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LUBRICANT

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26 Claims. (Cl. 252—32)

This invention relates, as indicated, to lubricating compositions and more particularly to lubricating compositions which are predominantly hydrocarbon oil, the properties of which affecting its use for particular purposes are improved by the addition of materials which are particularly effective in rendering the lubricants suitable for use under conditions of extreme stress as imposed by high temperatures, high loads, etc.

In my co-pending applications, Ser. Nos. 737,070, filed July 26, 1934; 216,153, filed June 27, 1938; and 245,226 filed December 12, 1938, I have disclosed a broad class of lubricating compositions of general utility, particularly in the field of use where extreme pressures are encountered.

My present invention relates to the discovery that a certain class of such materials is particularly suitable for use in lubricants subjected to conditions of extreme stress such as those involved in the lubrication of heavily loaded gears, and in the lubrication of internal combustion engines operating under severe service conditions; for example, those encountered by internal combustion engines particularly of the aviation and Diesel types.

It is the principal object of my invention, therefore, to provide a lubricating composition which is especially suited for the purposes described.

Other objects of my invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims; the following description setting forth in detail certain approved combinations of ingredients embodying my invention, such disclosed means constituting, however, but one of various forms in which the principle of the invention may be used.

Broadly stated, this invention comprises the provision of a lubricating composition for the purposes specified, characterized by the fact that the same contains a lubricating oil, preferably of the hydrocarbon type, as a major constituent with the properties of such composition affecting its use as a lubricant, especially under the conditions specified, by the incorporation therein of a minor amount, based on the amount of lubricating oil present, of a stable, oil-soluble salt of an aromatic acid.

More especially, my invention comprises the discovery that salts of aromatic acids, of the type which contain a substituent selected from the class consisting of aliphatic and cyclo-aliphatic radicles, are particularly suited for use.

The Oil Base

The oil base of my lubricating compositions is a lubricating oil of the type best suited for the particular use for which the ultimate composition is designed. When the lubricating compositions of my invention are designed for the lubrication of automobiles, the oil base will of course preferably consist of a refined mineral lubricating oil of lubricating viscosity for the particular point of application. In other words, a conventional gear oil may be used for the lubrication of the gears and generally a lighter, more highly refined, oil will be used in the crank case.

This invention is applicable to lubricating compositions in which the base may consist either entirely or in part of synthetic oils, hydrogenated oils, and volatilized oils.

The oil base may also desirably contain other well known constituents such as those which improve the oiliness, pour point, cold test, and oxidation properties, etc., of the oil. In general, compositions of my invention may be employed with any commercially available addition agents for the above defined purposes since they are generally compatible with the same in the amounts usually used.

The Addition Agents

As above indicated, the addition agents may be generally defined as salts of aromatic acids. The term salts as used herein is intended to include the organic salts of aromatic acids as well as the inorganic salts of aromatic acids. The inorganic salts such as the metallic salts of aromatic acids will generally be found to give best results, and of these, those salts in which the metal is present in divalent form, will usually be preferred.

The halogen bearing salts of aromatic acids generally are a broad class of addition agents which have been found to be notably effective.

For certain uses, the salts of aromatic acids of the type which contain a substituent selected from the class consisting of aliphatic radicles and cyclo-aliphatic radicles have been found very useful. This latter class of salts may optionally also contain a halogen such as chlorine.

Due to the nature of the addition agents contemplated for use, they may be conveniently identified by first having reference to the various aromatic acids from which the salts may be prepared and by then giving a list of the various radicles or bases which may be combined with such acids in producing the salts.

In the following table will be found listed a number of aromatic acids.

TABLE I.—*Aromatic acids*

Benzoic acid
Benzoic acid derivatives:
- Azobenzoic acid
- Mercapto benzoic acid
- Alkylated benzoic acids:
  - Lauryl benzoic acid

Salicyclic acid
Salicylic acid derivatives:
- Alkylated salicylic acids:
  - Ethyl salicylic acid

Heterocyclic acids:
- Pyrrole carboxylic acid
- Thiophene carboxylic acid

Acetic acid derivatives:
- Phenyl acetic acid
- Diphenyl acetic acid

Stearic acid derivatives:
- Phenyl stearic acid
- Phenyl mercapto stearic acid
- Xenyl stearic acid
- Naphthyl stearic acid
- Tolyl stearic acid

Puroic acid
Cinnamic acid
Phthalic acid
Tuloic acid
Mercapto rosolic acid
Naphthyloic acid
Any of the corresponding thio acids.
Any of the foregoing which have been halogenated.

