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LUBRICANT AND ADDITIVES THEREFOR

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This invention has to do with lubricating compositions and with a combination of additives therefor.

It is known that a variety of materials can be dispersed in lubricating oils to impart desirable improvements thereto. Calcium acetate is one such material. It is particularly advantageous in regard to load-carrying ability and antiwear properties. Because of its acid-neutralizing ability, calcium acetate is a particularly desirable additive for lubricating oils used in engines operated on high sulfur-content fuels, such as marine diesel engines.

Simple dispersions of calcium acetate in lubricating oil, however, are unstable, the calcium acetate separating out during transportation and/or storage of the oil composition. In order to overcome this problem and obtain insofar as possible the advantages provided by calcium acetate, particularly in fluid lubricants such as marine diesel oils, it has been the practice to employ emulsion type oils, i.e., those formed by emulsifying a water solution of calcium acetate with lubricating oil. These emulsion oils, however, have not been entirely satisfactory. Thus, due to their water contents, they tend to increase the corrosion problem and they are unstable under the varying conditions encountered in storage and use. For example, the high temperatures encountered during storage in the engine rooms of ships tend to break the emulsion. On the other hand, under the low temperature conditions often encountered in cold climates, the aqueous phase can become frozen so that the emulsion is destroyed.

Present day, large marine diesel engines operate under rigorous conditions and impose severe demands upon lubricating oils used therein. Specifically, clogging of cylinder exhaust ports is a serious problem. As more of the ports become clogged, lubrication efficiency is reduced and, ultimately, failure of one or more engine parts—such as piston rings—results. Not only is the extent of port clogging of importance, but so, too, is the nature of the deposits formed by decomposition or degradation of the oil used to lubricate the cylinders and of one or more of the additives generally present in the oil. Tacky, varnish-like deposits are difficult to remove from the engine and cause wear on moving engine parts, such as pistons; whereas, soft grease-like deposits are not disadvantageous.

It will be appreciated, therefore, that stable dispersions of calcium acetate in lubricating oil would be of considerable value, since such a "single-phase" oil avoids the aforementioned disadvantages of an emulsion type oil. Still of further value, however, would be such stable dispersions so fortified that port deposits and wear on engine parts, as described above, are minimized. It is with such stable dispersions of calcium acetate and lubricating compositions containing the same that this invention is concerned.

It is an object of the present invention, therefore, to provide lubricating compositions capable of effectively lubricating machinery operated under rigorous conditions. A particular object of the invention is to provide lubricating compositions effective in large marine diesel engines without formation of substantial cylinder port deposits and with minimal wear of engine parts. Another object is to provide such compositions characterized also by load carrying characteristics (ability to withstand extreme pressures) and capacity to neutralize sulfur-containing acids formed during the combustion of high-sulfur fuels in

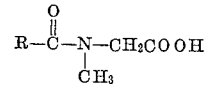
diesel engines. Still another object of the invention is to provide mineral oil concentrates containing particularly effective combinations of additives for use in lubricant compositions. A further object of the invention is to provide new compositions of matter comprising combinations of additives which can be incorporated in lubricating oils to enhance the lubrication value thereof. Additional objects will be apparent from the following description.

In a study to develop a single phase lubricating oil which could be used in large marine diesel engines with only low port deposit formation, while also affording excellent load-carrying characteristics and desirable neutralization of sulfur-containing acids formed during combustion of high-sulfur fuels, it has been found, surprisingly, that extremely low wear of engine parts is realized in addition to achieving the aims of the study, when particular combinations of additives, including calcium acetate, are used in lubricating oils. The new oil compositions so discovered, and forming the basis of this invention, comprise:

(a) A major proportion of a mineral lubricating oil,

(b) From about 1 to about 20 percent by weight of the composition of calcium acetate,

(c) From about 0.01 to about 3 percent by weight of the composition of a N-acyl-substituted sarcosine compound of the formula



wherein R represents an aliphatic hydrocarbon radical of from 8 to 24 carbon atoms,

(d) From about 0.1 to about 10 percent by weight of the composition of an oil-soluble metal sulfonate, and

(e) From about 0.1 to about 5 percent by weight of the composition of an oil-soluble, phosphorus- and sulfur-containing reaction product obtained by reaction at a temperature between about 100° C. and about 160° C. of substantially one mole of a phosphorus sulfide and four moles of a material selected from the group consisting of a dicyclic terpene and an essential oil predominantly comprised of a dicyclic terpene.

