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LUBRICANT

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28 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 containing an inorganic substituent.

More especially, my invention comprises the discovery that salts of aromatic acids, of the type which contain an inorganic substituent as well as 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 voltolized 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 containing an inorganic substituent. The term salts as used herein is intended to include the organic salts of these aromatic acids as well as the inorganic salts of these aromatic acids. The inorganic salts such as the metallic salts of these 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 containing an inorganic substituent are a particular 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 an inorganic substituent and also 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 additionally contain a halogen such as chlorine.

A convenient way of more specifically identifying the various salts which may thus be used in accordance with this invention as addition agents in the improved lubricating compositions is to first identify the aromatic acids containing an inorganic substituent; to then refer to the various radicles or bases, both organic and inorganic, which may be combined with such aromatic acids; and to then list a representative number of salts which may thus be produced.

In the identification of the aromatic acids which may thus be employed in the production of salts, the use of which is concerned in the present invention, reference may be had to convenient modes of preparation of such acids.

Since the aromatic acids from which the organic and inorganic salts are prepared are characterized by the inclusion therein of an inorganic substituent, it is believed desirable to first list a number of such characterizing inorganic substituents.

TABLE I.—*Inorganic substituents*

By the term "inorganic substituents" as used herein, I mean to include all substituents which either consist of, or contain, one or more of the following elements:

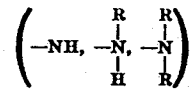
The halogens, e. g.,
- Chlorine
- Bromine
- Fluorine
- Iodine

Sulphur
Phosphorus
Arsenic
Nitrogen
The metals

(Any of the metals listed in Table XVII hereof. Such metal will, of course, be in addition to the metal which may be present in the base used to form the salt. If the salt is formed from an organic base, the metal present in the inorganic substituent referred to may be the only metal present in the compound.)

When nitrogen is present in a substituent group, such group may be selected from the following:

(1) Amino



(2) Imino

(=NH, =NR)

(3) Azo

(—N=N=R)

(4) Hydrazo

(—NH—NH—R)

(5) Hydrazine

(—NH—NH_2)

(6) Nitrile

(—C≡N)

When sulphur is present as part of a substituent group, it may be present as in any of the following:

(1) Mercapto

(—SH)

(2) Sulphide

where the radicle is directly attached to a carbon atom

(—S—R)

(3) Polysulphide

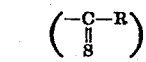
where x is at least 2

($—S_x—R$)

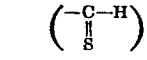
(4) Thio-cyanate

(—SCN)

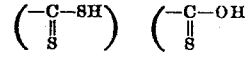
(5) Thioketone



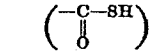
(6) Thio-aldehyde



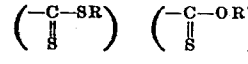
(7) Thio-carboxyl



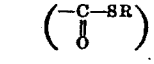
and



(8) Thio-ester



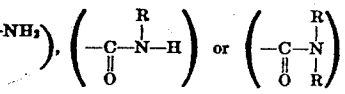
and



When the inorganic substituent also contains oxygen in addition to the characterizing inorganic element, such substituent may be any of the following, for example:

(1) (—O—M where M is a metal)

(2) Amide and substituted amide



(3) Where the oxygen is directly attached to a carbon atom: arsenite, hydrochlorite, phosphite, thiophosphate, thiophosphite, and β hydroxylamines.

(4) Where the oxygen is indirectly attached through the means of some other atom, e. g.: arsenate, chlorate, chlorite, cyanate, α hydroxylamine, nitrate, nitrite, nitro, nitroso, oxime, perchlorate, phosphate, sulphate, sulphite, sulphinic acid, sulphone, sulphonic acid, sulphoxide, and thiosulphate.

Additional examples of inorganic substituents are those thio substituents which correspond to the oxygen containing substituents given immediately above under (1), (2), (3) and (4), but in which one or more of the oxygen atoms in any of the substituents of (1), (2), (3) and (4) above are replaced with sulphur, for example,

Mercaptide (—S—M)
Thioamide, etc.

Any of the above-mentioned inorganic substituents may be combined by known means with any representative aromatic acids such as those specifically identified in Table II below as well as those whose mode of preparation is hereinafter defined, in the production of aromatic acids containing an inorganic substituent from which either organic or inorganic salts may be prepared.

TABLE II.—*Aromatic acids*

Benzoic acid
Benzoic acid derivatives
  Azobenzoic acid
  Mercapto benzoic acid
  Lauryl benzoic acid
Salicylic acid
Salicylic acid derivatives
  Ethyl salicylic acid
Carboxylic acid derivatives
  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
Furoic acid
Cinnamic acid
Phthalic acid
Toluic acid
Mercapto rosolic acid
Naphthyloic acid
Any of the foregoing which have been halogenated.

