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SULFURIZED TALL OIL-CONTAINING COMPOSITIONS

Stanley P. Waugh, Westfield, N. J., assignor to Tide Water Associated Oil Company, Bayonne, N. J., a corporation of Delaware

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The present invention relates to novel compositions, adaptable for use as cutting oils, and preparation thereof.

As is known by those skilled in the art, the presence of sulfur in cutting oils is highly desirable and, particularly, for the reason that sulfurized oils retain their lubricating and cutting qualities better than unsulfurized oils during cutting operations. However, oils vary greatly in their ability to absorb and maintain sulfur in stable solution and/or combination and many oils do not possess the capacity of absorbing, and maintaining in stable solution and/or combination, a concentration of sulfur sufficient to perform in a highly satisfactory manner as cutting oils, particularly for use in heavy duty cutting operations. Hence, and as evidenced by the numerous investigations that have been made and, on the basis of which many patents have issued, the art has resorted to use of sulfurized bases for addition to mineral oils to provide cutting oil compositions. For such purposes, the bases employed are normally characterized by having a high sulfur absorption capacity, e. g., a greater capacity for absorbing sulfur than the oil of lubricating quality with which the sulfurized base is blended to form cutting oil compositions.

One type of such bases which has found considerable application as a sulfurized cutting oil base is tall oil, a product well-known to the art, obtained as a by-product in paper manufacturing. Tall oil has a high sulfur absorption capacity and, for that reason, as well as for purposes of economy, has considerable merit for such usage. In illustration thereof, reference is made to sulfurized tall oil-containing cutting oils as disclosed in patents such as U. S. Patent No. 2,198,562, No. 2,417,283 and No. 2,492,193.

Tall oil, either in crude or refined form, is characterized by containing fatty acids, rosin acids, and sterols. Depending upon the particular source from which the tall oil is obtained, and whether in crude or refined form, the proportions of the aforesaid constituents in tall oil may vary over a rather wide range. For example, in some instances, the fatty acid content may vary between about 20 to about 60%, the rosin acids from about 70 to about 20%, with the remainder being sterols. A more specific illustration includes a commercially available tall oil composition marketed as "Indusoil A" comprising 55 to 60% fatty acids, 34 to 38% rosin acids and 6 to 10% sterols. Whether employed in crude or refined form, tall oil will usually absorb more than 25% by weight of sulfur, and, in some cases, up to about 40%.

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Although, for contemplated usage as a cutting oil base, tall oils may in some cases be sulfurized to their maximum sulfur absorption capacity, sulfurization to such an extent sometimes provides substances that indicate insolubility or otherwise unstable characteristics in mineral oils. Hence, and for contemplated usage as cutting oil bases, it is generally preferable to sulfurize tall oils for absorption thereby of up to about 25% by weight of sulfur, e. g., from about 5 to about 25%. Depending upon the particular cutting operations for which a cutting oil composition is to be employed, the amount of sulfurized tall oil blended with a mineral oil of lubricating grade may be varied over a rather wide range. In illustration, the amount of sulfurized tall oil employed may vary from about 2 to about 50% by weight based on the mineral oil in providing cutting oil blends, the lower concentrations of the sulfurized base being normally employed for light cutting operations with use of increasingly higher concentrations as the severity of the contemplated cutting operations increases. Since the art is aware of numerous methods for sulfurization of bases such as tall oils, it is not deemed necessary to describe such methods in detail herein, but, for purposes of illustration, a suitable method is set forth in U. S. Patent No. 2,198,562 which comprises heating tall oil admixed with sulfur to 300 to 400° F. for 2 to 4 hours.

Although, for reasons such as aforesaid, tall oil has considerable merit for sulfurization and blending of the sulfurized product with mineral oils to provide cutting oil compositions, the use of sulfurized tall oil as a cutting oil base is attendant with numerous difficulties in cutting operations. In one form, such difficulties arise from the tendency of sulfurized tall oil compositions to form sludge and/or gum upon standing or during use thereof in cutting operations. In still another form, difficulties arise from the tendency of sulfurized tall oil-containing compositions to form difficultly removable, adherent deposits on metals undergoing a cutting operation, as well as on the metal cutting equipment, with which metals the cutting oil is in contact. That such difficulties are encountered in the normal use of sulfurized tall oil-containing cutting oils is clearly apparent from prior art disclosures, illustrative of which are disclosures such as in aforesaid U. S. Patents Nos. 2,198,562 and 2,429,198. In addition to the foregoing, sulfurized tall oil-containing cutting oils have been found to have still another drawback in that they exhibit a decided tendency to stain and/or discolor metals with which they are

