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SYNTHETIC LUBRICANT

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18 Claims. (Cl. 252—44)

Our invention relates to a synthetic lubricant and more particularly to improved materials for addition to lubricants to increase their resistance to oxidation and formation of corrosive compounds during use.

It is well known that in order to obtain lubricants which are preeminently satisfactory from the standpoint of oxidation in use, it is necessary to refine the oil thoroughly and then to add an inhibitor of oxidation. The thorough refining may consist of more and heavier acid treatments or solvent treating so as to remove a considerable part of the oil and leave only the most stable portion. Such drastic refining is necessary in order to obtain stability with respect to sludge formation, but the oil is then subject to easy oxidation to form soluble acids and other corrosive materials. This can be prevented by the addition to the refined oil of small amounts of materials which either prevent the formation of these corrosive products or by some action render them inert.

Many of these additive materials are effective when added to poorly refined or even wholly unrefined lubricants. The addends may thus be substituted in whole or in part for the usual refining processes.

In the prior art of applying these principles to the manufacture of lubricants, many diverse types of materials have been suggested to be added to obtain improvement in various characteristics. It has been found that the addition of various metal-bearing organic compounds frequently improves film strength, oxidation resistance, noncorrosiveness, and other characteristics. In particular, tin in various combinations has been found to inhibit the development during use of corrosive materials. Lead compounds, particularly in combination with sulphur in some form (e. g. sulphurized oils) are used to improve film strength, especially in soap-thickened oils, such as greases and the like. Lead compounds do not in general, however, improve the oxidation and corrosive characteristics of a lubricant and it is usually considered that lubricants containing lead compounds are unsuited for crankcase lubricants. They are usually employed in transmissions, differentials, and the like where temperatures are relatively low and no easily corroded metals are present.

One object of our invention is to provide improved inhibitors of oxidation and corrosion for addition to lubricants.

Another object of our invention is to provide oil-soluble organo-metallic compounds which contain relatively high percentages of metal.

A further object of our invention is to provide materials which are effective in extremely small amounts.

A still further object of our invention is to provide film-strength improving organo-metallic compounds suitable for use in lubricants and especially in crankcase lubricants.

Another object of our invention is to provide the possibility of including in one and the same addition agent, factors for improving film strength, increasing resistance to the formation of oil-soluble (acidic) and oil-insoluble (sludge) oxidation products and decreasing corrosiveness developed during use.

Other and further objects of our invention will appear from the following description.

Briefly, our addition agents for accomplishing the above purposes are organo-metallic compounds containing more than one metallic atom per molecule but containing no metal to metal bonds. None of the valences of the metallic atoms present in the molecule may be combined with the valences of another metal atom.

Since it is the metallic atom or atoms in the molecule and not the particular organic radicals present which are responsible for the desirable functions, it is apparent that the more metal atoms present in the molecule, the better. Organo-metallic compounds containing more than one metal atom per molecule are not extremely common and most of those known have the plurality of metal atoms combined with each other in chains, for example, hexamethyl distannane, $(CH_3)_3Sn.Sn(CH_3)_3$. The bonds between the metal atoms in compounds of this type, however, are extremely weak as compared, for example, with the carbon-metal bond. As a result the compounds are relatively unstable chemically, tending to decompose and react readily.

While the elements of group IV of the periodic table of the elements and a very few others, and in particular tin and lead, have to a very limited extent the ability to combine with themselves, no element possesses this characteristic to the extent which carbon does. Carbon is par excellence, the element which forms chains, clusters, and rings united by stable bonds. Furthermore, while the metal-metal bonds are weak, the carbon-metal bonds are quite strong which provides greater stability. Hence, according to our invention, we use organo-metallic compounds containing two or more atoms of metal which may be the same or different and in which there are no metal-metal bonds. An example of this type of compound is 1,5-bistriethylstannylpentane: $(C_2H_5)_3Sn.(CH_2)_5Sn.(C_2H_5)_3$ which is a liquid boiling at 205.5° C. at 15 mm. pressure and having a density of 1,2654 at 20° C. and a refractive index of 1.5053 for sodium light at 20° C. This compound contains 46.5 percent of tin as compared with 27.2 percent of the metal in tetra-amyl tin, a liquid of comparable, though somewhat lower boiling point (188° C. at 24 mm. pressure).