In the preparation of those salts of aromatic acids containing an inorganic substituent and additionally 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, which may or may not, itself, contain an inorganic substituent included in the end product, with
  (*a*) An aliphatic unsaturated acid containing an inorganic substituent, or
  (*b*) A halogenated aliphatic acid which may optionally contain another inorganic substituent not completely replaced in the condensation reaction, and thus forming a part of the end product, or
  (*c*) A cyclo-aliphatic unsaturated acid containing an inorganic substituent, or
  (*d*) A halogenated cyclo-aliphatic acid optionally containing a further inorganic substituent not replaced in the condensation reaction, and thus occurring in the end product; or by

(2) Condensing an aromatic acid, which may or may not contain an inorganic substituent included in the end product, with
  (*a*) An unsaturated aliphatic compound containing an inorganic substituent, or
  (*b*) A halogenated aliphatic compound, which may optionally contain a further inorganic substituent not fully replaced during the condensation reaction, and thus occurring in the end product, or
  (*c*) An unsaturated cyclo-aliphatic compound containing an inorganic substituent, or
  (*d*) A halogenated cyclo-aliphatic compound optionally containing a further inorganic substituent not fully replaced during the condensation reaction, and thus occurring in the end product.

In the table below will be found listed examples of aromatic compounds which may be used in any of the condensation reactions identified under (1) above in the preparation of aromatic acids containing inorganic substituents, and from which appropriate salts may be prepared.

TABLE III.—*Aromatic compounds*

(1) With no inorganic substituent:
  Benzene
  Toluene
  Naphthalene
  Diphenyl
  Xylene
  Retene
  Mesitylene
(2) When the inorganic substituent is a halogen:
  Chlorbenzene
  Dichlorbenzene
  Chlornaphthalene
  Chlortoluene
  Chlor retene
  Chloranthracene
  Chlor benzophenone
  Chlor acetophenone
  Chlor diphenyl oxide
  Methylchlorphenyl ether
  Ethylchlorphenyl ether
  Chlor β naphthyl ketone
(3) When the inorganic substituent contains sulphur:
  Phenyl mercaptan
  Diphenyl sulphide
  Diphenyl disulphide
  Dinaphthyl sulphide
  Dinaphthyl disulphide
  Amyl phenyl sulphide
  Dimethyl phenyl sulphide
  Mercapto phenyl sulphide
  Mercapto phenyl disulphide
(4) When the inorganic substituent contains nitrogen:
  Nitrobenzene
  Phthalimide
(5) When the inorganic substituent contains nitrogen and sulphur:
  Phenylthiazole
  Phenyl nitro mercaptan
  Nitro derivative of phenyl disulphide
  Nitro derivative of phenyl phenyl monosulphide
  Thiobenzamide
  Thiobenzanalide

In Table IV below are given a number of representative long chain fatty acids with and without inorganic substituents.

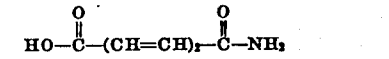
TABLE IV.—*Long chain fatty acids*

(1) With no inorganic substituent:
  Lauric
  Palmitic
  Stearic
  Myristic
  Oleic
  Linoleic
  Ricinoleic
  Hypogolic
  Erucic
  Linolenic
  Muconic
  Mono esters of muconic acids

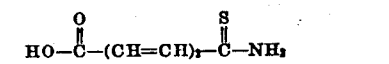
(2) Where the inorganic substituent includes a halogen:
Any of the halogen derivatives of the acids of class (1) above, as well as halogenated saturated fatty acids, such as
Chlorinated stearic acid, e. g.
Dichlor stearic acid
Hydroxy chlor stearic acids

(3) Where the inorganic substituent includes sulphur:
Mercapto stearic acids
Thiostearic acids
Mercapto oleic acids
Thio oleic acids
Chlor mercapto stearic acids
Chlor thiostearic acids
Thiomuconic acids
Acids obtained by the treatment of unsaturated fatty acids with sulphur, sulphur monochloride, or sulphur dichloride, for example, sulphurized linoleic acid.

(4) Where the inorganic substituent includes nitrogen:
Nitrostearic acids
Amino stearic acids
Amino mercapto stearic acids
Nitro hydroxy stearic acids
Amino hydroxy stearic acids
Amino chlor stearic acids
Amino oleic acids
Nitrochlorstearic acids
Amino thio oleic acids
Mono-amides of muconic acid, e. g.



Mono-thioamides of muconic acid, e. g.



