottle inserted in an oil bath and maintained at a temperature of 300° F. for six hours. At the completion of the six-hour heating period the test specimen was removed, washed in petroleum naphtha and examined. The

appearance of the bearing specimen was then observed and the amount and type of film formation indicated by the degree of discoloration of the specimen.

This test was carried out with a solvent-refined, dewaxed Mid-Continent lubricating oil of an SAE 30 grade as the reference oil, together with the reference oil containing small amounts of calcium diamyl phenoxy ethylate and zinc dibutyl dithiocarbamate individually and in combination. The results of this test are indicated in the following table in which the symbol A_1 represents calcium diamyl phenoxy ethylate and B_1 represents zinc dibutyl dithiocarbamate:

COPPER-LEAD BEARING STAIN TEST—300° F.

A_1	B_1	Bearing condition
Per cent 0.25	Per cent 0.25	Golden stain on part of bearing.
0.25	0.25	Very dark peacock stain to gray coating.
0.75	0.5	Clean-bright copper appearance.
		Do.

The foregoing test results indicate that although each of the individual components stains the bearing specimen, the combinations thereof provide a clean bearing. This test cannot be used to predict the degree of bearing protection afforded by the additives but gives an indication of whether or not the bearing protection, if any, is a function of the film formation.

In order to show the bearing protection or anti-corrosive properties of the additives, the experimental oils are subjected to an empirical test designed to simulate actual corrosive conditions in an internal combustion engine. This test was conducted in an apparatus consisting of a copper-lead bearing specimen encased in a special non-wearing bushing, rotatably mounted on a stainless steel shaft, and immersed in a glass pot of the oil to be tested. This oil was heated to a controlled temperature of 350° F. and continuously circulated between the bearing specimen and the shaft for a period of 10 hours. Throughout the test the oil was continuously maintained in a turbulent flow by copper baffles which acted

represents zinc dibutyl dithiocarbamate, and B_2 represents zinc dioctyl dithiocarbamate:

BEARING CORROSION-COPPER-LEAD

(10 HOURS)

Loss of weight—Mgs.

Reference oil	242-222
Reference oil+0.5% A_1	283
Reference oil+0.25% B_1	66
Reference oil+0.5% B_2	142-107
Reference oil+0.5% A_1 +0.25% B_1	1-2
Reference oil+0.5% A_1 +0.5% B_2	1-1

As indicated by the results of the foregoing corrosion test, the "A" component when incorporated individually in the oil is considerably more corrosive than the reference oil and the "B" components, taken individually, are still moderately corrosive. However, in spite of the corrosive tendencies of the individual components, the combinations thereof render the oil substantially non-corrosive.

A test of this additive combination was also made in a single cylinder high speed CFR engine which is used to determine the detergency of aircraft engine oils under conditions which correlate actual service operation. This engine was operated for 50 hours at 1800 R. P. M. with a compression ratio of 6.5:1, a manifold pressure of 40 inches mercury absolute, a jacket temperature of 285° F., and with an oil pressure of 100 pounds per square inch. The lubricating system was initially charged with seven pounds of oil, which was drained to a five pound level every ten hours, and two pounds of new oil added. At the end of the fifty hour test period the piston was removed and examined. The reference oil in this test was a commercial uninhibited aircraft engine oil having a Saybolt viscosity of 120 at 210° F. The results obtained from the reference oil were then used in comparison with the reference oil containing varying proportions of the individual additive components, together with combinations thereof. The results are indicated in the following table where A_1 represents calcium diamyl phenoxy ethylate and B_1 represents zinc dibutyl dithiocarbamate:

HIGH SPEED CFR DETERGENCY TEST

Piston condition

Reference oil	93% of piston skirt area covered with medium heavy black lacquer. Granular deposits in 1 and 2 ring grooves. Black lacquer in Nos. 3 and 4 ring grooves. All lands covered with black lacquer.
Reference oil+0.25% A_1	60% of piston skirt area covered with medium black lacquer. Granular deposits in No. 1 groove. Black lacquer in Nos. 2, 3 and 4 grooves. All rings lands covered with black lacquer.
Reference oil+1.5% B_1	94% of piston skirt area covered with heavy black tarry lacquer. Granular deposits in Nos. 1 and 2 ring grooves. Black lacquer in Nos. 3 and 4 ring grooves. All lands covered with black lacquer. Valve stem covered with black lacquer.
Reference oil+1.0% B_1	80% of piston skirt area covered with heavy black tarry lacquer. Granular deposits in Nos. 1 and 2 ring grooves. Black lacquer in Nos. 3 and 4 ring grooves. All lands covered with black lacquer. Valve stem covered with black lacquer.
Reference oil+0.25% A_1 +0.5% B_1	69% of piston skirt area covered by very thin golden lacquer. Ring grooves exceedingly clean. Valve stem clean. Light black lacquer only in Nos. 1, 2 and 3 ring grooves. Brown lacquer in No. 4 ring groove. Black lacquer on Nos. 1 and 2 ring lands. Brown lacquer on No. 3 ring land.
Reference oil+0.25% A_1 +0.25% B_1	59% of piston skirt area covered by very thin golden lacquer. Ring grooves very clean. Light sooty deposit in No. 1 ring groove, black lacquer on Nos. 1 and 2 ring lands and brown lacquer on No. 3 ring land. Valve stem clean.