Contemplated herein also are oil concentrates containing the additives identified as (b) through (e), immediately above, and new compositions of matter comprising combinations of said additives (b) through (e).

Proportions of the additives are of importance in order to obtain the unusual and unexpected combination of desirable results therewith. In this connection, calcium acetate (b) should be present in the oil compositions in concentrations of at least about 1 percent by weight, otherwise the compositions have inadequate load carrying capacity (extreme pressure characteristics). Correspondingly, the maximum concentration of calcium acetate in the oil compositions should not exceed about 20 percent by weight thereof, to avoid excessively high viscosity of the compositions and formation of grease or gel structures. Preferred concentrations of acetate are from about 2 to about 8 percent by weight. With respect to the sarcosine compound (c), concentration can vary between about 0.01 to about 3 percent by weight, with a preferred approximate range of 0.1 to 1. In general, larger amounts of the sarcosine compound are used with larger amounts of calcium acetate, and smaller with smaller amounts of the latter. The metal sulfonate (d) concentration ranges from about 0.1 to about 10 percent by weight, and preferably 1 to 5. Here again the concentration of the sulfonate is related to the concentration of the acetate, e.g. larger amounts of sulfonate accompanying larger amounts of acetate. The use of insufficient concentrations, or of

excess, sulfonate is to be avoided, lest inferior compositions be formed. That is, dispersions may be unstable and show sedimentation, or viscosity control may be vitiated. And the concentration of the reaction product (e) is controlled between about 0.1 to about 5 percent by weight of the oil compositions; the preferred range is 1 to 3. Here, too, insufficient reaction product leads to higher wear rate and too large a concentration causes poor water resistance properties.

The total quantity of additives (b) through (e) in the oil compositions of this invention, therefore, will range from about 1 to about 35 percent by weight. In marine diesel engine oils, particularly those operated on high sulfur content (1–5 percent sulfur) fuels, the total quantity is generally at the higher end of the range, namely, 15 to 25 percent. While emphasis has been placed here on oil composition for marine diesel engines, it is to be understood that the new oil compositions can be used to lubricate other equipment. For example, oils designed for lubrication of small 2-stroke diesel engines operating on low-sulfur fuel (up to 1%) will contain a total of 1 to 6 percent of additives (b) through (e).

As pointed out above, oil concentrates are also contemplated by this invention. Thus, much less oil can be used with the combination of additives than in oil compositions in condition for use in an engine, to form a concentrate and the concentrate can thereafter be diluted with additional oil to form the desired oil compositions. Concentrates are particularly desirable since they can be prepared in one refinery or related plant and can then be shipped to other localities where such facilities are lacking but where blending equipment is available. Considerable savings in transportation and equipment costs can be realized. A further extension of this feature is that of preparing mixtures of the additives free of oil and transporting the mixtures to locations where they can be incorporated in oil for formation of the desired oil compositions. In the mixtures, the parts by weight of the several additives are as follows:

	Broad Range	Preferred Range
(b) Calcium acetate	80–95	80–85
(c) Sarcosine compound	1–10	2–8
(d) Sulfonate	1.0–20	5–15
(e) Reaction product	0.1–10	3–5

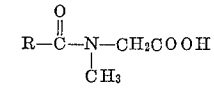
It is to be understood that the amount of each additive set forth throughout this application is expressed on an oil-free basis, unless otherwise specified.