In the preparation of those salts of aromatic acids of the type in which the aromatic acid is of the class which contains a substituent selected from the class consisting of aliphatic radicles and cyclo-aliphatic radicles, such acids may be conveniently prepared either by:

(1) Condensing an aromatic compound with
- (*a*) An aliphatic unsaturated acid, or
- (*b*) A halogenated aliphatic acid, or
- (*c*) A cyclo-aliphatic unsaturated acid, or
- (*d*) A halogenated cyclo-aliphatic acid; or by

(2) Condensing an aromatic acid with
- (*a*) An unsaturated aliphatic compound, or
- (*b*) A halogenated aliphatic compound, or
- (*c*) An unsaturated cycle-aliphatic compound, or
- (*d*) A halogenated cyclo-aliphatic compound.

In the table below will be found listed examples of aromatic compounds which may be used in any of the condensation reactions identified under Table I above in the preparation of aromatic acids from which appropriate salts may be prepared:

TABLE II.—*Aromatic compounds*

Benzene
Naphthalene
Toluene
Ethylbenzene
Xylene
Mesitylene
Chlorbenzene
Dichlorbenzene
Chlor-naphthalene
Chlortoluene
Diphenyl
Chlordiphenyl
Retene
Chlor-retene

The following is a list of aliphatic unsaturated acids which may be used as one of the components of the condensation reactions identified under (1) (*a*) above in the preparation of aromatic acids from which salts may be accordingly prepared.

TABLE III.—*Aliphatic unsaturated acids*

Vinyl acetic acid
Vinyl acrylic acid
Vinyl glycolic acid
Acrylic acid
Crotonic acid
Oleic acid
Linolenic acid
Maleic acid
Fumaric acid
Linoleic acid
Elaeostearic acid
Propiolic acid
Stearolic acid
Methyl acrylic
Beta pentanoic acid
Undecylenic
Myristolenic
Palmitolenic

In the following table are given a number of representative examples of halogenated aliphatic acids which may be used in the condensation reactions identified under I above.

TABLE IV.—*Halogenated aliphatic acids*

Chlorstearic acid
Chloracetic acid
Chlorlauric acid
Chlorpalmitic acid
Dichloroleic acid
Chlorbutyric acid
Chlorricinoleic acid
Chlorlactic acid
Chlorcitric acid
Chlorsuccinic acid
Chlormyristic acid
As well as the chlor derivatives of all of the acids given in Table III above.

In the following table are given representative examples of cyclo-aliphatic unsaturated acids which may be used as one component of the condensation reaction identified under (1) (*b*) above.

TABLE V.—*Cyclo-aliphatic unsaturated acids*

Chaulmoogric acid
Hydrocarpic acid

In the following table are given certain representative examples of halogenated cyclo-aliphatic acids which may be used as one of the components of the condensation reaction referred to under (1) (*c*) above.

TABLE VI.—*Halogenated cyclo-aliphatic acids*

Chlorinated naphthenic acids
Chlorhexahydrobenzoic acid
Chlorchaulmoogric acid
Chlorhydrocarpic acid

When the second type of condensation reaction is employed, i. e., that identified under (2) above, where an aromatic acid is condensed with an aliphatic compound, the aromatic acid may be any of the acids given in Table I above.

When the condensation reaction of the type identified under (2) (*a*) above is employed, the unsaturated aliphatic compounds, which may be used in such condensation reaction, may be any of those listed in the following table.

TABLE VII.—*Unsaturated aliphatic compounds*

Ethylene
Propylene
Butylene
Isobutylene
Decene
Acetylene
Butadiene
Allene
Amylene
As well as those unsaturated products derived from petroleum and petroleum fractions and derivatives such as paraffin wax as by cracking or for example removal of HCl by NaOH from monochlor paraffins. The unsaturated products derived from cracked gasoline, gas oil etc. will be found particularly useful.