in contact, as, for example, the metals undergoing a cutting operation and the cutting equipment employed. In many cases, observations have shown that such staining occurs even before the cutting oil evidences breakdown by occurrence of an appreciable amount of sludge and/or formation of a difficultly removable, adhesive deposit on the metals. Hence, and although tall oils have considerable merit for sulfurization and use as cutting oil bases, the advantages resulting from use thereof are substantially minimized, if not oftentimes outweighed, by the aforesaid drawbacks. Hence, there is a need in the art for an improved cutting oil composition, in which sulfurized tall oil is employed, that is devoid of, or inhibited against, the normal tendency of such cutting oils to exhibit the aforesaid drawbacks which, obviously, have retarded the more extensive usage of sulfurized tall oils in cutting oils. By the present invention, defined more fully hereinafter, such a need has been fulfilled by use, in a sulfurized tall oil-containing cutting oil, of certain chemical compounds that result in a novel cutting oil devoid of, or substantially inhibited against, the normal tendency of sulfurized tall oils to exhibit the aforesaid drawbacks.

Generally speaking, and with respect to the aspect of this invention relating to compositions adaptable for use as cutting oils, such compositions comprise a blend of a mineral oil with a sulfurized tall oil and, in which blend, there is dissolved a small amount, sufficient to inhibit the sulfurized tall oil to exhibit the aforesaid drawbacks, of an oil-soluble metal salt of an ester of thiophosphoric acid. In a more specific embodiment, and particularly wherein the metal salt exhibits insolubility characteristics in the sulfurized tall oil-mineral oil blend, the invention embodies use therein of a solubilizing agent for the metal salt, particularly suitable illustrations being the metal soaps of fatty acids and the alkali and alkaline earth metal soaps of sulfonic acids.

With reference to the mineral oil component of the novel compositions, a wide range of mineral oils may be employed, the particular physical characteristics thereof being dependent upon the particular cutting operations for which the cutting oil composition is to be employed. Thus, the mineral oil component may comprise either a mineral oil or fractions thereof that possess lubricating qualities and which may be derived from any of a variety of petroleum crudes, including the paraffinic, naphthenic and mixed crudes. In more specific aspect, the lubricating oils employed preferably have a viscosity of from about 50 to about 900 S. U. S., and still more preferably, from about 90 to about 300 S. U. S. at 100° F. and a flash point of at least about 300° F. It should be understood, however, that although mineral oils having properties as aforesaid are particularly suitable, such properties have been set forth as illustrating suitable characteristics from a preferred, and not limitative viewpoint, as the invention embodies use of mineral oils of lubricating quality that, though they may not possess the aforesaid properties, are nevertheless suitable for use in a cutting oil for particular cutting operations.

In preparing the compositions of this invention that are adaptable for use as cutting oils, the mineral oil component may be a mineral oil per se, fractions thereof, or such mineral oils and fractions that have been sulfurized so as to contain sulfur in stable solution and/or combination. By use of sulfurized oils as the mineral oil component, certain advantages may be obtained, particularly in that by use of a sulfurized mineral oil for blending with sulfurized tall oil, blended compositions may be prepared that contain a higher concentration of sulfur in stable solution and/or combination than is obtainable if the mineral oil itself is not sulfurized, or for purposes of economy, certain advantages may result in using both a sulfurized mineral oil and a sulfurized tall oil in preparing the cutting oil compositions. In the use of sulfurized mineral oils, any of the methods known to the art for effecting absorption of sulfur by a mineral oil may be employed, a suitable illustration of which comprises mixing the oil with sulfur (e. g., sulfur flour) and heating the mixture with agitation at an elevated temperature such as 280 to 300° F. until the sulfur is in solution. The thus heated mixture is then allowed to cool to a normal temperature, e. g., about 70° F., and any sulfur that may precipitate out of solution may be removed by any suitable method, e. g., filtration, to provide a mineral oil containing sulfur in stable solution and/or combination.