Any suitable condensation reaction may be employed for the purpose of carrying out the condensation between the aromatic compounds and the long chain fatty acids above identified. It will be observed that generally the long chain fatty acid should either be of the unsaturated type, or have a replaceable halogen in order that the condensation reaction may be conveniently carried out. Thus, in the foregoing lists where particular examples of long chain fatty acids given are saturated, it will be understood that a halogen derivative of the same will be prepared as an intermediate step in carrying out the condensation reaction.

It will be observed that the condensation reaction contemplated under (1) above contemplates the condensation or an aromatic compound which contains an inorganic substituent with various acids. When the aromatic compound contains an inorganic substituent, such as for example any of the list under Table III (2), (3), (4) and (5), then the components of the condensation reaction identified under (1) (*a*), (*b*), (*c*), and (*d*) may be any of those listed in the following Tables V to VIII, inclusive.

TABLE V.—*Aliphatic unsaturated acids*

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

TABLE VI.—*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 V above.

TABLE VII.—*Cyclo-aliphatic unsaturated acids*

Chaulmoogric acid
Hydrocarpic acid

TABLE VIII.—*Halogenated cyclo-aliphatic acids*

Chlorinated naphthenic acids
Chlorhexahydrobenzoic acid
Chlorchaulmoogric acid
Chlorhydrocarpic acid

When the aromatic acid, forming one component of the condensation reaction identified under (2) above, contains an inorganic substituent, then the components of such condensation reaction identified under (2)—(*a*), (*b*), (*c*), and (*d*) above may for example be any of the compounds identified in Tables IX to XII below.

TABLE IX.—*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.

TABLE X.—*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 IX above.

TABLE XI.—*Unsaturated cyclo-aliphatic compounds*

Cyclohexene
Cyclohexadiene
Cyclopentene
Cyclobutene

TABLE XII.—*Halogenated cyclo-aliphatic compounds*

Chlorcycloparaffines
Chlorcyclobutane
Chlorcyclopentane
Chlorethylcyclobutane
Chlorcyclohexane
Dichlorcyclohexane
Chlorcyclopentene

In the following table XIII will be found listed several representative examples of components (*a*), (*b*), (*c*), and (*d*) for use in the condensation reaction under (1) above, which components contain an inorganic substituent, in addition to such examples found in Table IV.

TABLE XIII

(*a*) Aliphatic unsaturated acids containing an inorganic substituent:
Chlor vinyl acetic acids
Chlor acrylic acids
Chlor crotonic acids
Amino vinyl acetic acids
Amino acrylic acids
Amino crotonic acids
Thio vinyl acetic acids
Thio acrylic acids
Thio crotonic acids
Mono-amides of maleic acid and of glutaconic acid

(*b*) Halogenated aliphatic acids containing an additional inorganic substituent:
Chlor nitrobutyric acids
Chlor thiobutyric acids
Chlor thioacetic acids

(*c*) Cyclo-aliphatic unsaturated acids containing an inorganic substituent:
Thio hydrocarpic acids
Amino chaulmoogric acids

(*d*) Halogenated cyclo-aliphatic acids containing an additional inorganic substituent:
Chlorinated thio naphthenic acids
Chlor nitro hexahydrobenzoic acids

In the following Table XIV will be found listed several representative examples of components (*a*), (*b*), (*c*), and (*d*) for use in the condensation reaction under (2) above, which components contain an inorganic substituent.

TABLE XIV

(*a*) Unsaturated aliphatic compounds containing an inorganic substituent:
Dichlor ethylene
Tetrachlor ethylene
Dichlor butylene
Acrylic acid amide
Acrylic acid thio amide
Oleic acid amide
Oleic acid thio amide
Tri-allyl phosphite
Tri-allyl phosphate
Esters of thio unsaturated fatty acids, such as those of thio-acrylic, thio-crotonic, thio-oleic and thio-linoleic acids, e. g.
Methyl thio-crotenate
Cyclohexyl thio-crotenate
Lauryl thio-crotenate
Methyl thio-oleate
Cyclohexyl thio-oleate
Lauryl thio-oleate

(*b*) Halogenated aliphatic compounds which contain a further inorganic substituent.
Chlor acetamide
Chlor nitro acetamide
Nitro acetyl chloride
Thio acetyl chloride
Chlor thio acetamide
Chlor stearic acid amide
Chlor nitro stearic acid amide
Nitro stearoyl chloride
Thio stearoyl chloride
Chlor stearic acid thio amide
Tri (chlor ethyl) phosphite
Tri (chlor ethyl) phosphate
Chlor esters of thio fatty acids such as those of thio acetic acid and thio stearic acid, e. g.
Chlor methyl thio acetates
Chlor cyclohexyl thio acetates
Chlor lauryl thio acetates
Chlor methyl thio stearates
Chlor cyclohexyl thio stearates
Chlor lauryl thio stearates
Chlor cyclohexyl crotonate
Cyclohexyl thio-oleate
Chlor cyclohexyl thio-oleate