Lubricating oils (a) contemplated herein can vary widely in origin and characteristics. Naphthenic base, paraffin base, Coastal base, and mixed base mineral oils are representative. Other hydrocarbon lubricants include lubricating oils derived from coal products and alkylene polymers such as polymers of propylene, butylene, etc., and mixtures thereof. Synthetic oils other than composed of hydrogen and carbon include: alkylene oxide polymers, dicarboxylic acid esters, liquid esters of phosphorus, polypropylene glycol, di-(2-ethyl hexyl) sebacate, di-(2-ethyl hexyl) adipate, trimethylolpropane tricaprylate and related esters of pentaerythritol, neopentyl glycol, and the like. In general, the hydrocarbon oils and synthetic vehicles which can be used herein are characterized by a viscosity (S.U.S.) of greater than 70 seconds at 38° C. (100° F.), preferably from 100 to 2000 seconds at 38° C. Outstanding for use in the oil compositions particularly adapted for large marine diesel engines are solvent-refined Coastal oils, and mixtures thereof, having viscosities of 150–700 seconds at 38° C.

The quantities of lubricating oil, or oils (a), in the oil compositions are of the order of about 65 to about 99 percent by weight, and preferably 75 to 85. It follows that the oil concentrates of this invention will contain lesser quantities of the oil, or oils (a), than the oil compositions. Generally, the oil concentrates will contain 30 to 60 percent by weight of oil.

Calcium acetate, (b) above, used herein can be anhydrous or hydrated. The calcium acetate can be either preformed or it can be formed in situ in a suitable oil.

The N-acyl-substituted sarcosines, (c) above, utilized herein are represented by the formula:



wherein R represents an aliphatic hydrocarbon radical having from 8 to 24 carbon atoms and which can be either saturated or unsaturated. Typical examples are the following sarcosines:

N-pelargonyl	N-oleyl
N-undecyloyl	N-linoleoyl
N-lauroyl	N-arachidoyl
N-myristoyl	N-behenoyl
N-palmitoyl	N-hyenoyl
N-stearoyl	

Several N-acyl-substituted sarcosines are available commercially under the trade name "Sarkosyl," for example, "Sarkosyl–L" (lauroyl sarcosine), "Sarkosyl–O" (oleyl sarcosine) and "Sarkosyl–S" (stearoyl sarcosine).

Preferred for the compositions of this invention is oleyl sarcosine.

All oil-soluble metal sulfonates, (d) above, are contemplated by this invention. This sulfonic acids used in forming the sulfonates include oil soluble petroleum sulfonic acids and synthetic alkaryl sulfonic acids, particularly those having higher molecular weights, i.e., from about 300 to about 800. These sulfonic acids may be produced by sulfonation of petroleum stocks or synthetic alkyl aromatic compounds, such as alkyl-substituted benzenes or naphthalenes wherein the alkyl groups attached to the aromatic ring contain from at least about 8 to about 24, or more, carbon atoms. Specific synthetic sulfonic acids are, for example, octyl benzene sulfonic acid, dodecyl benzene sulfonic acid, dioctyl benzene sulfonic acid, octadecyl benzene sulfonic acid, wax benzene sulfonic acid and wax naphthalene sulfonic acid.

All metals are contemplated herein as constituents of the sulfonates. Most suitable are calcium, barium and magnesium. When the metal constituent is polyvalent, basic as well as neutral metal sulfonates can be formed; all serve the purposes of this invention. Preferred is a slightly basic calcium petroleum sulfonate.

The oil-soluble, phosphorus- and sulfur-containing reaction products (e) above, contemplated herein are those obtained by reacting a dicyclic terpene and a phosphorus sulfide at a temperature above about 100° C. Although any one of the several phosphorus sulfides such as P_3S_6 (or PS_2), P_4S_6 (or P_2S_3), P_4S_3, P_2S_5 (or P_4S_{10}), P_4S_7, etc., may be used in the preparation of the said reaction products, particularly preferred are those reaction products obtained from P_2S_5.

"Dicyclic terpenes" are defined herein as those terpenes which are characterized by the presence of one double bond in the molecule and which are comprised of two ring systems. Typical of such terpenes are pinene, camphene and fenchene. Contemplated as coming within this particular designation are those materials which are predominantly comprised of one or more dicyclic terpenes; representative of such materials are the essential or volatile oils which are predominantly comprised of such a terpene, or terpenes, and are typified by turpentine oil, the predominant constituent of which is pinene. Preferred of the dicyclic terpene reactants are pinene and turpentine oil. Accordingly, the preferred reaction products are those obtained from P_2S_5 and pinene and from P_2S_5 and turpentine oil.