The component employed in combination with the sulfurized tall oil-mineral oil blend or sulfurized tall oil-sulfurized mineral oil blend to inhibit the tendency of the sulfurized tall oil to exhibit the aforesaid drawbacks is an oil-soluble metal salt of an ester of thiophosphoric acid. In more specific illustration, such components include the oil-soluble metal salts of esters such as cetyl thiophosphate, cetyl phenyl thiophosphate, lauryl thiophosphate, octadecyl thiophosphate, dicyclohexanyl thiophosphate, oleyl thiophosphate, and the like. Especially suitable illustrations are the oil-soluble metal salts of thiophosphoric acid esters obtainable by reacting aliphatic, cycloaliphatic, or alkyl cycloaliphatic alcohols with phosphorus pentasulfide which apparently are di-(alkyl, cycloaliphatic or alkyl cycloaliphatic) thioesters of phosphoric acids. The metal salts of such esters may be prepared by any suitable means therefor known to the art, suitable examples of which include simple neutralization of the esters with suitable salt-forming bases or by double decomposition. A wide variety of salt-forming radicals may be employed for the purposes of this invention but, for purposes of illustration, without intent of limitation, suitable salt-forming radicals include those of metals such as zinc, barium, calcium, and the like.

In order to further illustrate the invention, the following examples are set forth. In the examples, Example I represents a composition illustrative of a commercially available cutting oil, containing sulfurized tall oil, which, however, is devoid of a metal salt of a thiophosphate, and hence, is not in accordance with compositions as embodied by the present invention. The remaining examples represent compositions prepared in accordance with this invention and, by comparison of the data presented therewith with the data set forth in Example I, it is clearly evident that the compositions of this invention exhibit a marked superiority due to use therein of the metal salts of the thiophosphates in combination with the sulfurized tall oil-containing compositions.

In the examples, "Sulfurized 100 Pale Oil" represents 100 pale oil that was sulfurized by mixing sulfur flour therewith and by means of agitation with heating to 280 to 300° F., absorption of sulfur by the oil was effected to the concentrations set forth in the examples.

As employed in the examples, the term "sul-

furized base" designates "Indusoil A," as defined hereinbefore, sulfurized to a 15% sulfur concentration, sulfurization thereof having been effected by heating "Indusoil A" with sulfur flour, with agitation, at 350° F. for 2 to 3 hours.

With reference to the data in the following examples, the results set forth with respect to the metal staining and adherent deposit-forming characteristics of each composition were determined by subjecting each composition to the following test: A measured amount of the composition was placed in a tin cup containing a coiled strip of steel in a manner whereby a portion of the coiled strip was kept immersed in the test oil. The test assembly was then placed in an oven maintained at 200° F., and, at daily intervals, the specimen was observed for evidence of metal staining and occurrence of adherent difficultly-removable deposits from the metal surfaces in contact with the test oil composition.

Example I

A composition was prepared comprising a blend by weight of 93% of sulfurized 100 pale oil (92.1% pale oil and 0.9% sulfur), 2% of #1 lard oil, and 5% of sulfurized base. When subjected to the aforesaid test, this composition, illustrating a currently available cutting oil composition, exhibited initial metal staining within 48 hours and by the completion of 100 hours, an adherent deposit that was difficult to remove had deposited upon the metal surfaces.

Example II

In accordance with this invention, a composition was prepared comprising a blend by weight of the following ingredients: 92.5% sulfurized 100 pale oil (91.7% pale oil and 0.8% of sulfur), 4.5% sulfurized base and 3% of "Lubrizol 328," which is understood to comprise a mineral oil solution containing on the order of about 47 to 55% by weight of a zinc salt of di(alkyl cyclohexyl) dithiophosphates. The composition of this example, when subjected to the aforesaid test, showed a marked improvement over the composition of Example I in that initial metal staining was inhibited for about 115 hours and no formation of an adherent deposit on the metal had occurred up to 500 hours.

Example III

A composition was prepared containing a blend by weight of the following ingredients: 92% sulfurized 100 pale oil (91.2% pale oil and 0.8% sulfur), 5.0% sulfurizing base, 1.5% of "Lubrizol 328" and 1.5% of "Petronate," the latter being a 60–65% solution of sodium salts of mahogany acids in mineral oil. When exposed to the conditions of the aforesaid test, initial metal staining was inhibited for about 125 hours and no adherent deposits had occurred on the metal up to 500 hours.

Example IV

A composition was prepared containing a blend by weight of the following ingredients: 93% sulfurized pale oil (92.2% pale oil and 0.8% sulfur), 4.5% sulfurized base, and 2.5% of "Lubrizol 338," a composition understood to comprise about 16% of a zinc salt of a di(alkylcyclohexyl) dithiophosphate and about 36% of a calcium salt of a petroleum mahogany acid dissolved in a mineral oil. When exposed to the conditions of the aforesaid test, no evidence of metal staining occurred for about 280 hours and formation of an adherent deposit on the metal was inhibited for about 450 hours.