(*c*) Unsaturated cyclo-aliphatic compounds containing an inorganic substituent.
Dichlor cyclo-hexene
Nitro cyclo-hexene

(*d*) Halogenated cyclo-aliphatic compounds containing an inorganic substituent.
Chlor nitro cyclo-hexane
Chlor cyclo-hexyl thio-acetates
Chlor cyclo-hexyl thio-stearates
Cyclo hexyl chlor thio-stearates
Amides of chlor thio-naphthenic acids
Tri (chlor cyclo-hexyl) phosphate
Tri (chlor cyclo-hexyl) phosphite
The acid chloride of cyclo-hexyl thio-stearic acid amides of chlor thio-stearic acids

Many of the aromatic acids which contain a substituent selected from the class consisting of aliphatic radicles and cyclo-aliphatic radicles, in addition to an inorganic substituent, may be prepared by first carrying out the condensation reaction to produce an aromatic acid containing the aliphatic or cyclo-aliphatic radicle and another substituent the latter being then converted to the desired inorganic substituent. The acid thus produced may then be used to form the salt which is the addition agent contemplated herein. For example, in the preparation of amino phenyl stearic acid, nitro-benzene may be condensed with oleic acid to form nitro-phenyl stearic acid, and the latter compound reduced, for example by means of zinc and hydrochloric acid,

to form amino-phenyl stearic acid. The amino-phenyl stearic acid may in turn be further modified by substituting various organic radicles for one or more of the hydrogens attached to the nitrogen atom, for example to form N-lauryl amino phenyl stearic acid.

Certain inorganic radicles, for example mercapto, phosphate, phosphite, thio-ester and similar radicles, may be prepared by the action of certain reagents on compounds containing the hydroxyl radicle. When aromatic acids which contain these substituents in addition to an aliphatic or a cyclo-aliphatic substituent are to be prepared, an aromatic acid which contains only the hydroxyl radicle may be formed as an intermediate step. For example from hydroxy phenyl stearic acid the following may be prepared:

1. By the reaction of phosphorus penta sulphide—mercapto phenyl thio stearic acids;
2. By the reaction of phosphorus trichloride—the phosphite of hydroxy phenyl stearic acid;
3. By the reaction of phosphorus oxygen chloride—phosphate of hydroxy phenyl stearic acid; and
4. By the reaction of acid chlorides of thio organic acids, for example thio acetyl chloride—the thio esters (such as the thio acetate) of hydroxy phenyl stearic acid.

It may be preferable to use an ester of the aromatic acid (e. g. the methyl ester of hydroxy phenyl stearic acid in the above examples) rather than the acid itself in carrying out reactions of this type.

The aromatic acids forming one component of the condensation reaction identified under (2) above may, of course, be any of the aromatic acids of Table II above, or such derivatives of the same as may be provided by combining, with the aromatic acids of Table II above, any of the inorganic substituents of Table I above.

The following is a list of a few aromatic acids containing an inorganic substituent and from which organic and inorganic salts may be prepared:

Mercapto benzoic acid
Nitro benzoic acid
Mercapto phthalic acid
Mercapto toluic acid
Nitro toluic acid
Nitro naphthoic acid
Mercapto naphthoic acid
Monosulphide and disulphide of benzoic acid, i. e.
  Dicarboxyl diphenyl sulphide
  Dicarboxyl diphenyl disulphide
Monosulphide of nitrobenzoic acid
Mono- and disulphide of salicylic acid
Thiobenzoic acids
Thionaphthoic acids
Thiophenyl benzoic acids
Thiocyclohexyl benzoic acids
Phenyl thiostearic acids
Chlorbenzoic acids
Chlornaphthoic acids
Chlorphenylbenzoic acids
Cyclohexyl chlorbenzoic acids
Chlorphenyl stearic acids
Mercaptophenyl stearic acids
Phenyl mercapto stearic acids
Chlorphenyl mercapto stearic acids
Chlorphenyl thiostearic acids
Thiosalicylic acids
Chlorsalicylic acids
Lauryl thiosalicylic acids
Lauryl chlorsalicylic acids

In the following will be found listed a number of organic radicles or bases which may thus be employed in the preparation of organic salts of the various aromatic acids containing inorganic substituents as above specifically identified, or as to which the mode of preparation has been indicated.

