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3,074,886

LUBRICATING COMPOSITION

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No Drawing. Filed Dec. 5, 1958, Ser. No. 778,308

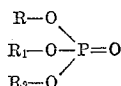
2 Claims. (Cl. 252-49.8)

This invention relates to an improved lubricating composition having excellent load-carrying properties. More particularly, it relates to a lubricating oil containing a combination of extreme pressure agents which lend unexpected load-carrying capacity to the composition.

With the continuing development and improvement of high speed industrial machinery and heavily loaded engines, the need for improved lubricating oils exhibiting superior extreme pressure qualities increases. Modern turbine engines, for example, have increased gear loads and as a consequence, require lubricating oils exhibiting high extreme pressure properties.

In accordance with the present invention, a lubricating oil having superior load-carrying ability comprises a mineral lubricating oil containing from about 0.1 to about 5% by weight of an aryl hydrocarbon phosphate and from about 0.01 to about 1.0% by weight of a fatty material consisting essentially of a dimer of ethylenic fatty acids, wherein said acids have from 12 to 22 carbon atoms.

The aryl hydrocarbon phosphate compounds of this invention are defined by the following general formula:



wherein R, R₁, and R₂ are aryl hydrocarbon radicals, for example, phenyl, cresyl, xylyl, thymyl, and naphthyl radicals. It is preferred that R, R₁, and R₂ are the same aryl radical and the compound particularly preferred is tricresyl phosphate based on availability and synergistic activity. The preferred amount of phosphate compound useful for the present invention ranges from 0.5 to about 2.5 weight percent.

Dimerized fatty acids are well known in the art as anti-corrosive additives in both lubricant and non-lubricant mineral oils and as intermediates in the preparation of other mineral oil additives. Their preparation and physical properties are set forth in varying degrees in such U.S. patents as 2,482,761 to Goebel, 2,631,979 to McDermott, and 2,632,695 to Landis et al. It has been shown that material consisting primarily of the dimer acid can be prepared by subjecting unsaturated fatty acids to moderate steam pressures of from 80 to 300 pounds per square inch, at temperatures of from 260 to 360° C. for a period of from about 3 to 8 hours.

Another method for preparing the dimer acids broadly comprises heating a short chain aliphatic alcohol ester of an ethylenic fatty acid at about 300° C. for several hours in an inert atmosphere. The resulting dimerized ester is then separated by distillation and hydrolyzed with hydrochloric acid or its equivalent. Fatty oils have also been heat polymerized and thereafter hydrolyzed to produce dimer acids. The first mentioned method is preferred however, owing to the fact that a larger percentage of dimer acids are produced from the starting materials by the utilization of that method of production.

The dimer acids of the present invention, although preferably conjugation products of two of the same molecules which are di- or polyethylenic, are also products of one monoethylenic compound and a polyethylenic compound. For instance, linoleic acid and oleic acid dimerized to become the dimer of linoleic and oleic acids.

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It is however, necessary to have one polyethylenic compound present to form the dimer.

The fatty acids useful in accordance with this invention include ethylenic monocarboxylic acids having from 12 to 22 carbon atoms examples of which are as follows: 4-dodecenoic, 5,9-dimethyl-2,8-decadienoic, myristoleic, palmitoleic, oleic, linoleic (9,11-octadecadienoic, 10,12-octadecadienoic and 11,13-octadecadienoic) linolenic, erucic and 13,15-docosadienoic. The preferred acid is linoleic acid on the basis of availability and cost. Good source materials from which these fatty acids can be obtained by hydrolysis are vegetable oils, such as soybean oil, linseed oil, cotton seed oil, corn oil, castor oil, mustard seed oil, and peanut oil.