Further details of the reaction products (e) are provided in U.S. Patent No. 2,416,281 of Henry G. Berger

et al. and reference is made herein to the patent disclosure.

In preparing the oil compositions of the invention, a stabilized dispersion of the calcium acetate, employing the sarcosine compound as the stabilizing agent, is prepared separately. This is accomplished by intimately mixing the several components, i.e., oil, calcium acetate and sarcosine, preferably in a Manton-Gaulin Homogenizer operated at a pressure of from about 1000 to about 5000 p.s.i. The other components, including additional oil, if desired, are then mixed with the stabilized dispersion at temperatures ranging from 20 to 100° C., and preferably about 90–100° C.

Examples illustrating and in no sense limiting the invention are given below. All parts are by weight in the examples unless otherwise specified.

ILLUSTRATIVE EXAMPLES

Example 1

Mineral oil, 57 parts, and calcium acetate, 40 parts, and oleoyl sarcosine, 3 parts, were charged to a grease kettle equipped with a paddle type mixer, in the order specified. The resulting mixture was heated with stirring to 138° C., held at this temperature for 20 minutes and cooled with continued agitation to room temperature (about 25° C.). It was then homogenized when passed once through a Manton-Gaulin Homogenizer operated at 3000 pounds per square inch (p.s.i.). The resulting highly stable dispersion of calcium acetate is identified hereinafter as Product 1.

The mineral oil used was a solvent-refined naphthenic (Coastal) oil having a viscosity (S.U.S.) of 500 seconds at 38° C. Calcium acetate contained 6 percent of water, i.e., approximately 2/3 mole water of hydration.

Example 2

A Mid-Continent distillate of 95 seconds Saybolt viscosity at 38° C. was treated with oleum, the resulting sludge was settled and removed, and the oil layer which formed was neutralized with caustic soda solution. The sodium sulfonates thus formed were recovered by adding ethyl alcohol, separating the resulting alcohol layer, and then evaporating off the alcohol. This left a mixture of oil and sodium sulfonates. This mixture was then reacted with a water solution of barium chloride. After separation of the oil layer and drying, the resulting oil solution of barium petroleum sulfonate (Product 2) contained 6.9% barium and 2.5% sulfur.

Example 3

A mineral oil solution of a slightly basic calcium petroleum sulfonate (about 40% active ingredient), identified hereinafter as Product 3, was used. This material has the following properties:

Gravity, °API	15.6
Flash point, ° C.	243
S.U.S. @ 99° C., secs.	1100
Calcium, weight percent	1.7
Sulfur, weight percent	2.7
Base number	8.0

Example 4

Eight hundred (800) parts by weight of pinene and an equal weight of motor oil (Saybolt Universal Viscosity of 45 seconds at 99° C.) were heated at 105° C. with stirring. Three hundred and twenty-six (326) parts of P_2S_5 (a ratio of 4 moles of pinene to 1 mole of P_2S_5) were added slowly, the temperature rising to 115° C. because of the exothermic reaction. The mixture was then heated and the resultant mixture was filtered. The filtrate, consisting of 1842 parts by weight, was then vacuum topped at 5 mm. pressure to a pot temperature of 150° C. The residue consisting of 1963 parts by weight was a clear, viscous oil—Product 4—containing 12.5% sulfur and 5.1% phosphorus.

Example 5

A marine diesel engine oil composition was formed by using the products of Example 1, 3 and 4. The oil composition was formulated from:

	Parts
Solvent-refined Coastal oil:	
55–60 S.U.S. at 99° C.	78
150–160 S.U.S. at 99° C.	5
Product 1 ($CaAc_2$—sarcosine)	14
Product 3 (sulfonate)	2
Product 4 (P_2S_5—pinene)	1

The oils and the several Products were initimately mixed in a blending tank at about 90° C. for about 2 hours. A clear oil composition—Product 5—having the following properties was so formed:

Gravity, °API	21.5
S.U.S. @ 38° C.	1242
S.U.S. @ 99° C.	95
Viscosity index	88
Total base number (TBN)	40

Example 6

Another diesel engine oil composition was formed with the products of Examples 1, 3, and 4. The formulation is given below:

	Parts
Paraffinic-distillate neutral oil, 46.5 S.U.S. at 99° C.	70
Mid-Continent neutral oil, 90 S.U.S. @ 99° C.	13
Product 1 ($CaAc_2$—sarcosine)	14
Product 3	2
Product 4	1

All components were charged to a blending tank, were heated to about 82° C., and were agitated thoroughly until a homogeneous composition was obtained. Properties of the composition—Product 6—so prepared, are:

Gravity, °API	22.0
S.U.S. @ 38° C.	1200
S.U.S. @ 99° C.	95
Total base number (TBN)	40

TEST DATA

Product 5 was subjected to several tests in order to determine its effectiveness as a cylinder lubricant for large marine diesel engines. It was so tested on a strictly comparable basis with a widely used, commercial, high-grade marine diesel oil containing a carbonated basic, calcium sulfurized alkyl phenate. The latter oil is identified herein as Commercial Oil A. Results of the several tests are provided below.

Accelerated diesel engine test.—This is a severe CFR diesel engine test. The engine is run under such conditions as: high sulfur fuel; sooty combustion; and a very high blowby level in order to accelerate oil contamination by the soot and by acidic blowby gases. The tests were made on S.A.E. 40 grade oils. The engine used is a single cylinder, four stroke cycle CFR engine modified with a Comet Diesel head; bore 3¼ inches; displacement, 37.3 cubic inches; compression ratio, 17:1; horsepower output, 6; and crankcase oil, 2500 milliliters plus 1000 milliliters for the filter.

Operating conditions of the test include:

R.p.m.	1800.
Supercharging	50" Hg absolute, intake air pressure.
Intake air temp. °C.	93.
Fuel rate, lb./hr.	5.8.
Smoke level	6.
Blowby	[1] 55–60 c.f. hr.

[1] High blowby obtained by using four scraper compression rings and a ventilated oil ring.

Coolant temp. °C.	100.
Oil temp. °C.	107.
Filtration system	By-pass.
Filter type	Cotton waste.
Make-up oil, ml./10 hrs.	75.
Test duration	80 hrs.

Test fuel: Special diesel fuel (7% CCR, 2% S)
Break-in procedure: 3 hr. break-in with base oil and No. 2 fuel
Filter disconnected during break-in. Oil changed and filter connected before test.

At the beginning and at the end of each test, inspection is made of the cylinder to determine whether there has been any wear of the cylinder bore surface.

Results of the tests made with several oils are given in Table I below.

TABLE I

	Commercial Oil A	Product 5
Bore Parallel to Pin: Minimum Wear, mils	1.3	0.2
Bore Perpendicular to Pin: Maximum Wear, mils	2.6	1.2

It is evident from the results shown in Table I that a significant improvement is obtained with Product 5.

Radioactive piston ring wear test.—This permits measurement of piston ring wear rates in a relatively short period of time as no disassembly of the engine for inspection and wear measurement is required. Briefly, the procedure is as follows. The rings used are made from a single melt of metal. They are activated to a level of approximately 2.5 millicuries per ring. Iron 59 is the salient radioactive isotope produced.

The engine used is a Bolnes type L diesel engine. It is a two-cylinder, two stroke, single acting diesel engine fitted with a cross-head piston which acts as a scavenge pump and with a Brown-Boveri exhaust gas turbo-charger. The engine is equipped to burn light diesel fuel and heavy residual fuels. In the tests reported here, a residual fuel, sulfur content of 3.75%, was used. The cylinder bore is 7.480 inches and the stroke is 13.75 inches. Using special tools and equipment to protect against radiation hazards, a radioactive piston ring is installed as the top compression ring in the No. 2 cylinder of the engine where the highest pressures, temperatures and wear are encountered.