TABLE XV.—*Organic radicles or bases*

Amino compounds, such as:
  Monoethanolamine
  Diethanolamine
  Triethanolamine
  Analine
  Benzylamine
  Laurylamine
  Diphenylamine
  Triphenylamine
  Diethylamine
  Triethylamine
  Putrescine
Amido compounds

$$\left(\begin{matrix}-C-NH_2\\ \| \\ O\end{matrix}\right)$$

such as:
  Benzoyl amide
  Phenylacetic amide
  Lauroyl amide
  Stearoyl amide
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 containing an inorganic substituent which may thus be prepared for use may be listed the following as illustrative examples.

TABLE XVI.—*Organic salts*

Benzylamine
Mercapto phenyl stearate
Benzylamine nitro phenyl stearate
Benzylamine nitro mercapto stearate
Benzylamine phenyl mercapto stearate
Benzylamine phenyl nitro stearate
Condensation product of diphenyl sulphide and an organic acid
Benzylamine salt of that
Laurylamine salt of phenyl mercapto hydroxy stearic acid
Salt of laurylamine phenyl mercapto stearic acid

Benzylamine phenyl sulphurized organic acid
Benzylamine phenyl sulphurized rescinoleic acid
The corresponding aniline salts of the foregoing

In the following table are listed a number of inorganic bases which may be combined with any organic substituent which may thus be prepared for use.

TABLE XVII.—*Inorganic bases*

Sodium
Potassium
Ammonium
Lithium
Magnesium
Calcium
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 examples of inorganic salts of aromatic acids containing an inorganic substituent which may be produced by the combination of certain of the aromatic acids above specifically identified, or as to which the mode of preparation has been given with certain of the inorganic bases of Table XVII above.

TABLE XVIII

Calcium chlorphenyl stearate
Magnesium chlorphenyl stearate
Aluminum chlorphenyl stearate
Beryllium chlorphenyl stearate
Cobalt chlorphenyl stearate
Nickel chlorphenyl stearate
Copper chlorphenyl stearate
Manganous chlorphenyl stearate
Stannous chlorphenyl stearate
Stannic chlorphenyl stearate
Cadmium chlorphenyl stearate
Cyclohexyl amine chlorphenyl stearate
Benzyl amine chlorphenyl stearate
Tribenzyl amine chlorphenyl stearate
Magnesium stearoyl chlorbenzoate
Stannous stearoyl chlorbenzoate
Cyclohexylamine stearoyl chlorbenzoate
Aluminum salt of the mono-octyl ester of chlorphthalic acid
Benzylamine salt of the mono-(methyl-cyclohexyl) ester of chlorphthalic acid
Magnesium lauryl-thiobenzoate
Magnesium lauryl-chlorbenzoate
Magensium thio-stearoyl benzoate
Magnesium stearoyl thiobenzoate
Magensium stearoyl mercapto benzoate
Magnesium octyl salt-ester of chlorphthalic acid
Magnesium lauryl salt-ester of chlorphthalic acid
Magnesium cetyl salt-ester of chlorphthalic acid
Magnesium salt of the acid octyl mono-thio-ester of phthalic acid, i. e.

$Mg[OOC(C_6H_4)COSC_8H_{17}]_2$

Magnesium thio-salt of the acid octyl ester of phthalic acid, i. e. $Mg[SOC(C_6H_4)COOC_8H_{17}]_2$
Magnesium butyl salt-ester of tetrachlorphthalic acid
Calcium salt of lauryl thio-salicylic acid
Magnesium salt of stearoyl thio-salicylic acid
Calcium phenyl mercapto stearate
Calcium chlorphenyl mercapto stearate
Calcium phenyl thiostearate
Calcium chlorphenyl thiostearate
Cobalt chlorphenyl thiostearate
Calcium chlorcresyl stearate
Calcium chlornaphthyl stearate
Calcium chlorxenyl stearate
Calcium cyclohexyl-chlorphenyl stearate
Calcium and cobalt salts of the acids formed by the condensation of oleic acid with:
Phenyl mercaptan
Diphenyl sulphide
Diphenyl disulphide
Chlorphenyl mercaptan
Chlordiphenyl sulphide
Benzyl mercaptan
Dibenzyl sulphide
Dibenzyl disulphide
Chlorbenzyl mercaptan
Chlordibenzyl sulphide
Di(chlorbenzyl) disulphide
Chlorbenzyl acetate
Benzyl thio-acetate
Benzyl thio-stearate
Methyl thiobenzoate
Cyclohexyl thiobenzoate
Lauryl thiobenzoate
Cyclohexyl chlorbenzoate
Thiobenzoyl chloride
Thiobenzamide
N-lauryl thiobenzamide
N-cyclohexyl thiobenzamide
Chlor-thiobenzoyl chloride
Chlor-thiobenzamide
N-lauryl chlor-thiobenzamide
Phenyl cyanide
Benzyl cyanide
Phenyl thiocyanate
Benzyl thiocyanate
Tribenzyl phosphate
Tribenzyl phosphite
Tri(chlorbenzyl) phosphate
Tri (chlorbenzyl) phosphite
Chlor diphenyl ether
Chlor acetophenone
Chlor benzophenone
Thio-acetophenone
Thiobenzophenone
Chlor-thiobenzophenone