An example of our compounds containing lead suitable for improving film strength of a lubricant is 1,5-bistrimethylplumbylpentane:

$$(CH_3)_3Pb(CH_2)_5Pb(CH_3)_3$$

a liquid boiling at 166.5° C. at 14 mm. pressure:

$$D\frac{23.5}{4}=1.9448;\ N\frac{23.5}{D}=1.5571$$

An example of our compounds containing atoms of different metals is 1-trimethylstannyl-5-trimethylplumbylpentane:

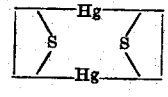
$$(CH_3)_3Sn(CH_2)_5Pb(CH_3)_3$$

In combination with sulphur-bearing addition agents, this material is an excellent addend for crankcase lubricants, the lead conferring film strength while the tin inhibits corrosion or the development of corrosive materials.

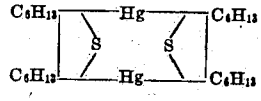
It is to be understood that in practicing our invention, oil-soluble organo-metallic compounds of the type described are to be selected. Some of the examples described below have only limited solubility in hydrocarbon oils. It is to be remembered, however, that because of the high content of metal in our compounds, extremely small amounts are often effective. Thus we may use as little as 0.001 percent of some of these compounds and it will be seen that a fairly insoluble material may dissolve to a sufficient extent to be satisfactory for our purpose. In general 0.001 percent or more of our addition agents is used and we may add one, two, or even five percent or more.

Furthermore, it is well-known that different types of oils have different capabilities of dissolving a given material. For some purposes, therefore, we prefer paraffinic, for other purposes asphaltic, naphthenic, or mixed base lubricants. Another method of obtaining a satisfactory mixture of addition agent with the hydrocarbon oil is the use of a mutual solvent to bring the addend into solution. Alternatively peptizing agents may be added to maintain the organo-metallic compound in permanent suspension.

Many of the more difficultly soluble materials are rendered more soluble by the introduction of alkyl groups, particularly those containing four or more carbon atoms. The isoamyl, octyl, lauryl, and octadecyl radicals, and radicals from paraffin wax greatly increase the solubility of organic compounds in oil. One or more of such groups may be introduced as required. For example, dimercury-2,2',5,5'-dithienylene,



melts above 330° C. and is insoluble in most organic solvents, but the tetrahexyl derivative,



is much more soluble.

The following examples of our addition agents which we may use are given as illustrations and not as limitations:

1. 1-trimethylstannyl-5-trimethylplumbylpentane, $(CH_3)_3Sn(CH_2)_5Pb(CH_3)_3$. B. P. 162° C. at 17.5 mm.

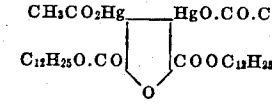
$$D\frac{23.2}{4}=1.6482;\ N\frac{23.2}{D}=1.52282$$

2. 1,5-bistriethylstannylpentane, $(C_2H_5)_3Sn(CH_2)_5Sn(C_2H_5)_3$. B. P. 205.5° C. at 15 mm.

$$D\frac{20}{4}=1.2654;\ N\frac{20}{D}=1.5053.$$

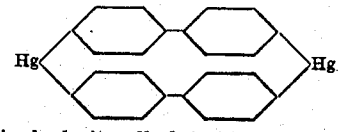
3. 1,2-bistriethylstannylethane, $(C_2H_5)_3Sn(CH_2)_2Sn(C_2H_5)_3$.

4. 3,4-diacetoxymercurifurane-1,5-dicarboxylate dilauryl ester:



5. 1,10-bistriethylstannyldecane, $(C_2H_5)_3Sn(CH_2)_{10}Sn(C_2H_5)_3$. B. P. 247-9° C. at 15 mm.

6. Dimercury bisdiphenyl,

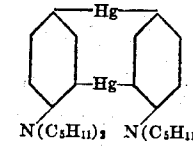


and particularly its alkylated homologues such as the tetraamyl derivative.

7. 1,5-bistrimethylplumbylpentane, $(CH_3)_3Pb(CH_2)_5Pb(CH_3)_3$. B. P. 166.5° C. at 14 mm.

$$D\frac{23.5}{4}=1.9448;\ N\frac{23.5}{D}=1.5571$$

8. 4,6-dimercuri-bis-diamylaniline:



9. 1,5-bisdiamylbismuthylpentane, $(C_5H_{11})_2Bi(CH_2)_5Bi(C_5H_{11})_2$

10. Tristriethylstannylmethane, $CH(Sn(C_2H_5)_3)_3$

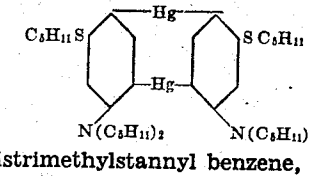
11. 1,5-bisdimethylarsenylpentane, $(CH_3)_2As(CH_2)_5As(CH_3)_2$