In the following table are listed a number of representative halogenated aliphatic compounds which may be used as one of the components of the condensation reaction identified under (2) (*b*) above.

TABLE VIII.—*Halogenated aliphatic compounds*

Ethyl chloride
Butyl chloride
Amyl chloride
Lauryl chloride
Benzyl chloride
Ethylene dichloride
Carbon tetrachloride
Chlorparaffin wax
Chlor naphtha
Chlor decane
Amyl dichloride
Chlorinated aliphatic paraffin derivatives as well as the chlorinated derivatives of the various materials and compounds listed in Table VII above.

In the following table are listed a number of specific examples of unsaturated cyclo-aliphatic compounds which may be employed as components of the condensation reaction identified under (2) (*c*) above.

TABLE IX.—*Unsaturated cyclo-aliphatic compounds*

Cyclohexene
Cyclohexadiene
Cyclopentene
Cyclobutene

In the following table are listed a number of representative examples of halogenated cycle-aliphatic compounds which may be employed as one of the components of the condensation reaction identified under (2) (*d*) above.

TABLE X.—*Halogenated cyclo-aliphatic compounds*

Chlorcyclobutane
Chlorcyclopentane
Chlorethylcyclobutane
Chlorcyclohexane
Dichlorcyclohexane
Chlorcycloparaffin
Chlorcyclopentane

The various aromatic acids, either those specifically identified in Table I above or those prepared by the various condensation reactions above identified, may, as previously indicated, be combined with either an organic radicle or base in the preparation of organic salts or with inorganic bases in the preparation of the inorganic salts.

In the following table will be found listed a number of organic radicles or bases which may thus be employed in the preparation of organic salts of aromatic acids.

TABLE XI.—*Organic radicles or bases*

Amino compounds such as:

Monoethanolamine
Diethanolamine
Triethanolamine
Analine
Benzylamine
Laurylamine
Diphenylamine
Triphenylamine
Diethylamine
Triethylamine
Putrescine

Nitrogen ring compounds, such as:

Pyrimidine
Pyrazine
Phenazine
Quinazoline
Pyrolline
Pyridazine
Picoline
Pyrazole
Pyridine
Quinoline
Pyrrole
Piperidene
Thiazole
Carbazole
Phenoxazine
Phenthiazine
Indole
Indoxyl
Thiodiazole

Oxygen-bearing ring compounds, such as:

γ-pyrone

Among the specific organic salts of aromatic acids which may thus be prepared for use, may be listed the following as illustrative examples.

TABLE XII.—*Organic salts*

Aniline phenyl stearate
Benzylamine chlorphenylstearate
Laurylamine naphthylstearate
Diphenylamine chlornaphthylstearate
Diethylamine phenylmercaptostearate
Ethanolamine phenylpalmitate
Triethanolamine pipidyllaurate
Pyridine phenyl stearate
Quinoline naphthyl palmitate
Piperidene chlor naphthyl laurate
Thiazole phenyl palmitate
γ-pyrone phenyl stearate

In the following table are listed a number of inorganic radicles which may be combined with any of the aromatic acids given above in the production of inorganic salts of aromatic acids which may be used as addition agents in the lubricating compositions of my invention.

TABLE XIII.—*Inorganic radicles*

Sodium
Potassium
Ammonium
Lithium
Magnesium
Calcium

TABLE XIII.—*Inorganic radicles*—Continued

Strontium
Barium
Cobalt
Zinc
Nickel
Manganese
Aluminum
Chromium
Stannous
Lead
Copper
Cadmium
Bismuth
Silver
Mercury
Vanadyl (VO≡)

In the following table are given a list of representative inorganic salts which may be produced by the combination of certain of the aromatic acids above identified with certain of the inorganic radicles of Table XIII above.