Calcium salts of the acids formed by the condensation of thio-crotonic acids with:
Stearoyl-benzene
Stearoyl-diphenyl
Stearoyl-naphthalene
Stearoyl-dibenzyl
Calcium salts of the acids formed by the condensation of crotonic acid with:
Stearoyl-chlorbenzene
Stearoyl-chlordiphenyl
Stearoyl-chlornaphthalene
Thiostearoyl-benzene
Thiostearoyl-diphenyl
Thiostearoyl-chlorbenzene
Stearoyl-cyclohexylthiophenol
Stearoyl-cyclohexylchlorthiophenol

Calcium salts of the acids formed by the condensation of esters of oleic acid (e. g. cyclohexyl oleate, and methyl oleate) with:
- Chlorbenzoic acid
- Thiobenzoic acid
- Chlorsalicylic acid
- Thiosalicylic acid
- Chlornaphthoic acid
- Mono-esters of chlor-phthalic acids, e. g. mono-methyl, mono-cyclohexyl, and mono-lauryl esters of chlor-phthalic acids

Calcium salts of the acids formed by the condensation of thio-esters of oleic acid (e. g. cyclohexyl thio-oleate and methyl thio-oleate) with:
- Benzoic acid
- Chlorbenzoic acid
- Thiobenzoic acid
- Chlornaphthoic acid
- Salicylic acid
- Chlorsalicylic acid
- Thiosalicylic acid
- Mono-methyl, mono-lauryl, and mono-cyclohexyl esters of phthalic acid and chlorphthalic acids

Calcium salts of the acids formed by the condensation of substituted amides of oleic acid (e. g. N-cyclohexyl, and N-lauryl, oleic acid amide) with:
- Benzoic acid
- Chlorbenzoic acid
- Thiobenzoic acid
- Chlornaphthoic acid
- Salicylic acid
- Chlorsalicylic acid
- Thiosalicylic acid
- Mono-methyl and mono-cyclohexyl esters of phthalic acid and chlorphthalic acids

Calcium salts of the acids formed by the condensation of substituted thio-amides of oleic acid (e. g. N-cyclohexyl, and N-lauryl, thio-oleic acid amides) with:
- Benzoic acid
- Chlorbenzoic acid
- Thiobenzoic acid
- Chlornaphthoic acid
- Salicylic acid
- Chlorsalicylic acid
- Thiosalicylic acid
- Mono-methyl and mono-cyclohexyl esters of phthalic acid and chlorphthalic acids

Salts of each of the following amines:
- Dilauryl amine
- Dicyclohexyl amine
- Stearoyl aniline
- Thiostearoyl aniline
- Stearoyl di-phenylamine
- Lauryl phenthiazine
- Stearoyl phenthiazine

With each of the following acids:
- Chlorphenyl stearic acid
- Phenyl thiostearic acid
- Mercapto phenyl stearic acid
- Stearoyl chlorbenzoic acid
- Stearoyl thiobenzoic acid
- Stearoyl mercapto benzoic acid
- Mono-methyl ester of chlorphthalic acids
- Mono-butyl ester of chlorphthalic acids
- Mono-lauryl ester of chlorphthalic acids
- Mono-cyclohexyl ester of chlorphthalic acids

The basic calcium, magnesium, copper and nickel salts of chlor-phenyl stearic acid. These were prepared by dissolving about 20% of chlorphenyl stearic acid in a mineral oil, adding twice the theoretical amount of freshly precipitated metal hydroxide required to neutralize the acid and heating for about two hours at about 100° C. An equal volume of benzol was then added, and after filtering the benzol and water removed by heating the oil-benzol solution under vacuum up to a temperature of about 120° C. The oil solutions of the basic salts thus produced were then added to motor oil to make a lubricating composition containing about 1% of the basic salt.

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 chlorphenylstearate.