Example V

A composition was prepared containing a blend by weight of the following ingredients: 93% sulfurized 100 pale oil (92.2% pale oil and 0.8% sulfur), 4.5% sulfurized base, 1.25% of "Lubrizol 338" and 1.25% of "Petronate." When subjected to the aforesaid test, the results obtained with respect to staining and deposition of adherent deposits were similar to those obtained in Example IV.

Example VI

A composition was prepared containing a blend by weight of 93% sulfurized 100 pale oil (92.2% pale oil and 0.8% sulfur), 4.5% of sulfurized base, and 2.5% of "Lubrizol 747," the latter being understood to comprise about 30 to 40% by weight of the barium salt of a di(alkylcyclohexyl) dithiophosphate dissolved in a mineral oil. Although such a composition may be satisfactory for use in certain cutting operations, such as those involving high temperatures, it has a tendency to exhibit cloudiness and precipitate at normal temperatures (room). Hence, to overcome such a tendency, the aforesaid composition was modified by decreasing the amount of "Lubrizol 747" and adding "Petronate" to provide the following composition: 93% of 100 pale oil (92.2% pale oil and 0.8% sulfur), 4.5% of sulfurized base, 1.25% of "Lubrizol 747" and 1.25% of "Petronate." When the modified composition was subjected to the aforesaid test, initial metal staining was inhibited for about 285 hours and formation of adherent deposits on the metal was inhibited for about 400 hours.

Example VII

A composition was prepared containing a blend by weight of the following ingredients: 93% of sulfurized 100 pale oil (92.2% pale oil and 0.8% sulfur), 4.5% of sulfurized base, and 2.5% of "Aerolube 68," the latter being understood to comprise a barium salt of thiophosphoric acid esterified with C_6 to C_8 alcohols. Similarly to the composition set forth in the preceding example, the composition of this example exhibited a tendency to develop haze and precipitation at normal temperature (room) and, hence, to overcome such a tendency, the composition was modified to the following: 93% of sulfurized 100 pale oil (92.2% oil and 0.8% sulfur), 4.5% sulfurized base, 1.25% of "Aerolube 68" and 1.25% of "Petronate." In preparing the modified composition, a concentrate was prepared by blending the sulfurized base, "Aerolube 68" and "Petronate" in a ratio of 4.5:1.25:1.25, respectively, by weight and the concentrate was then dissolved in the sulfurized 100 pale oil to form the aforesaid modified composition. When this composition was subjected to the aforesaid tests, no metal staining or formation of adherent deposits had occurred upon an observation at 1,000 hours.

Example VIII

A composition was prepared that was identical to the modified composition of Example VII except that sodium oleate was substituted for the "Petronate." Such a composition inhibited initial metal staining for about 300 hours and no formation of adherent deposits was observed up to about 420 hours.

Although, as in the foregoing examples, specific concentrations have been employed for the various ingredients of the compositions set forth that are highly satisfactory cutting oils, the concentrations have been employed as illustrative of specific, and not limitative, aspects of the invention. As aforesaid, the invention, with respect to compositions suitable for use as cutting oils, relates to compositions comprising a mineral oil, a sulfurized tall oil, and an oil-soluble metal salt of an ester of thiophosphoric acid in an amount sufficient to stabilize the sulfurized tall oil in the manner aforesaid, and when necessary, a solubilizing agent for the metal salts, said solubilizing agent being, preferably, an oil-soluble metal soap as illustrated by the oil soluble metal soaps of fatty acids, oil-soluble metal soaps of sulfonic acids, e. g., petroleum mahogany acids, and the like. In more specific illustration, the compositions embodied herein, comprise a mineral oil, (or sulfurized mineral oil), a sulfurized tall oil in an amount of about 2 to about 50% based upon the weight of the mineral oil (or sulfurized mineral oil), and an oil-soluble metal salt of an ester of thiophosphoric acid in an amount sufficient to stabilize the composition as aforesaid, the metal salt normally being employed in concentrations of from about 0.1 to about 10% based upon the weight of the composition. In cases wherein the aforesaid metal salt indicates insolubility characteristics, the solubilizing agent should generally be employed in a concentration on the order set forth hereinbefore for the metal salt of the thiophosphate. In still more specific illustration are mineral oils (or sulfurized mineral oils) having the following concentrations of the sulfurized tall oil and inhibitors dissolved therein:

	Percent by weight of mineral oil compositions
Sulfurized tall oil	About 2 to about 20
Oil-soluble metal salt of ester of thiophosphoric acid	About 0.1 to about 5.0

Although, as evidenced by the data in Examples II to VIII, it is apparent that highly satisfactory results as embodied herein are obtained by practicing the invention in the generic manner aforesaid, particular reference is made to Example VII wherein the stabilizing component employed was "Aerolube 68," a barium salt of thiophosphoric acid esterified with C_6 to C_8 alcohols. Although the blend, devoid of the metal soap, exhibited a tendency to haze at normal temperatures, the use therein of the metal soap of mahogany acids not only provided a clear, stable solution but, additionally, provided markedly superior results in that no metal staining nor deposition of adherent deposits had occurred after 1,000 hours of exposure in the aforedefined test. As such, and as indicated by such superior performance, a particularly preferred aspect of this invention embodies the use of barium salts of the thiophosphates in combination with an oil-soluble metal soap, and, still more preferably, barium salts of thiophosphoric acids, esterified with C_6 to C_8 alcohols, in combination with an oil-soluble metal salt of a petroleum mahogany acid.

In the aforesaid examples, the compositions set forth therein, with the exception of modified composition of Example VII, were prepared by blending the mineral oil with the sulfurized base and dissolving the inhibitors in the resulting blends. The modified composition of Example VII, as aforesaid, was prepared by first preparing a concentrate comprising the sulfurized tall oil and the inhibitors, the sulfurized tall oil representing the major proportion by weight of the concentrate. Irrespective of whether the compositions embodied herein are prepared by use of a concentrate as in the modified composition of Example VII, or by blending of individual ingredients, the final compositions exhibit similar properties with respect to the action of the metal salt in inhibiting the sulfurized tall oil against its tendency to exhibit drawbacks as aforesaid. Hence, in addition to the novel cutting oils per se, the present invention also embodies as novel compositions, concentrates comprising a sulfurized tall oil in major proportion in combination with an amount of an oil-soluble metal salt of a thiophosphate sufficient to stabilize the sulfurized tall oil as aforesaid. In illustration, such concentrates may comprise, by weight, more than 50% of sulfurized tall oil, e. g., 60 to 80%, about 2 to 25% of an oil soluble metal salt of a thiophosphate, and the balance may comprise a suitable diluent and/or solvent, e. g., a mineral oil, and in cases wherein it is desired to employ an oil-soluble metal soap, the composition may suitably contain a concentration thereof of from about 2 to 20%. More specific illustrations of such concentrates include the following:

	Percent by weight
(a) Sulfurized tall oil	62
Zinc salt of di(alkylcyclohexyl) dithiophosphates	17–20
Mineral oil	balance
(b) Sulfurized tall oil	62
Zinc salts of di(alkylcyclohexyl) dithiophosphates	8–12
Na salt of mahogany acids	12–15
Mineral oil	balance
(c) Sulfurized tall oil	64.0
Zinc salts of di(alkylcyclohexyl) dithiophosphates	6.0
Ca salt of petroleum mahogany acids	14.0
Mineral oil	balance
(d) Sulfurized tall oil	64.0
Zinc salts of di(alkylcyclohexyl) dithiophosphates	3.0
Na salt of mahogany acids	7.0
Mineral oil	balance
(e) Sulfurized tall oil	64.0
Barium salt of di(alkylcyclohexyl) dithiophosphates	8–12
Na salt of mahogany acids	12–15
Mineral oil	balance

It is apparent from the foregoing that by use of concentrates comprising the sulfurized tall oil in major proportional amount by weight blended with an oil-soluble salt of a thiophosphate, and, when desired, also containing a suitable oil-soluble metal soap, concentrates are provided that may be employed to facilitate blending operations in preparation of suitable cutting oils, and especially enables adjustable on-the-job preparation of such cutting oils to suit particular cutting needs that may vary as to severity of the cutting operations.

Although, and as is apparent from the foregoing description, the invention relates to compositions, adaptable for use as cutting oils, that essentially contain a mineral oil, sulfurized tall oil and an oil-soluble metal salt of an ester of

thiophosphoric acid, as well as concentrates that contain a sulfurized tall oil in combination with such a metal salt, it is within the scope of this invention to include such compositions and concentrates that may contain, in addition to the aforesaid, small amounts of other addition agents to impart certain desired properties to the compositions. In illustration, the compositions embodied herein may contain substances such as fatty oils, anti-corrosives, scenting agents, germicides, diluents, etc. However, in making use of such added ingredients the particular type and concentrations thereof employed are such as not to deleteriously alter the capacity of the metal salts of the thiophosphates from performing in desired manner, as aforedescribed, in combination with sulfurized tall oils.

