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LUBRICANT

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This invention relates to lubricant compositions. More particularly, it is concerned with mineral oil lubricants adapted to the lubrication of bearing surfaces operating under high pressures.

The bearing surfaces of certain modern machines such as gear-teeth and the like are subjected to considerably higher pressures in use than was the case in the past, and it is now well known by those familiar with the art that the ordinary mineral oil lubricants formerly used are not effective for the lubrication of such bearing surfaces. In the automotive field, for example, the employment of hypoid gears and the use of higher powered engines in connection therewith has resulted in greatly increased operating pressures at the bearing surfaces of such gears, requiring improved lubricants for effective lubrication thereof.

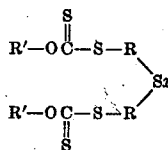
It has been found that certain substances when added to mineral lubricating oils greatly increase the load-carrying properties and result in lubricant compositions capable of effectively lubricating gears and the like operating under extreme pressure conditions. These additive substances usually contain either chlorine or sulfur, or both, and the compositions comprising lubricating oil and relatively minor proportions of such additives are known as extreme pressure lubricants or hypoid lubricants.

A primary object of the present invention is to provide an improved lubricant of the extreme pressure type capable of effectively lubricating bearing surfaces operating under high pressures.

It is generally believed by those familiar with the art that the effectiveness of extreme pressure lubricants is due to the formation of a load-carrying film upon the bearing surfaces as a result of reaction with the additive substance. The additive substance must, therefore, be sufficiently reactive or unstable as to form such a protective film. Many of the additives heretofore proposed, however, have been found to be too reactive or unstable with the result that undesirable corrosive reaction products were produced which cause objectionable corrosion of the metal parts of the machines. This objectionable corrosive effect is particularly noticeable when certain compounds containing chlorine are used as additives.

In accordance with the present invention I have discovered that compounds of the class of alkyl thioethers containing substituted thiocarbonate groups have extremely high load-carrying capacities and produce effective and satisfactory

extreme pressure lubricant compositions. More particularly, I have found that members of the class of sulfur-containing compounds known as dixanthyl dialkyl thioethers may be incorporated in lubricating oils, particularly petroleum lubricating oils to produce effective extreme pressure lubricants. The dixanthyl dialkyl thioethers may be represented by the following structural formula



where R and R' are alkyl groups and x=1 or 2.

Obviously where x=1 in the above formula the compounds represented are mono-thioethers, and where x=2 di-thioethers are represented. The term dixanthyl dialkyl thioether as used herein and in the appended claims includes the di-thioethers as well as the mono-thioethers. The presence of the thioether linkage which may take the form of —S—, —S—S— or

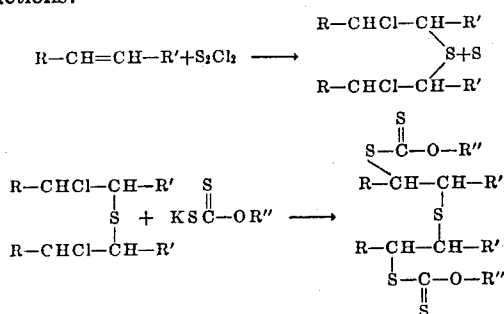


in the compounds of this invention is believed largely responsible for the markedly high load-carrying capacity of the lubricant compositions herein described while the high oil-solubility and relatively low corrosiveness of these agents may be attributed mainly to the absence of active chlorine and the presence and arrangement of the xanthate and alkyl groups, and to the general structure of the molecules.

The described class of thioethers may be prepared by reacting olefins with sulfur monochloride to produce a dichloroalkyl thioether and then reacting the latter with an alkali metal salt of an alkyl xanthate. The first reaction is suitably carried out at 60 to 80° C. with the olefins in slight excess. Reaction of the chloroalkyl thioether with alkali metal alkyl xanthate is carried out by refluxing in alcoholic or methyl ethyl ketone solution, or the like.

The dichloroalkyl thioethers resulting from the reaction of olefins with sulfur monochloride are quite efficient as extreme pressure agents, but these compounds are very corrosive to metals due to the presence of active chlorine, i. e., highly reactive chlorine which causes corrosion of metal containers and machine parts. By treatment with alkyl xanthate this active chlorine is re-

placed with xanthyl radicals and the less corrosive dixanthyl dialkyl thioethers are produced without impairing the extreme pressure properties. The following equation illustrates these reactions:



where R, R' and R'' are alkyl groups.

Of particular importance is the fact that relatively cheap and readily available mixtures of olefins, such as cracked gasoline and the like, may be employed as starting materials, resulting in mixtures of dixanthyl dialkyl thioethers which are relatively inexpensive and very effective as extreme pressure agents.

The dixanthyl dialkyl thioethers of this invention are adequately soluble in mineral oils, and the proportions of these additives to be used in my extreme pressure compositions may be varied over a wide range as desired. The additive substance is generally effective, however, in minor proportions. I have found that in practice the incorporation of about 10% of the stated additive in petroleum lubricating oil compositions provides an extreme pressure lubricant which is suitable for lubrication of gears and the like operating under high pressure conditions.