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 9 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 chlorbenzoic acid, methyl chlorbenzoate may be condensed with stearoyl chloride to form methyl stearoyl chlorbenzoate, this ester saponified with sodium hydroxide, and the resulting sodium salt reacted with magnesium chloride in aqueous solution to form magnesium stearoyl chlor-benzoate. An example of the preparation of magnesium stearoyl chlor-benzoate in detail is as follows:

A mixture of 1 mole each of methyl chlorbenzoate 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 chlor-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 chlor-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 when dissolved in a naphthenic type oil in a concentra-

tion of 1% will be found to materially improve the oil for use 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 containing an inorganic substituent. These may be formed for example by neutralizing an acid ester of a polybasic aromatic acid, which contains an inorganic substituent, with a base, or by partially saponifying a neutral ester of such 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 containing an inorganic substituent, e. g.
   Thio, mercapto, amino, nitro, or chloro substituted:
   - Phthalic acids
   - Trimesic acid
   - Trimellitic acid
   - Hemimellitic acid
   - Pyromellitic acid
   - Mellophanic acid
   - Prehnitic acid
   - Benzene pentacarboxylic acid
2. Naphthalene polycarboxylic acids containing an inorganic substituent, e. g.
   Thio, mercapto, amino, nitro, or chloro substituted:
   - 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 acids
   - Pyridine pentacarboxylic acid
4. Pyrrole polycarboxylic acids
5. Quinoline polycarboxylic acids
6. Thiophene polycarboxylic acids
7. Thiazole polycarboxylic acids
8. Diphenyl polycarboxylic acids containing an inorganic substituent, e. g.
   Thio, mercapto, amino, nitro, or chloro substituted:
   - Diphenic acid
9. Dibenzyl polycarboxylic acids containing an inorganic substituent
10. Anthracene polycarboxylic acids containing an inorganic substituent
11. Phenanthrene polycarboxylic acids containing an inorganic substituent
12. Thianthrene polycarboxylic acids containing an inorganic substituent
13. Acids formed by the condensation of an unsaturated polycarboxylic acid with an aromatic compound containing an inorganic radicle

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 thiophthalic acids have been found suitable.

Specific examples of such salt-esters are:

1. The magnesium salt of the mono lauryl ester of mono-thio phthalic acid
2. The calcium salt of the mono-(lauryl-benzyl) ester of di-thio phthalic acid
3. The calcium salt of the mono-(cyclohexyl-cyclohexyl) ester of chlor-phthalic acid
4. The cobaltous salt of the mono-cyclohexyl ester of dichlor diphenic acid

Also included among the compounds contemplated for use by this invention are stable oil soluble salts of the amides and thioamides of polybasic aromatic acids in which at least one carboxyl group has not been converted to the amide. As examples of this class of compounds are those having the general formula:

$$R{-}O{-}\overset{\overset{O}{\|}}{C}{-}R'(CONH_2)_n$$

in which R is a metal or radicle derived from a base, and R' is an aromatic radicle. Examples of sulphur-containing compounds of this class are those in which one or more of the oxygen atoms of the above general formula have been replaced by sulphur, e. g.

$$ROC{-}R'CSNH_2, \quad RSC{-}R'CONH_2, \quad ROC{-}R'CONH_2$$

$$RSC{-}R'CONH_2, \quad RSC{-}R'CSNH_2 \text{ and } RSC{-}R'CSNH_2$$

This class of compounds also includes those in which one or both of the hydrogen atoms of the above general formulas have been replaced by organic radicles. Compounds of the latter type are often preferred because of improved oil solubility.

Examples of polybasic aromatic acids from which salts, of the above type, may be prepared are 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 acids
   - Pyridine pentacarboxylic acid
4. Pyrrole polycarboxylic acids
5. Quinoline polycarboxylic acids
6. Thiophene polycarboxylic acids
7. Thiozole 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

13. Acids formed by the condensation of an unsaturated polycarboxylic fatty acid with an aromatic compound

Specific examples of these salts of amido-aromatic acids are:

1. The magnesium salt of mono-(N-lauryl amido) phthalic acid

2. The calcium salt of mono-(N-lauryl-benzyl thio-amido) phthalic acid

Another class of compounds also included among those contemplated by this invention are the "basic" oil-soluble salts of aromatic acids containing an inorganic radicle. By the term "basic salt" is intended the product which is obtained by reacting the acid with twice the amount of base theoretically required to neutralize the acid. These products are conveniently made by dissolving the aromatic acid in mineral oil in a concentration up to about 30% and adding twice the theoretical amount of freshly precipitated metallic hydroxide required to neutralize the acid and heating to a temperature of about 100° C. for about two hours. An equal volume of benzol or other suitable solvent is added and the oil-solvent mixture filtered. The resultant filtrate will be found to contain twice the amount of metal, as compared with the amount of aromatic acid radicle, which would be present in the normal salt. After filtration the mixture is heated under vacuum in order to remove the solvent together with the water which may have been added with the metallic hydroxide and that formed by the reaction of the hydroxide with the acid. The oil solution of the basic salt may then be used as a material to add to the mineral oil which forms the major portion of the lubricating composition which is the subject of this invention.

