United States Patent Office

2,844,538

Patented July 22, 1958

2,844,538

EXTREME PRESSURE LUBRICANT

Robert H. Krug, Cornwall, N. Y., and Otto C. Elmer, Akron, Ohio, assignors to The Texas Company, New York, N. Y., a corporation of Delaware

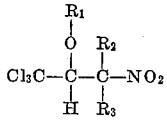
No Drawing. Application September 16, 1955
Serial No. 534,886

9 Claims. (Cl. 252—51)

This invention relates to an improved extreme pressure lubricant.

In modern gas turbine engines, loads are heavier, speeds are faster and tolerances closer than ever before necessitating the formulation of new and improved lubricants to withstand this severe treatment.

The present invention concerns an extreme pressure lubricating composition comprising a base oil, a minor amount of trichloronitropropanol or certain derivatives and homologues thereof to increase the extreme pressure properties of the composition. The E. P. component of this invention has the following general formula:



wherein R_1 is hydrogen or an acyl group having from 2 to 3 carbon atoms; and R_2 and R_3 are hydrogen, methyl or ethyl groups. These compounds have no more than a total of seven carbon atoms. Examples of these compounds are 1,1,1-trichloro-3-nitro-2-propanol, 1,1,1-trichloro-3-nitro-2-propyl acetate, 1,1,1-trichloro-3-nitro-2-propyl propionate, 1,1,1-trichloro-3-nitro-2-butanol, 1,1,1-trichloro-3-nitro-2-butyl acetate, 1,1,1-trichloro-3-nitro-2-butyl propionate, 1,1,1-trichloro-3-nitro-3-methyl-2-butanol and 1,1,1-trichloro-3-nitro-3-methyl-2-butyl acetate. Of the above compounds, 1,1,1-trichloro-3-nitro-2-propanol is preferred since it exhibited the most remarkable extreme pressure properties. The broad range of useful amounts of these trichloronitropropanol compounds is from 0.05 to 15 weight percent in a base oil. The preferred range is from 0.1 to 10 weight percent basis the superior effect at these concentrations.

The base oil in accordance with this invention can be a paraffin or naphthene distillate type mineral oil. It may also be a residuum type oil or mixtures of any and all type mineral oils. Synthetic base oils are particularly useful, and mixtures of synthetic oils and mineral oils are also included within the concept of this invention.

The synthetic base oils of the present invention are, broadly speaking, ester base oils and in particular aliphatic diesters of organic dicarboxylic acids. The dicarboxylic acid component is usually an aliphatic dicarboxylic acid containing 6 to 12 carbon atoms but glutaric acid esters and succinic acid esters may also be used. From the standpoint of cost and availability, the preferred dibasic acids are adipic acid, sebacic acid and azelaic acid. The aliphatic alcohols used to form the diesters usually contain at least 4 carbon atoms and may contain 20 or more carbon atoms. C_6 to C_{18} alcohols are most commonly used. Ether alcohols such as Cellosolve and Carbitol may also be used in the formation of the aliphatic diesters of organic dicarboxylic acids used as the lubricating base in the compositions of this invention.

Specific examples of the dialkyl esters of aliphatic dicarboxylic acids, which are the preferred reagents for use in the lubricant compositions of the invention, are

as follows: di-1,3-methylhexyl adipate, di-2-ethylhexyl sebacate, di-2-ethylhexyl azelate, di-2-ethylhexyl adipate, dilauryl azelate, di-sec-amyl sebacate, di-2-ethylhexyl alkenylsuccinate, di-2-ethoxyethyl sebacate, di-2-(2'methoxyethoxy) ethyl sebacate, di-2-(2'ethylbutoxy) ethyl sebacate, di-2-butoxyethyl azelate, di-2-(2'butoxyethoxy) ethyl alkenylsuccinate, etc.

In addition to the aliphatic dicarboxylic acid esters described above, polyester lubricants formed by a reaction of an aliphatic dicarboxylic acid, a glycol and a monofunctional compound, which is either an aliphatic monohydroxy alcohol or an aliphatic monocarboxylic acid, in specified mol ratios are also employed as the synthetic lubricating base in the compositions of this invention; polyesters of this type are described in U. S. 2,628,974 to Robert T. Sanderson, issued February 17, 1953. Polyesters formed by reaction of a mixture containing specified amounts of 2-ethyl-1,3-hexanediol, sebacic acid and 2-ethylhexanol and by reaction of a mixture containing adipic acid, diethylene glycol and 2-ethylhexanoic acid illustrate this class of synthetic polyester lubricating bases.

Polyesters formed by reaction of a monocarboxylic acid and a glycol may also be used as the ester component. The acid component is usually an aliphatic acid containing at least 6 carbon atoms. The glycol component is advantageously a straight glycol, such as 1,6-hexanediol, but ether glycols, such as tetraethylene glycol, may also be used.

Specific examples of the diesters of glycols are the following: di-n-decanoate of 1,4-butanediol, dioctanoate of 1,5-pentanediol, dilaurate of tetraethylene glycol, dilaurate of triethylene glycol, dioctanoate of pentaethylene glycol.