As illustrative substances of the class which I have found to be particularly effective extreme pressure agents according to this invention, the following are cited:

Di(methyl xanthyl amyl) thioether

Di(ethyl xanthyl amyl) thioether (resulting from reacting amylene-1 and sulfur monochloride and treating the reaction product with potassium methyl xanthate and potassium ethyl xanthate respectively)

Di(butyl xanthyl limonyl) thioether (from reacting dipentene with S_2Cl_2 and treating the reaction product with potassium butyl xanthate)

To show the load-carrying capacity of the extreme pressure agents of the type described herein a lubricant composition was prepared consisting of a distillate petroleum lubricating oil, derived from a Coastal crude, having an A. P. I. gravity of 23.7; flash (open cup) 375°F .; pour -20°F .; viscosity at 100°F . 203; color (A. S. T. M.) $2\frac{1}{2}$; and carbon residue 0.03, and 10% of di(methyl xanthyl amyl) thioether. Other lubricant compositions were also prepared consisting of 90% of the lubricating oil described and 10% of di(ethyl xanthyl amyl) thioether, and di(butyl xanthyl limonyl) thioether respectively. These three lubricant compositions were then tested to determine their extreme pressure characteristics on a standard testing machine known as the S. A. E. machine.

The S. A. E. machine test is recognized as a standard method for determining extreme pressure characteristics of lubricating oils. This machine, which is fully described and illustrated on page 296 of the S. A. E. Journal (Transactions),

vol. 39, No. 1, July 1936, is equipped with two special steel rings (Timken test cups) engaged at their outer surfaces in theoretical line contact. Each of these rings is rotated at a different speed.

- 5 The rings are pressed together by means of a screw and lever system at a definite rate of loading, the load being indicated by a large scale dial. The lubricant to be tested is placed in a container partially surrounding one of the rings, the lubricant being in contact with said ring, so that a film of lubricant is continuously supplied to the engaging surfaces of the rings by rotation of the rings. The criterion of the machine is the load at which the test rings start to scuff which is shown by lines appearing on the surfaces.

In the test the ratio of the speeds of rotation of the two rings was 14.6 to 1, the speed of the fastest being 1000 R. P. M. The loading rate was 83.5 lbs. per second.

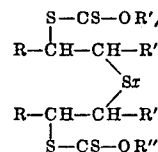
- 20 Although the load was increased during the test until the upper limit of the dial reading (590 lbs.) had been reached there was no indication of scuffing of the rings in the case of any of the three above-described oil compositions. Samples of the mineral oil described above with no additive substance failed in the test when the dial reading reached about 30 pounds.

This test clearly proves the compositions of this invention to be very effective extreme pressure lubricants and indicates their suitability for use in hypoid lubricants and the like.

- 30 The invention, in addition to the improved lubricants disclosed herein, also includes methods of lubricating bearing surfaces of gears and the like by application of said lubricants thereto.

I claim:

1. An extreme pressure lubricant composition comprising a lubricating oil and a minor proportion of a dixanthyl dialkyl thioether.
- 40 2. An extreme pressure lubricant composition comprising a mineral lubricating oil and a minor proportion of a product obtained by substituting active chlorine of a chloroalkyl thioether with a thiocarbonate group.
- 45 3. An extreme pressure lubricant composition comprising a mineral lubricating oil and a minor proportion of a non-chlorinated dixanthyl dialkyl thioether.
- 50 4. An extreme pressure lubricant composition comprising a mineral lubricating oil and a compound of the formula



- 55 where R, R' and R'' are alkyl groups and x=1 or 2, said compound being effective to impart extreme pressure lubricating characteristics to the composition.

- 60 5. An extreme pressure lubricant composition comprising a major portion of a mineral lubricating oil and a minor portion of dixanthyl dialkyl thioether obtained by substituting the active chlorine of chlorodialkyl thioethers derived from cracked gasoline olefins with alkyl xanthyl groups.

- 65 6. An extreme pressure lubricant composition comprising a major portion of a mineral lubricating oil and a minor portion of dixanthyl dialkyl thioether obtained by substituting the active chlorine or chlorodialkyl thioethers derived from olefin mixtures with alkyl xanthyl groups.

- 70 7. An extreme pressure lubricant composition

comprising a lubricating oil and about 10 per cent of a dioxanthyl dialkyl thioether.

8. An extreme pressure lubricant comprising a major portion of a mineral lubricating oil and a minor portion of di(methyl xanthyl amyl) thioether.

9. An extreme pressure lubricant comprising a major portion of a mineral lubricating oil and a minor portion of di(ethyl xanthyl amyl) thioether.

10. An extreme pressure lubricant comprising a major portion of a mineral lubricating oil and a minor portion of di(butyl xanthyl limonyl) thioether.

11. An extreme pressure lubricant comprising a major portion of a mineral lubricating oil and a

minor portion of a substance produced by reacting an olefinic material with sulfur chloride to produce dichloroalkyl thioether and substituting chlorine groups of the dichloroalkyl thioether with xanthyl groups.

12. Method of lubricating bearing surfaces which are subjected to high pressures which comprises applying to said surfaces a lubricant composition comprising lubricating oil and a dioxanthyl dialkyl thioether effective to give to said composition extreme pressure characteristics.

13. An extreme pressure lubricant composition comprising a mineral lubricating oil and a product obtained by substituting active chlorine of a chloroalkyl thioether with xanthyl radicals.

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