as oxidation accelerators. The bearing specimen was weighed before the test and after the 10 hour period and the loss of weight recorded in milligrams. The reference oil used in this test was a solvent-refined, dewaxed aircraft engine oil having a Saybolt viscosity of 120 at 210° F. The results obtained on the reference oil were then used as a comparison test against the reference oil compounded with the individual additive components and with combinations thereof. The results obtained are indicated in the following table in which the symbol A_1 represents calcium diamyl phenoxy ethylate, B_1 rep-

As the results of this test indicate, the uncompounded aircraft engine oils possess the tendency of coating almost the entire piston area with a heavy black lacquer which builds up to a considerable thickness and is not easily removed in service. These oils also deposit granular carbonaceous deposits in the ring grooves, particularly in the first two or three ring grooves, which seriously reduce the operating periods of the engine and usually result in ring sticking. By the addition of a small portion of component "A" the amount of lacquer formation is decreased, but the type of lacquer still remains the

same as that produced by the reference oil. The deposits in the ring grooves are similar to those of the reference oil in that granular carbonaceous deposits are still found in the top ring grooves.

When adding small amounts of component "B" to the reference oil the type of lacquer formed on the piston is changed to a heavy black lacquer, a part of which is of a viscous tarry nature and may be wiped off to a considerable extent. Although this type of lacquer is not as hard as that formed by the reference oil or by the reference oil containing component "A," it still covers a major portion of the piston area and the valve stem.

When the components "A" and "B" are used in combination and incorporated in the reference oil an exceedingly clean piston results. The type of lacquer formation is different from that formed by the reference oil or by the reference oil containing each of the components individually. This lacquer is a very thin golden film, actually covering a very small portion of the piston area. In some of the test runs on this combination there was no evidence of any granular carbonaceous deposits in the top ring grooves and only a thin black to brown lacquer formation in the remaining grooves.

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.

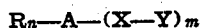
We claim:

1. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether, said alkylol radical containing from one to ten carbon atoms, said carbocyclic radical being selected from the group consisting of aromatic and alicyclic radicals 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate.

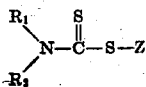
2. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible alkaline earth metal salt of a carbocyclic alkylol ether and 0.01-5.0% by weight of an oil-miscible metal salt of an aliphatic dithiocarbamic acid.

3. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil miscible alkaline earth metal salt of a carbocyclic alkylol ether and 0.01-5.0% by weight of an oil-miscible metal salt of a dialkyl dithiocarbamic acid.

4. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:

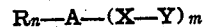


in which R is an oil-solubilizing radical; A is a carbocyclic radical; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of metal salts of alkylol and thio-alkylol radicals; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:

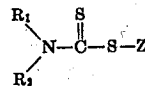


in which R₁ and R₂ are aliphatic radicals, the sum of which contains at least six carbon atoms, and Z is an ester radical selected from the group consisting of aryl, aralkyl, cycloalkyl, and naphthyl radicals.

5. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:

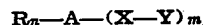


in which R is an aliphatic radical; A is a carbocyclic radical selected from the group consisting of aromatic and alicyclic radicals; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of metal salts of alkylol and thio-alkylol radicals; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:

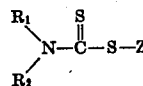


in which R₁ and R₂ are aliphatic radicals, the sum of which contains at least six carbon atoms and Z is a metal.

6. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:

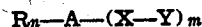


in which R is an aliphatic radical; A is a carbocyclic radical; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of alkaline earth metal salts of alkylol and thio-alkylol radicals; n and m are integers of at least 1; and 0.1-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:

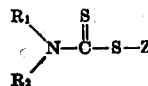


in which R₁ and R₂ are aliphatic radicals, the sum of which contains at least six carbon atoms, and Z is a metal.

7. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:



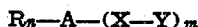
in which R is an aliphatic radical; A is a carbocyclic radical; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of alkaline earth metal salts of alkylol and thio-alkylol radicals, said alkylol or thio-alkylol radicals containing from one to ten carbon atoms; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:



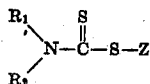
in which R₁ and R₂ are aliphatic radicals, the sum of which contains at least six carbon atoms, and Z is a metal.