In the preparation of these basic salts, presumably all of the metallic hydroxide has reacted since any unreacted metallic hydroxide or oxide would be removed by the filtration step. Although the resultant salt is characterized as "basic," it does not necessarily have a basic reaction when shaken with water. The foregoing is the assumption of what takes place in the carrying out of the reaction just described and is believed to be correct. The mineral oil used in carrying out the foregoing reaction was a 150 pale Mid-Continent neutral oil. It may be that some of the metal combined with components present in the oil. Whatever may have been the precise occurrence and the exact nature of the end product, such end product was found to be of practical utility.

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 encountered, 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 .5% 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 describ-

ing 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 salts contemplated for use as addition agents in the lubricants of my invention are salts which 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 containing an inorganic substituent such salt containing the radicle



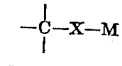
in which X is an element of the class consisting of oxygen and sulphur and M is a member of the class consisting of metals and basic radicles.

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 salt of an aromatic acid containing a substituent selected from the class consisting of aliphatic and cyclo-aliphatic radicles, and an inorganic substituent.

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 salt of an aromatic acid containing an aliphatic substituent and an inorganic substituent.

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 salt of an aromatic acid containing a cyclo-aliphatic substituent and an inorganic substituent.

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 metallic salt of an aromatic acid containing a sulphur containing radicle such salt containing the radicle

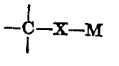


in which X is an element of the class consisting of oxygen and sulphur and M is a member of the class consisting of metals and basic radicles.

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 metallic salt of an aromatic acid containing a sulphide radicle.

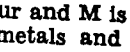
7. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble metallic salt of an aromatic acid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

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 metallic salt of an aromatic acid containing a nitrogen containing radicle such salt containing 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.

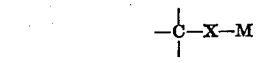
9. A lubricating composition containing as a principal lubricating constituent a major amount of a mineral lubricating oil with the properties of such composition affecting its use as a lubricant improved by incorporating therein a minor amount of a stable oil-soluble metallic salt of an aromatic acid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

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 metallic salt of an aromatic acid containing a sulphur and oxygen containing radicle such salt containing 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.

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 metallic salt of an aromatic acid containing a nitrogen and sulphur containing radicle.

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 nitrogen, sulphur, and oxygen containing radicle.

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 salt of an aromatic acid containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound containing an inorganic substituent with a long chain fatty acid.

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 salt of an aromatic acid containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound containing a sulphide substituent with a long chain fatty acid.

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 salt of an aromatic acid containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound containing a polysulphide substituent with a long chain fatty acid.

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 salt of an aromatic acid containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound containing nitrogen with a long chain fatty acid.

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 salt of an aromatic acid containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound containing sulphur and oxygen with a long chain fatty acid.

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 containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound containing nitrogen and sulphur with a long chain fatty acid.

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 containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound containing nitrogen, sulphur and oxygen with a long chain fatty acid.

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 containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound with a long chain fatty acid containing an inorganic substituent.

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 containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound with a sulphur bearing long chain fatty acid.

22. 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 inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound with a nitrogen bearing long chain fatty acid.

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 containing an inorganic constituent, which acid is of the type which may be produced by condensing an aromatic compound with a long chain fatty acid containing a sulphide constituent.

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 containing an inorganic substituent, which acid is of the type which may be produced by condensing an aromatic compound with a long chain fatty acid containing a polysulphide constituent.

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 containing an inorganic substituent, which acid is of the type which may be produced by condensing an aromatic compound with a long chain fatty acid containing a sulphur and oxygen bearing substituent.

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 containing an inorganic substituent, which acid is of the type which may be produced by condensing an aromatic compound with a long chain fatty acid containing a sulphur and nitrogen bearing substituent.

27. 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 inorganic substituent, which acid is of the type which may be produced by condensing an aromatic compound with a long chain fatty acid containing a sulphur, nitrogen and oxygen substituent.

28. 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 inorganic substituent, which acid is of the type which may be produced by condensing an aromatic compound with a long chain fatty acid containing a nitrogen and oxygen bearing substituent.

CARL F. PRUTTON.

CERTIFICATE OF CORRECTION.

Patent No. 2,223,130. November 26, 1940.

CARL F. PRUTTON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 12, first column, lines 37, 48, 58, and 69, and second column, lines 4, 14, 24, 36, 47, 58 and 69, claims 13 to 23 inclusive, for the word "constituent" read --substituent--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of January, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.