It is well known that in the preparation of the dimer acid material, trimer acid material and some higher polymeric acids are also formed in varying degrees depending upon the method used to polymerize and the conditions employed. It is also known that unpolymerized acids or monomers are sometimes present to a small extent usually under 10 percent by weight after preparing the dimer material. These materials can be separated or retained as desired. However, as previously stated, the dimer acid should be present in the total fatty material to the extent of at least 70 percent by weight. This limitation is imposed to ensure an effective additive at the stated concentration of dimer acid containing material.

Examples of the percentage composition of some fatty materials consisting essentially of a dimer acid which are useful in accordance with the invention are as follows:

	Wt. Percent
(1) Dimer acid -----	78
Trimer and higher polymer acids -----	22
(2) Dimer acid -----	72
Trimer and higher polymer acids -----	20
Monomer acid -----	8
(3) Dimer acid -----	85
Trimer and higher polymer acids -----	12
Monomer acid -----	3
(4) Dimer acid -----	92
Trimer and higher polymer acids -----	6
Monomer acid -----	1.5
Fatty residue material -----	0.5
(5) Dimer acid -----	99.5
Fatty residue material -----	0.5

The preferred amount of the dimer acid material of this invention is from 0.05 to 0.5% by weight based on the total lubricating composition.

The mineral lubricating oils which are useful as the base fluid for the compositions of this invention comprise hydrocarbon mineral oils derived from paraffin base, naphthene base or residual type oils and include mixtures of any of these. It should be emphasized that the combination E.P. additive of the invention does not exhibit the unexpectedly superior load-carrying properties in lubricating bases other than a hydrocarbon mineral oil.

The combination additive of the invention is particularly useful when incorporated in turbine oils. These oils may be broadly characterized as paraffin base and naphthene base oils having a viscosity range from 80 to 780 S.S.U. at 100° F., a flash range of from 320 to 520° F., a pour range of from +20 to -45° F., and a viscosity index of from 95 to less than -10.

Turbine oils usually have anti-oxidants and anti-rust agents incorporated therein to inhibit oxidation and the accompanying rusting which occur particularly under the severe conditions to which turbine oils are subjected. The broad class of anti-oxidants which are preferred in accordance with the present invention are the alkyl substituted phenols which are used in amounts ranging

from about 0.05 to 2.0 percent by weight. The anti-rust compounds which may also be advantageously admixed with turbine oils are broadly defined as aliphatic-substituted aliphatic dicarboxylic acids and are used in amounts ranging from about 0.005 to 0.5 percent by weight. These anti-rust compounds can be used with or without minor portions of mono or diesters of inorganic acids or mixtures thereof, such as a mixture of mono and dilauryl phosphoric acid esters. For a further description of these anti-rust compounds see U.S. Patent 2,452,319 to John A. Patterson and Herman D. Kluge, issued October 26, 1948, and assigned to The Texas Company. As disclosed therein, suitable aliphatic dicarboxylic acids for this purpose are oil-miscible compounds containing at least 10 carbon atoms in the molecule and having at least one carbon atom between the carboxylic groups.

Other anti-oxidant compounds such as phenothiazine and substituted derivatives thereof, aromatic amines such as naphthylamine and derivatives thereof, phenylene diamine and derivatives thereof, and diphenylamine and derivatives thereof, are useful for this invention. These anti-oxidant compounds are usually incorporated in amounts ranging from about 0.05 to 4.0 percent by weight of the composition.

Other additives such as anti-foam agents can be advantageously incorporated in the lubricating oils of this invention. A useful anti-foam material is a hydrocarbon, preferably kerosene, concentrate of dimethyl silicone which is usually incorporated in amounts ranging from 0.0001 to 0.01 percent by weight.