TABLE XIV.—*Inorganic salts*

Calcium diphenyl acetate
Magnesium diphenyl acetate
Nickel diphenyl acetate
Cobalt diphenyl acetate
Stannous diphenyl acetate
Sodium phenyl stearate
Potassium phenyl stearate
Ammonium phenyl stearate
Lithium phenyl stearate
Magnesium phenyl stearate
Calcium phenyl stearate
Strontium phenyl stearate
Barium phenyl stearate
Cobalt phenyl stearate
Zinc phenyl stearate
Nickel phenyl stearate
Manganese phenyl stearate
Aluminum phenyl stearate
Chromium phenyl stearate
Stannous phenyl stearate
Copper phenyl stearate
Cadmium phenyl stearate
Silver phenyl stearate
Vanadyl phenyl stearate
Calcium phenyl mercapto stearate
Magnesium phenyl mercapto stearate
Nickel phenyl mercapto stearate
Cobalt phenyl mercapto stearate
Stannous phenyl mercapto stearate
Calcium xenyl stearate
Magnesium xenyl stearate
Nickel xenyl stearate
Cobalt xenyl stearate
Stannous xenyl stearate
Calcium naphthyl stearate
Magnesium naphthyl stearate
Nickel naphthyl stearate
Cobalt naphthyl stearate
Stannous naphthyl stearate
Calcium tolyl stearate
Magnesium tolyl stearate
Nickel tolyl stearate
Cobalt tolyl stearate
Stannous tolyl stearate
Magnesium butyl phthalate (salt-ester)
Calcium butyl phthalate (salt-ester)
Nickel butyl phthalate (salt-ester)
Cobalt butyl phthalate (salt-ester)
Aluminum butyl phthalate (salt-ester)
Calcium decyl phthalate (salt-ester)

TABLE XIV.—*Inorganic salts*—Continued

Cobalt decyl phthalate (salt-ester)
Nickel decyl phthalate (salt-ester)
Stannous decyl phthalate (salt-ester)
Calcium lauryl phthalate (salt-ester)
Cobalt lauryl phthalate (salt-ester)
Nickel lauryl phthalate (salt-ester)
Stannous lauryl phthalate (salt-ester)
Magnesium mercapto rosolate
Calcium mercapto rosolate
Nickel mercapto rosolate
Cobalt mercapto rosolate
Aluminum mercapto rosolate

The halogen-bearing salts corresponding to the foregoing holagen-free salts will be found of utility and the following are particularly useful:

Calcium chlor phenyl stearate
Sodium chlor phenyl stearate
Magnesium chlor phenyl stearate
Calcium chlor naphthyl palmitate
Stannous chlor phenyl palmitate
Calcium chlor phenyl laurate
Sodium chlor phenyl laurate
Nickel chlor phenyl laurate
Cobalt chlor phenyl laurate
Stannous chlor phenyl laurate
Calcium chlor phenyl palmitate
Sodium chlor phenyl palmitate
Nickel chlor phenyl palmitate
Cobalt chlor phenyl palmitate
Stannous chlor phenyl palmitate
Calcium chlor phenyl myristate
Sodium chlor phenyl myristate
Nickel chlor phenyl myristate
Cobalt chlor phenyl myristate
Stannous chlor phenyl myristate
Calcium chlor naphthyl laurate
Sodium chlor naphthyl laurate
Nickel chlor naphthyl laurate
Cobalt chlor naphthyl laurate
Stannous chlor naphthyl laurate
Calcium chlor naphthyl palmitate
Sodium chlor naphthyl palmitate
Nickel chlor naphthyl palmitate
Cobalt chlor naphthyl palmitate
Stannous chlor naphthyl palmitate
Calcium chlor naphthyl myristate
Sodium chlor naphthyl myristate
Nickel chlor naphthyl myristate
Cobalt chlor naphthyl myristate
Stannous chlor naphthyl myristate
Calcium chlor xenyl laurate
Sodium chlor xenyl laurate
Nickel chlor xenyl laurate
Cobalt chlor xenyl laurate
Stannous chlor xenyl laurate
Calcium chlor xenyl palmitate
Sodium chlor xenyl palmitate
Nickel chlor xenyl palmitate
Cobalt chlor xenyl palmitate
Stannous chlor xenyl palmitate
Calcium chlor xenyl myristate
Sodium chlor xenyl myristate
Nickel chlor xenyl myristate
Cobalt chlor xenyl myristate
Stannous chlor xenyl myristate
Calcium chlor toluyl laurate
Sodium chlor toluyl laurate
Nickel chlor toluyl laurate
Cobalt chlor toluyl laurate
Stannous chlor toluyl laurate
Calcium chlor toluyl palmitate
Sodium chlor toluyl palmitate
Nickel chlor toluyl palmitate