8. A lubricating composition comprising a hy-

drocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible alkaline earth metal salt of a carbocyclic alkylol ether of the following general formula:

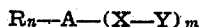


in which R is an oil-solubilizing radical; A is a carbocyclic radical; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of alkaline earth metal salts of alkylol and thio-alkylol radicals; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:

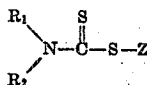


in which R_1 and R_2 are aliphatic radicals, and Z is a metal.

9. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:

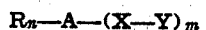


in which R is an oil-solubilizing radical; A is a carbocyclic radical; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of metal salts of alkylol and thio-alkylol radicals; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:

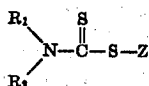


in which R_1 and R_2 are aliphatic radicals, and Z is a metal from the class consisting of tin, zinc and the iron sub-group metals of the periodic table of elements.

10. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:

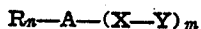


in which R is an aliphatic radical; A is a carbocyclic radical; X is oxygen; Y is a metal salt of an alkylol radical, said alkylol radical containing from 1 to 10 carbon atoms; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:



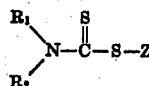
in which R_1 and R_2 are aliphatic radicals, the sum of which contains at least 6 carbon atoms, and Z is a metal.

11. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:



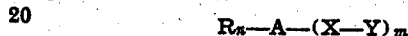
in which R is an aliphatic radical; A is a carbocyclic radical; X is oxygen; Y is a metal salt of

an alkylol radical, said alkylol radical containing from 1 to 10 carbon atoms; n and m are integers of at least 1; and 0.1-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:



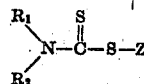
10 in which R_1 and R_2 are aliphatic radicals, the sum of which contains at least 6 carbon atoms, and Z is a metal from the class consisting of tin, zinc and the iron sub-group metals of the periodic table of elements.

15 12. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:



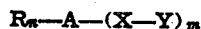
in which R is an aliphatic radical; A is a carbocyclic radical selected from the group consisting of aromatic and alicyclic radicals; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of metal salts of alkylol and thio-alkylol radicals; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:

25 30



35 in which R_1 and R_2 are aliphatic radicals, the sum of which contains at least six carbon atoms, and Z is an ester radical.

13. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:

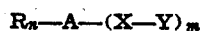


45 in which R is an aliphatic radical; A is a carbocyclic radical; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of alkaline earth metal salts of alkylol and thio-alkylol radicals; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:



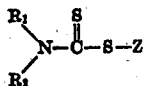
in which R_1 and R_2 are aliphatic radicals, the sum of which contains at least six carbon atoms, and Z is an ester radical.

14. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:



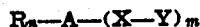
in which R is an aliphatic radical; A is a carbocyclic radical; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of alkaline earth metal salts of alkylol and thio-alkylol radicals, said alkylol or thio-alkylol radicals containing from one to ten carbon atoms; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-

miscible N-aliphatic dithiocarbamate of the following general formula:

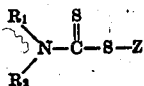


in which R_1 and R_2 are aliphatic radicals, the sum of which contains at least six carbon atoms, and Z is an ester radical.

15. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:



in which R is an aliphatic radical; A is a carbocyclic radical; X is oxygen; Y is a metal salt of an alkylol radical, said alkylol radical containing from 1 to 10 carbon atoms; n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:



in which R_1 and R_2 are aliphatic radicals, the sum of which contains at least six carbon atoms, and Z is an ester radical.

16. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible alkaline earth metal salt of an aliphatic phenoxy ethanol, and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate.

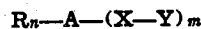
17. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of

0.01-5.0% by weight of an oil-miscible alkaline earth metal salt of a carbocyclic alkylol ether, and 0.01-5.0% by weight of a zinc salt of a dialkyl dithiocarbamic acid.

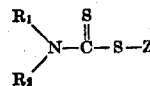
18. A lubricating composition comprising a mineral lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible alkaline earth metal salt of a dialkyl phenoxy ethanol, and 0.01-5.0% by weight of an oil-miscible zinc salt of a dialkyl dithiocarbamic acid.

19. A lubricating composition comprising a hydrocarbon oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether, and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate.

20. A lubricating composition comprising a hydrocarbon lubricating oil and the combination of 0.01-5.0% by weight of an oil-miscible metal salt of a carbocyclic alkylol ether of the following general formula:



in which R is an oil-solubilizing radical; A is a carbocyclic radical; X is an element from the group consisting of oxygen and sulfur; Y is a radical from the group consisting of metal salts of alkylol and thio-alkylol radicals, n and m are integers of at least 1; and 0.01-5.0% by weight of an oil-miscible N-aliphatic dithiocarbamate of the following general formula:



in which R_1 and R_2 are aliphatic radicals, and Z is a metal.

RUSH F. McCLEARY.
JOSEPH E. FIELDS.