The unexpected load-carrying capacity of a mineral oil composition containing the combination additive of the invention was demonstrated in the high speed gear test. This test is intended for the evaluation of the scuff-limited load-carrying ability of those lubricants used in reduction and accessory drives of turbo-jet and turbo-prop engines. The method of test provides for the running of two spur gears in a Pratt and Whitney gear and lubricant tester (also termed the Ryder gear tester). The oil inlet temperature to the gears was $165^{\circ} \pm 5^{\circ}$ F. The face width of the driven gear was 0.937 inch and the face width of the driving gear was 0.25 inch. The dynamometer speed of the gear tester was 3830 r.p.m. (equivalent to a gear speed of 10,000 r.p.m.) and loading pressure of $2\frac{1}{2}$ p.s.i. applied during break-in. After running for 10 minutes, the tester was shut down and the driving gear removed and an estimate of the percentage of tooth area scuffed on each tooth of that gear was made. The gear was replaced and the above procedure continuously repeated using a higher loading pressure with increments of 5 p.s.i. at each repetition until 22.5 percent of the tooth face area on the driving gear had been scuffed, the load corresponding to this point being considered the scuff load. Scuffing is defined as that degree of wear or abrasion which obliterates the axial grinding marks on the gear tooth. The loading pressures used were as follows: 2, 5, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80 p.s.i. and up. A tooth load conversion factor of 18.5 sq. in., which was constant calculated from measured data from the tester, was multiplied by the loading pressure at the scuff load and divided by the width of the driving gear (0.25) to obtain the tooth load in pounds per inch.

The base oil used in the test compositions was a refined

naphthene base oil fraction having a viscosity of 500 S.S.U. at 100° F., a pour -10° F. max., a flash of 380° F. min., a Neut. No. of 0.1 and a $^{\circ}$ API gravity of 22.5. This base oil had the following additives incorporated therein: 0.3% by weight of the anti-oxidant 4-methyl-2,6-di-*t*-butyl phenol, 0.033% by weight of an anti-rust concentrate comprising a mixture of 90% of a C_{12} propylene tetramer succinic acid and 10% of a mixture of mono and dilauryl phosphoric acid esters, and about 0.001% by weight of an anti-foam concentrate comprising dimethyl silicone in a 10% kerosene solution.

The results of the high speed gear test on the composition of the invention and comparison lubricating compositions are given in the following table:

TABLE
High Speed Gear Test

	Tooth Load, p.p.i.	
Base oil.....	1,500	1,700
Base oil plus 1% tricresyl phosphate.....	1,640	1,670
Base oil plus 0.1% Linoleic acid dimer material (78% dimer).....	1,830	2,020
Base oil plus 1% tricresyl phosphate plus 0.1% Linoleic acid dimer material (78% dimer).....	3,200	3,340

The unexpected load-carrying ability of the composition containing the combination additive of the invention is evident from the above table. Tricresyl phosphate is a known E.P. additive for lubricating oils and as shown in the above table increases the load-carrying capacity of the base oil to a slight degree. The dimer acid material also independently lends extra load-carrying ability to the base oil. However, the base oil containing the combination of these two materials demonstrates an unexpected amount of E.P. activity.

Obviously, many modifications and variations of the invention as hereinabove set forth may be made without departing from the spirit and scope thereof and therefore only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. A lubricating composition consisting essentially of a mineral lubricating oil containing about 0.3 percent of 4-methyl-2,6-ditertiary butyl phenol, about 0.03 percent of alkenyl (C_{12}) succinic acid, about 0.003 percent of a mixture of mono- and dilauryl phosphoric acid esters, about 1.0 percent of tricresyl phosphate and about 0.1 percent of polymerized linoleic acid consisting essentially of the dimer.

2. The lubricating composition according to claim 1 containing about 0.0001-0.01 percent of a 10 percent dimethyl silicone concentrate.

References Cited in the file of this patent

UNITED STATES PATENTS

2,157,873	Van Peski et al.	May 9, 1939
2,631,979	McDermott	Mar. 17, 1953
2,721,846	Lyons et al.	Oct. 25, 1955
2,730,499	Pokorny	Jan. 10, 1956
2,883,339	Richardson	Apr. 21, 1959

FOREIGN PATENTS

790,231	Great Britain	Feb. 5, 1958
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