TABLE XIV.—*Inorganic salts*—Continued

Cobalt chlor toluyl palmitate
Stannous chlor toluyl palmitate
Calcium chlor toluyl myristate
Sodium chlor toluyl myristate
Nickel chlor toluyl myristate
Cobalt chlor toluyl myristate
Stannous chlor toluyl myristate

Salts of any of the metals of Table XIII with an aromatic acid produced by condensing paraffin wax hydrocarbons with benzoic acid. The salts produced by combining the metals of Table XIII with an aromatic acid such as with benzoic acid, toluic acid or salicylic acid having one or more long aliphatic groups condensed onto the ring structure.

Calcium lauryl toluate
Cobalt lauryl toluate
Nickel lauryl toluate
Stannous lauryl toluate

Instead of preparing the salts designed for use as the addition agents of the present invention by treating any of the acids, of the type above identified, with an alkali for example such as sodium hydroxide in the preparation of the corresponding sodium salt of the acid, it is also possible to prepare corresponding salts by first preparing an ester of the acid, and then reacting such ester with an alkali such as sodium hydroxide to prepare, for example, the sodium soap of the acid, and then treating such soap with another salt in the preparation of a salt of a different inorganic radicle. Thus, for example, the methyl ester of chlorphenylstearic acid may be reacted with sodium hydroxide in the production of sodium chlorphenylstearate which is in turn reacted with calcium chloride in the production of calcium chlorphenyl stearate.

It may be preferable to prepare the ester, employed in the foregoing preparation of the salt, where such ester is one of an aromatic acid belonging to classification 2 on page 2 above, by condensing an ester of an aromatic acid with an unsaturated compound or halogenated organic compound instead of condensing the aromatic acid itself with such compound. For example, in the preparation of salts of stearoyl benzoic acid, methyl benzoate may be condensed with stearoyl chloride to form methyl stearoyl benzoate, this ester saponified with sodium hydroxide, and the resulting sodium salt reacted with magnesium chloride in aqueous solution to form magnesium stearoyl benzoate. An example of the preparation of magnesium stearoyl benzoate in detail is as follows:

A mixture of 1 mole each of methyl benzoate and stearoyl chloride is dissolved in an equal weight of carbon bisulphide. One mole of anhydrous aluminum chloride is added slowly with the temperature at 45° C. and the mixture held at that temperature for one hour longer. The materials are then poured into a mixture of cracked ice and concentrated hydrochloric acid, and the carbon bisulphide layer removed and washed with warm water. Carbon bisulphide and moisture are then removed by distilling under vacuum leaving the condensation product, namely methyl stearoyl benzoate. The latter is saponified by adding 1 mole of sodium hydroxide in the form of a 10% aqueous solution, the mixture being refluxed until the aqueous solution is approximately neutral. One-half mole of magnesium chloride is added in the form of an aqueous solution which causes the precipitation of magnesium stearoyl benzoate. The water layer is decanted from the precipitate which is then dissolved in benzol and dried by removing the benzol and water by distilling under vacuum. The resulting product was dissolved in a naphthenic type oil in a concentration of 1% and found to materially improve the oil when used in an internal combustion engine, particularly in preventing the formation of harmful deposits on the piston and piston rings.

Included among the compounds contemplated for use by this invention are stable oil soluble salt-esters of polybasic aromatic acids. These may be formed for example by neutralizing an acid ester of a polybasic aromatic acid with a base, or by partially saponifying a neutral ester of a polybasic aromatic acid with a base so that each molecule of the saponified material retains at least one ester group in addition to at least one basic group.