12. 3-amino-1,5-bistriamylstannylpentane, $(C_5H_{11})_3SnCH_2CH_2CHNH_2CH_2CH_2Sn(C_5H_{11})_3$

13. 3-hydroxy-1,5-bistributylstannylpentane, $(C_4H_9)_3SnCH_2CH_2CHOHCH_2CH_2Sn(C_4H_9)_3$

14. Isopropyl ester of 1,5-bistriethylplumbylpentane-3-carboxylic acid, $(C_2H_5)_3PbCH_2CH_2CH(CO_2C_3H_7)CH_2CH_2Pb(C_2H_5)_3$

15. 4,6-dimercuri-bis-diamyl aniline-3-amyl thioether,



16. p-bistrimethylstannyl benzene, $(CH_3)_3SnC_6H_4Sn(CH_3)_3$.

17. p-trimethylstannyl diamylbismuthylbenzene, $(CH_3)_3SnC_6H_4Bi(C_5H_{11})_2$.

$(CH_3)_3SnC_6H_4Bi(C_5H_{11})_2$.

18. Bis-trimethylstannylmethyl dimethyl tin, $(CH_3)_3SnCH_2Sn(CH_3)_2CH_2Sn(CH_3)_3$.

A blend of 0.05 percent by volume of 1,5-bistriethylstannylpentane in a Mid-Continent, paraffin base, S. A. E. 30 lubricating oil will require approximately twice as many hours to form 10 mg. sludge per gram or a neutralization number of 1.0 than the base oil itself when treated in the well-known Indiana oxidation test.

It may be desirable to include in one and the same blend based on a hydrocarbon oil, in addition to the addends here described, other addends for specific purposes. Thus we may add a pour point depressor such as a naphthalene-chlor wax condensation product and a viscosity index improver such as certain resins or polymerized hydrocarbons in addition to our organo-metallic compounds. Furthermore, other metallic compounds may be added to the blend without interfering with the action of our ingredients. Indeed, in some cases it is advantageous to combine with our organo-metallic compounds in a hydrocarbon oil blend such materials as calcium dichlorostearate, chromium oleate, tin octadecyl phthalate, aluminum stearate, and other metallic soaps.

Our addends are admirably adapted for use in lubricating oils of all types including those designed for use in automotive crankcases, Diesel oils, and any other oils of lubricating viscosity. Furthermore, our addends are advantageously blended in gasoline and other petroleum fuels either directly or after being blended first in a lubricating oil and then added to the fuel. Soap-thickened mineral oils of all types, ranging from those showing only a slight increase in viscosity over that of the mineral oil alone, to the semi-solid and solid greases containing fifty percent or more of soap, are amenable to treatment according to our invention.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is, therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, we claim:

1. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-metallic compound containing more than one metallic atom but no metal-to-metal bonds.

2. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-metallic compound containing at least two metallic atoms and no metal-to-metal bonds.

3. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-metallic compound containing at least two metallic atoms in which all the valences of the metallic atoms are joined to nonmetals.

4. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-metallic compound containing more than one metallic atom in which all the valences of the metallic atoms are joined to carbon.

5. A lubricant comprising an oil of lubricating viscosity and from 0.001 to 5 percent of an organo-metallic compound containing more than one metallic atom but no metal-to-metal bonds.

6. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-tin compound containing more than one tin atom but no direct bond between the tin atoms.

7. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-tin compound containing two atoms of tin and no direct bond between the tin atoms.

8. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of organo-metallic compound containing at least one atom of each of at least two metallic elements in which there are no metal-to-metal bonds.

9. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organic lead compound containing at least two atoms of lead but no direct bond between the lead atoms.

10. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of 1,5-bistriethylstannylpentane.

11. A lubricant comprising an oil of lubricating viscosity and from 0.001 to 5 percent of 1,5-bistriethylstannylpentane.

12. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-lead compound containing two lead atoms but no direct bond between the lead atoms.

13. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of 1,5-bistrimethyl-plumbyl-pentane.

14. A lubricant comprising an oil of lubricating viscosity and from 0.001 to 5 per cent of 1,5-bistrimethylplumbyl-pentane.

15. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-bismuth compound containing more than one bismuth atom but no direct bond between the bismuth atoms.

16. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of an organo-bismuth compound containing two atoms of bismuth and no direct bond between the bismuth atoms.

17. A lubricant comprising a major proportion of an oil of lubricating viscosity and a minor proportion of 1,5-bisdiamylbismuthyl-pentane.

18. A lubricant comprising an oil of lubricating viscosity and from 0.001 to 5 per cent of 1,5-bisdiamylbismuthyl-pentane.

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