During the operation of the engine, the radioactive iron worn from the piston ring is carried by the oil to radiation detection equipment which is activated by gamma radiation (from iron 59) from ring debris in the circulating oil. The pulses generated are received by a ratemeter and are translated to counts per minute (c.p.m.) which, in turn, are recorded as an integrated graph of c.p.m. versus time. Wear rates can be converted to absolute wear in milligrams per unit of time. To do this, a weighed segment of a piston ring irradiated at the same time as the test ring is first converted to an oil-soluble salt, such as iron naphthenate. An oil blend of this salt is then circulated to the detector to determine the c.p.m. per milligram of iron present. A standard curve for decay of iron 59 is drawn, based on a 46.3 day half life. By comparing the c.p.m./milligram for the test oil and the c.p.m./m. of iron 59 in the iron naphthenate blend, a value of wear expressed in milligrams of iron per minute can be assigned to the test oil. For purposes of comparison, absolute wear rate values are generally converted to milligrams (of iron) per hour. Results are set forth in Table II below.

TABLE II

	Wear rate, mgs./hr.
Commercial Oil A	6.6
Product 5	3.4

As indicated, the wear rate obtained with Product 5 is only about one-half of the rate obtained with Commercial Oil A.

Sea trial.—Product 5 was also tested for an extended period of time in the cylinders of diesel engines of a commercial motor ship routed between Europe and North America. This is a ship of 16,300 tons capacity, equipped with a main diesel engine. The engine is a Fiat, 7-cylinder, 757S, 2 stroke, single-acting, supercharged, cross-head, marine diesel. Significant operating conditions observed by regular record keeping were:

Engine output, H.P.	5900–6900
Speed, r.p.m.	122–128
Cylinder port temperature, °C.	285–310
Exhaust collector temperature, °C.	310
Cylinder feed rate:	
kg./cyl./hr., approx.	1
g./H.P./hr., approx.	1

Product 5 was used to lubricate cylinders 3, 4 and 5 of one of the engines, and Commercial Oil A was used in cylinders 6 and 7 of the same engine. The amount and type of exhaust port deposits formed were rated visually at the end of several voyages, totaling over 1450 hours. Test results are reported in Table III, below.

TABLE III

Oils	Product 5			Commercial Oil A	
Cylinder No.	3	4	5	6	7
Hours of Operation	1,452	1,452	1,452	1,452	1,452
Average Port Clogging, percent	6	5	8	17	15

Another sea trial of Product 5 in comparison with Commercial Oil A in the same motor ship is summarized in Table IV, following, wherein average exhaust port clogging is reported.

TABLE IV

Hours of Lubrication	Average Exhaust Port Clogging, percent	
	Product 5	Commercial Oil A
200	6	
300		12
425		14
500	6	
710		21
780	11	
1000		17
1200	7	
1400		[a]18
1550	7	

[a] Ports cleaned mechanically after 1400 hours.

Data given in Tables III and IV reveal a substantial superiority of Product 5 over Commercial Oil A. Port clogging is reduced substantially. This constitutes a major commercial advantage since "down-time" for engine maintenance purposes represents a loss of about $10,000 per day for a shipowner; less port clogging, of course, requires less "down-time" for clean-out.

In several other comparative tests wherein determinations were made of antiscuffing and load carrying properties, and oxidation resistance at 163° C. for 40 hours, Product 5 was found to be significantly superior to Commercial Oil A, and to other commercially available products.

It is to be underestood that additional additives can also be present in the oil compositions, oil concentrates and additive combinations described and claimed herein.

For example, pour point depressants, viscosity index improvers, rust preventatives, other detergents, such as ashless detergents, defoamants, etc., can be used in customary concentration. As a particular illustration, a small amount (about 0.0004 percent by weight) of a defoamant, Dow Corning Fluid 200, a silicone composition, can be used in Product 5 to inhibit foam formation.

Although the invention has been described herein by means of certain specific embodiments and illustrative examples, it is not intended that it be limited in any way thereby, but only as indicated in the following claims.

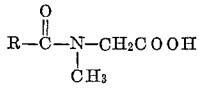
We claim:

1. A lubricating oil composition consisting essentially of:

(a) a major proportion of a mineral lubricating oil,

(b) from about 1 to about 20 percent by weight of the composition of calcium acetate,

(c) from about 0.01 to about 3 percent by weight of the composition of an N-acyl-substituted sarcosine compound of the formula



wherein R represents an aliphatic hydrocarbon radical of from 8 to 24 carbon atoms,

(d) from about 0.1 to about 10 percent by weight of the composition of an oil-soluble metal sulfonate, and

(e) from about 0.1 to about 5 percent by weight of the composition of an oil-soluble, phosphorus- and sulfur-containing reaction product obtained by reaction at a temperature between about 100° C. and about 160° C. of substantially one mole of a phosphorus sulfide and four moles of a material selected from the group consisting of a dicyclic terpene and an essential oil predominantly comprised of a dicyclic terpene.