Examples of such compounds are the salt-esters of the following:

1. Benzene polycarboxylic acids, e. g.
   - Phthalic acids
   - Trimesic acid
   - Trimellitic acid
   - Hemimellitic acid
   - Pyromellitic acid
   - Mellophanic acid
   - Prehnitic acid
   - Benzene pentacarboxylic acid
2. Naphthalene polycarboxylic acids, e. g.
   - Naphthalic acids
3. Pyridine polycarboxylic acids, e. g.
   - Lutidinic acid
   - Dipicolinic acid
   - Cynchomeronic acid
   - Isocynchomeronic acid
   - Dinicotinic acid
   - Alpha-carbocynchomeronic acid
   - Beta-carbocynchomeronic acid
   - Berberonic acid
   - Trimesitinic acid
   - Pyridine tetracarboxylic acid
   - Pyridine pentacarboxylic acid
4. Pyrrole polycarboxylic acids
5. Quinoline polycarboxylic acids
6. Thiophene polycarboxylic acids
7. Thiazole polycarboxylic acids
8. Diphenyl polycarboxylic acids, e. g.
   - Diphenic acid
9. Dibenzyl polycarboxylic acids
10. Anthracene polycarboxylic acids
11. Phenanthrene polycarboxylic acids
12. Thianthrene polycarboxylic acids

Where such salt-esters are employed, it will generally be found advantageous to have at least one of the ester groups consist of an aliphatic or cyclo-aliphatic group and preferably one containing four or more carbon atoms. For example, salts of the acid butyl or amyl esters of phthalic acid have been found suitable.

Specific examples of these salt-esters have been so labeled in the principal list of specific examples given above.

In view of the particular uses for which my compounded lubricants are intended, it is apparent that of the salts included in the foregoing enumeration of the addition agents which may be employed, those which are readily oil-soluble are the ones preferred for use. When these compounded oils are designed for use under conditions where high temperatures are usually en-

countered, the addition agents should be stable at elevated temperatures. For use in crankcase lubricants for internal combustion engines, they should preferably be stable to the extent where there will be substantially no decomposition, when the lubricating composition is exposed to temperatures up to 250° F.

The addition agents which are to be selected from the class described should be such that they are relatively non-corrosive with respect to the metallic surfaces with which they come in contact during use. Certain of the named addition agents may be found to be detrimentally corrosive to certain sensitive bearing metals, in which case an appropriate corrosion inhibitor may be employed in conjunction therewith in the composition.

A lubricating composition prepared in accordance with my invention and which is predominantly hydrocarbon oil may contain from an effective amount to 20% of the salt addition agent above identified. In general, it will be found that an amount as low as .1% will often be quite effective and that amounts in excess of 10% are seldom necessary. A preferred range of concentrations for the salt in the oil is from .25% to about 2%.

It is also within the contemplation of this invention to provide the addition agents in the form of a concentrate in a suitable oil, said oil containing rather high percentages of the addition agents. Such concentrates may be employed for further blending with a lubricating oil in the proportions desired for the particular conditions of use.

While mineral oil, generally, is the principal ingredient of the lubricant, it is not essential that it be the only ingredient other than the addition agents, provided that there be no additional ingredient which is incompatible with such addition agent. It is within the contemplation of this invention to include, if necessary or desirable, such other addition agents as are commonly added to improve the viscosity index or cold test of the lubricants; and a lubricating composition according to this invention which also has a separate film-strength or oiliness increasing agent has been found to be especially effective.

When used in conjunction with a hydrocarbon lubricating oil, it is obvious that, generally, only such amounts of the addition agent may be included as are soluble in the specified amount of oil. By the term "soluble," as herein used, it is intended to indicate the ability to form not only true solutions but also any form of substantially permanently homogeneous composition when incorporated in mineral oil. With most of the compounds there is usually little difficulty, especially if the incorporation is effected in the manner described in Cornell Patent No. 2,042,880, and since quite small percentages often give remarkably improved results, it is seldom of extreme importance that the addition agents be oil-soluble in all proportions. Also, certain compounds are of value as gelling or bodying agents when used in amounts greater than are strictly soluble.

The addition agents above enumerated for use in my compounded lubricants include certain ones which may be found to at least partially decompose under conditions of extreme stress such as the very high temperature encountered in certain classes of use, while others are quite stable even under such extreme conditions.

The use for which the lubricant is designed therefore determines the particular type of addition agent to be selected. A certain amount of decomposition, which proceeds at a relatively slow rate, is usually not harmful. Care should be exercised, however, to select for a particular set of operating conditions, an addition agent which in the oil base used, will not decompose under such operating conditions except at a low rate.