The sulfur analogs of the above-described esters are also used in the formulation of the lubricating compositions of the invention. Dithioesters are exemplified by di-2-ethylhexyl thiosebacate, di-n-octyl thioadipate and the dilaurate of 1,5-pentanedithiol; sulfur analogs of polyesters are exemplified by the reaction product of adipic acid, thioglycol and 2-ethylhexyl mercaptan.

The lubricant composition of this invention may at times advantageously have incorporated therein other well known additives, such as V. I. improvers and anti-oxidants. For example, phenothiazine, which acts as an anti-oxidant, and various methacrylate polymers, which act as V. I. improvers, can be incorporated when necessary in order to meet specified lubricant requirements. Other additives such as metal deactivators may be advantageously incorporated when necessary, such as the commercially available disalicylal propylenediamine, which is also known as disalicylidene-1,2-diaminopropane.

The extreme pressure properties of trichloronitropropanol and certain derivatives and homologues thereof with respect to their use in high speed, heavily loaded engines, such as gas turbines, in accordance with this invention are demonstrated in the following tables. These compounds were tested in a base oil consisting of di-2-ethylhexyl adipate. The well known four-ball mean Hertz load test was used for the evalution. Table I covers the preferred 1,1,1-tirichloro-3-nitro-2-propanol in increasing amounts.

Table I

Trichloronitropropanol conc., wt. percent	Mean Hertz load, kg.
0.0	17
1.0	33
2.0	46
3.0	55
5.0	78
10.0	120

It can be seen from the above table that trichloronitropropanol in a base oil has the surprising ability to produce almost any E. P. level desired according to the concentration.

The following table shows the results of the four-ball mean Hertz load test on a trichloronitropropanol derivative and homologue at a concentration of 3 weight percent in a base oil consisting of di-2-ethylhexyl adipate.

Table II

E. P. Component:	Mean Hertz Load, kg.
None	17
1,1,1-trichloro-3-nitro-2-propyl acetate	49
1,1,1-trichloro-3-nitro-2-butanol	42

From the above table it will be seen that trichloronitropropanol derivatives and homologues in accordance with this invention also impart excellent extreme pressure characteristics to lubricant compositions.

The compounds of this invention also have application in additive amounts in cutting and grinding oils. The following table demonstrates the effectiveness of trichloronitropropanol in various amounts in a base oil blend of about 20 weight percent of a highly refined paraffin base mineral oil having a viscosity of 100 SUS at 100° F., a pour of +25° F. and a V. I. of 75, with a remainder of a highly refined paraffin base mineral oil having a viscosity of 182 SUS at 100° F., a pour of +20° F. and a V. I. of 96.

Table III

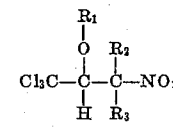
Composition	SAE E. P. Test at 500 R. P. M.	Copper strip Corrosion Test, 6 Hrs. at 212° F.
Base Oil	630	Negative.
	517	Do.
Base Oil + 0.1 wt. percent Additive	1,196	Do.
	3,010	Do.
Base Oil + 0.2 wt. percent Additive	2,273	Do.
	3,056	Do.
Base Oil + 0.4 wt. percent Additive	3,653	Do.

The preceding Table III shows the additive to lend good E. P. properties to a cutting oil while maintaining definite non-corrosiveness.

Obviously, many modifications and variations of the invention, as hereinbefore 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. An improved lubricant composition comprising a major amount of a base oil selected from the group consisting of mineral lubricating oils and polyesters of aliphatic carboxylic acids and a minor amount of a compound having the following general formula:



wherein R_1 is selected from the group consisting of hydrogen and an acyl radical having from 2 to 3 carbon atoms, and R_2 and R_3 are selected from the group consisting of hydrogen, methyl and ethyl, said minor amount being sufficient to improve the extreme pressure properties of the base oil.

2. An improved lubricant composition as described in claim 1 wherein the minor amount is from 0.05 to 15 percent by weight.

3. An improved lubricant composition as described in claim 1 wherein the compound is 1,1,1-trichloro-3-nitro-2-propyl acetate.

4. An improved lubricant composition as described in claim 1 wherein the compound is 1,1,1-trichloro-3-nitro-2-butanol.

5. An improved lubricant composition as described in claim 1 wherein the compound is 1,1,1-trichloro-3-nitro-2-butyl propionate.

6. An improved lubricant composition as described in claim 1 wherein the compound is 1,1,1-trichloro-3-nitro-2-propanol.

7. An improved lubricant composition as described in claim 6 wherein the minor amount is from 0.1 to 10 percent by weight.

8. An improved lubricant composition comprising a major amount of a polyester of an aliphatic carboxylic acid and from 1.0 to 10.0 weight percent of 1,1,1-trichloro-3-nitro-2-propanol.

9. An improved lubricant composition comprising a major amount of a mineral lubricating oil and from 0.05 to 1 weight percent of 1,1,1-trichloro-3-nitro-2-propanol.

References Cited in the file of this patent

UNITED STATES PATENTS

2,137,777	Lincoln et al.	Nov. 22, 1938
2,402,487	Batchelder et al.	June 18, 1946
2,599,794	Webber	June 10, 1952

FOREIGN PATENTS

114,340	Australia	Dec. 2, 1941