2. A composition as defined by claim **1** wherein calcium acetate (b) is present in an amount of from about to to about 8 percent by weight.

3. A composition as defined by claim **1** wherein the sarcosine compound (c) is oleoyl sarcosine.

4. A composition as defined by claim **1** wherein the sarcosine compound (c) is present in an amount of from about 0.1 to about 1 percent by weight.

5. A composition as defined by claim **1** wherein the metal of sulfonate (d) is calcium.

6. A composition as defined by claim **1** wherein the metal sulfonate (d) is a basic calcium petroleum sulfonate.

7. A composition as defined by claim **1** wherein the metal sulfonate (d) is present in an amount of from about 1 to about 5 percent by weight.

8. A composition as defined by claim 1 wherein the phosphorus sulfide used in forming product (e) is phosphorus pentasulfide.

9. A composition as defined by claim **1** wherein the reaction product (e) is obtained by reaction of substantially one mole of phosphorus pentasulfide and four moles of pinene at about 150° C.

10. A composition as defined by claim **1** wherein the reaction product (e) is present in an amount of from about 2 to about 3 percent by weight.

11. A lubricating oil composition consisting essentially of:

(a) a major proportion of a mineral lubricating oil,

(b) about 5.6 percent by weight of the composition of calcium acetate,

(c) about 0.42 percent by weight of the composition of oleyl sarcosine,

(d) about 0.8 percent by weight of the composition of an oil-soluble calcium sulfonate,

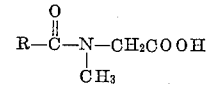
(e) about 1 percent by weight of the composition of an oil-soluble, phosphorus- and sulfur-containing reaction product obtained by reaction of substantially one mole of a phosphorus sulfide and four moles of pinene at about 150° C.

12. A mineral oil concentrate consisting essentially of:

(a) a mineral lubricating oil,

(b) calcium acetate,

(c) an N-acyl-substituted sarcosine compound of the formula



wherein R represents an aliphatic hydrocarbon radical of from 8 to 24 carbon atoms,

(d) an oil-soluble metal sulfonate,

(e) an oil-soluble, phosphorus- and sulfur-containing reaction product obtained by reaction at a temperature between about 100° C. and about 160° C. of substantially one mole of a phosphorus sulfide and four moles of a material selected from the group consisting of a dicyclic terpene and an essential oil predominantly comprised of a dicyclic terpene;

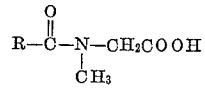
the relative quantities of (a) through (e) being such that when said concentrate is diluted with mineral lubricating oil the lubricating oil composition so formed will contain

Component:	Approximate weight percent
(b)	1–20
(c)	0.01–3
(d)	0.1–10
(e)	0.1–5

13. A composition of matter consisting essentially of:

(a) from about 1 to about 10 parts by weight of calcium acetate,

(b) from about 0.1 to about 1 part by weight of an N-acyl-substituted sarcosine compound of the formula



wherein R represents an aliphatic hydrocarbon radical of from 8 to 24 carbon atoms,

(c) from about 0.1 to about 5 parts by weight of an oil-soluble metal sulfonate,

(d) from about 0.1 to about 5 parts by weight of an oil-soluble, phosphorus- and sulfur-containing reaction product obtained by reaction at a temperature between about 100° C. and about 160° C. of substantially one mole of a phosphorus sulfide and four moles of a material selected from the group consisting of a dicyclic terpene and an essential oil predominantly comprised of a dicyclic terpene.

14. The composition of claim **1** wherein the metal of sulfonate (d) is selected from the group consisting of calcium, barium and magnesium.

15. The composition of claim **14** wherein the sulfonate is derived from a sulfonic acid having a molecular weight of from about 300 to about 800.

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