Although the present invention has been described in conjunction with certain preferred embodiments thereof, those skilled in the art will readily recognize that variations and modifications are to be considered within the purview of the specification and scope of the appended claims.

I claim:

1. A composition, adaptable for use as a cutting oil, comprising a mineral oil in major amount based on the weight of said composition, an oil-soluble sulfurized tall oil in an amount sufficient to improve the lubricating qualities of said oil but having a tendency to form deposits adhesive to metals in contact therewith, and an oil-soluble metal salt of an ester of thiophosphoric acid in an amount sufficient to inhibit said composition against formation of adherent deposits on metals in contact therewith.

2. A composition, as defined in claim 1, wherein the mineral oil is a sulfurized mineral oil.

3. A composition, as defined in claim 1, which contains, in addition, an oil-soluble solubilizing agent for said metal salt.

4. A composition, as defined in claim 3, wherein the solubilizing agent is an oil-soluble metal soap.

5. A composition, as defined in claim 1, wherein the mineral oil is a sulfurized mineral oil and which composition contains, in addition, a solubilizing agent for said metal salt.

6. A composition, as defined in claim 1, which contains the sulfurized tall oil in an amount of about 2 to about 50% based on the weight of the mineral oil.

7. A composition, as defined in claim 1, which contains about 0.1 to about 10% by weight of the metal salt.

8. A composition, as defined in claim 1, which contains the sulfurized tall oil in an amount of about 2 to about 50% based on the weight of the mineral oil and from about 0.1 to about 10% of said metal salt based on the weight of said composition.

9. A composition, as defined in claim 8, wherein the mineral oil is a sulfurized mineral oil.

10. A concentrate, adaptable for blending with a mineral oil of lubricating quality to prepare cutting oil compositions, comprising a sulfurized tall oil in major proportional amount based on the weight of said concentrate and a minor amount, sufficient to inhibit the tendency of the sulfurized tall oil to form adherent deposits on metals in contact therewith, of an oil-soluble metal salt of a thiophosphoric acid ester.

11. A concentrate, as defined in claim 10, which, in addition, contains an oil-soluble solubilizing agent for said metal salt.

12. A concentrate, as defined in claim 11, wherein the solubilizing agent is an oil-soluble metal soap.

13. A concentrate, as defined in claim 10, which contains the sulfurized tall oil in about 60 to about 80% based on the weight of said concentrate and the metal salt in an amount of about 2 to about 25%.

14. A concentrate, as defined in claim 13, which contains about 2 to about 20% of an oil-soluble solubilizing agent for said metal salt.

15. A composition, adapted for use as a cutting oil, comprising in major amount based on the weight of said composition a lubricating oil from the group consisting of mineral oils and sulfurized mineral oils, an oil-soluble sulfurized tall oil in an amount sufficient to improve the lubricating qualities of said lubricating oil but having a tendency to form deposits adherent to metals in contact therewith, and an oil-soluble metal salt of an alkyl cycloaliphatic dithiophosphate in an amount sufficient to inhibit said composition against formation of adherent deposits on metals in contact therewith.

16. A composition, as defined in claim 15, wherein the metal component of the oil-soluble metal salt is a member from the group consisting of zinc and barium.

17. A composition, as defined in claim 15 which, in addition, contains a solubilizing agent for said metal salt, said solubilizing agent being an oil-soluble metal soap of an acid from the group consisting of fatty acids and petroleum sulfonic acids.

18. A concentrate, adapted for blending with a mineral oil of lubricating quality to prepare cutting oil compositions, comprising a sulfurized tall oil in major proportional amount based on the weight of said concentrate, an oil-soluble metal salt of an alkyl cycloaliphatic dithiophosphate in an amount sufficient to inhibit the tendency of the sulfurized tall oil to form adherent deposits on metals in contact therewith, and a mineral oil.

19. A concentrate, as defined in claim 18, wherein the metal component of the metal salt is a member from the group consisting of zinc and barium.

20. A concentrate, as defined in claim 18, which in addition, contains a solubilizing agent for said metal salt, said solubilizing agent being an oil-soluble metal soap of an acid from the group consisting of fatty acids and petroleum sulfonic acids.

STANLEY P. WAUGH.

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