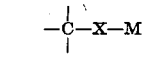
By the term "stable" as used herein in describing the addition agents is meant the characteristic of the addition agents which enables them to resist decomposition in the oil under the condition of use for which the lubricating composition is designed.

The lubricating compositions of this invention may be prepared by first preparing the salt and then dissolving the salt in the oil base, or they may be prepared by reacting the acid in solution in all or a portion of the oil with a suitable basic compound in order to form the desired salt directly in solution in oil. In the latter case, it is frequently desirable to remove the water formed by the reaction, or which may have been added with the basic compound, by some means such as by heating at atmospheric or sub-atmospheric pressure.

In case the salt to be used is water-insoluble, an alternative procedure is as follows:

An aqueous solution of a water-soluble salt of the acid is first prepared, for example by dissolving the acid in an aqueous solution of caustic soda or caustic potash. The aqueous salt solution is then emulsified with oil and a water-soluble salt containing the cation of the desired salt is added to the mixture. The desired salt is thus precipitated from the aqueous medium and subsequently or simultaneously dissolved by the oil medium. Separation of the aqueous and oil layers is then effected for example by settling or centrifuging. Subsequent water-washing of the oil solution to remove traces of inorganic salts may be desirable, and removal of moisture may also be required.

It will be observed that all of the specific examples of addition agents for use in my improved lubricating composition may be defined as salts of aromatic acids, which salts contain the radicle



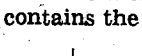
in which X is an element of the class consisting of oxygen and sulphur and M is a member of the class consisting of metals and basic radicles.

This application is a continuation-in-part of my aforesaid co-pending applications Serial Numbers 737,070, 216,153 and 245,226.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

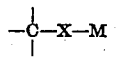
I therefore particularly point out and distinctly claim as my invention:

1. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid which salt contains the radicle



in which X is an element of the class consisting of oxygen and sulphur and M is a member of the class consisting of metals and basic radicles.

2. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble metallic salt of an aromatic acid which salt contains the radicle



in which X is an element of the class consisting of oxygen and sulphur and M is a member of the class consisting of metals and basic radicles.

3. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble halogen bearing salt of an aromatic acid.

4. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble halogen bearing metallic salt of an aromatic acid.

5. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of a halogenated aromatic acid.

6. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an alkylated aromatic acid.

7. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble metallic salt of an alkylated aromatic acid.

8. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble halogen bearing metallic salt of an alkylated aromatic acid.

9. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid containing a substituent selected from the class consisting of aliphatic and cyclo-aliphatic radicles.

10. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid containing an aliphatic substituent.

11. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid containing a cyclo-aliphatic substituent.

12. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble metallic salt of an aromatic acid containing a substituent selected from the class consisting of aliphatic and cyclo-aliphatic radicles.

13. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble metallic salt of an aromatic acid containing an aliphatic substituent.

14. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble metallic salt of an aromatic acid containing a cyclo-aliphatic substituent.

15. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble divalent metallic salt of an aromatic acid containing a substituent selected from the class consisting of aliphatic and cyclo-aliphatic radicles.

16. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble, halogen bearing salt of an aromatic acid containing a substituent selected from the class consisting of aliphatic and cyclo-aliphatic radicles.

17. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble, halogen bearing metallic salt of an aromatic acid containing a substituent selected from the class consisting of aliphatic and cyclo-aliphatic radicles.

18. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing an aromatic acid with an unsaturated aliphatic compound.

19. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing a halogenated aromatic acid with an unsaturated aliphatic compound.

20. A lubricating composition containing as a principal lubricating constituent a major amount

of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing an aromatic acid with a halogenated aliphatic compound.

21. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing an aromatic acid with an unsaturated cyclo-aliphatic compound.

22. A lubricating composition containing as a princip l lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing an aromatic acid with a halogenated cyclo-aliphatic compound.

23. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing an aromatic compound with an unsaturated aliphatic acid.

24. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing an aromatic compound with a halogenated aliphatic acid.

25. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing an aromatic compound with an unsaturated cyclo-aliphatic acid.

26. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble salt of an aromatic acid of the type which may be produced by condensing an aromatic compound with a halogenated cyclo-aliphatic acid.

CARL F. PRUTTON.