Patented June 13, 1944 2,351,280

UNITED STATES PATENT OFFICE

2,351,280

LUBRICANT

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No Drawing. Application July 16, 1942, Serial No. 451,219

8 Claims. (Cl. 252—35)

This invention relates to lubrication. More specifically the invention relates to low temperature lubrication.

For those machines, such as the aeroplane, truck, automobile and cannon, which must operate under a wide range of temperature conditions, it is important that the viscosity of the lubricants being used shall be quite uniform throughout the entire temperature range of operations. It is also important that the lubricants used shall not be corrosive or easily oxidizable or susceptible of being decomposed under the conditions of operation.

The primary object of the present invention is to provide a method of lubrication and the lubricant therefor which will be effective for lubrication over the entire temperature range in which it may be called upon to operate.

Another object of the invention is to provide a lubricant that is non-corrosive on the commonly used bearing metals.

A further object of the invention is to provide a lubricant that is stable and not readily decomposed and which has high load-carrying capacities.

With these and other objects in view the invention consists in the improved method of lubrication and the lubricant therefore hereinafter described and particularly defined in the claims.

I have discovered that the organic esters of benzoic acid have good lubricating qualities. For example the alkyl benzoates are generally colorless liquids, benzyl benzoate is a colorless liquid, and all of these esters have lubricating qualities or load-carrying capacities approximately equal to the load-carrying capacities of a Pennsylvania grade spindle oil having a viscosity of 100 at 100° F.

The physical properties of the benzoic acid esters are well adapted for lubrication over a temperature range of 200° F. down to —50° F. The esters which have been tested, furthermore, are non-corrosive to the usual bearing metals and alloys and are not decomposed at the high temperature or at the low temperature, or under the strain of extreme pressure lubrication.

The physical properties of some of the benzoic acid esters are as follows:

Ester	Boiling point	Melting point	Physical property
	°F.	°F.	
Methyl benzoate	300	−10	Colorless liquid.
Ethyl benzoate	412	−30	Do.
Propyl benzoate	444		Do.
Butyl benzoate	477		Colorless oil.
Isoamyl benzoate	502		Colorless liquid.
Benzyl benzoate	614	66	Do.

The viscosities of some of these esters have been determined as follows:

Ester	Temperature			
	−40° F.	0° F.	100° F.	200° F.
	Viscosity centistokes	*Viscosity centistokes*	*Viscosity centistokes*	*Viscosity centistokes*
Methyl benzoate	Viscous	6.1	1.39	0.73
Ethyl benzoate	20.4	6.5	1.52	0.79
Propyl benzoate	47.5	11.3	2.09	0.91
Butyl benzoate	72.8	14.1	2.27	1.03
Isoamyl benzoate	79.1	17.7	2.56	1.11
Benzyl benzoate	Viscous	93.8	5.06	1.73

It will be seen that the above viscosities of these benzoate esters are comparatively uniform over a wide temperature range. Furthermore the esters have high boiling points and most of them have good viscosities at a temperature of —40° F. The ethyl, amyl and benzyl benzoates all have load-carrying capacities for lubrication which are better than the ordinary Pennsylvania grade spindle oil. Furthermore, with all of the benzoate esters if approximately 1% of one of the commonly used extreme pressure addition agents is used, it will impart to the esters a load-carrying capacity suitable for extreme pressure lubrication. With the 4-ball testing machine for extreme pressure loading it has been found that the benzoates will tend to develop a friction when loads of 250 to 600 lbs. have been placed on the bearings. With the 1% addition of an extreme pressure additive all of these benzoates will operate without showing a tendency to develop friction for load-carrying capacities above 1000 lbs., which is the upper measuring limit of the 4-ball testing machine.

The addition agents which are soluble in the benzoates and which give effective load-carrying properties to the benzoates are tricresyl phosphite, or a mixture of tricresyl phosphite and tricresyl phosphate which is described in the patent to Engelke No. 2,260,303 granted October 28th, 1941. Polane, which is a commercial product, is manufactured by the Patent Chemicals Company and is understood to be an ester of a fatty acid or chlorinated ester of a fatty acid, such as ethyl laurate or chlormethyl stearate. Santolube #261 which is an addition agent, is manufactured and sold by the Monsanto Chemical Company. This product is described as a metallic derivative of an alkylated carboxylic acid containing compounds of tin and sulfur.

The benzoates may be used as the base lubricant for the manufacture of greases. Methyl benzoate is soluble in or compatible with lithium stearate or other lithium soaps such as lithium oleate or lithium palmitate. Butyl benzoate and benzyl benzoate are compatible with the lithium soaps mentioned above. Isoamyl benzoate is

compatible with a mixture of sodium and aluminum stearates. It is preferred to use about 1% of one of the additives mentioned above in the benzoates when they are blended with the soaps. The lithium soaps may vary from 3 to 15% by weight of the benzoate bases. In the manufacture of a sodium base soap with isoamyl benzoate the preferred proportions are 6% of sodium stearate and 1% of aluminum stearate.

The benzoate esters may be blended with other esters such as tributyl phosphate, ethyl oxalate, ethyl lactate, dibutyl phthalate and the like, for the purpose of obtaining a lubricant which has any desired viscosity curve and boiling point. Hydraulic fluids which are used for brake operation or gun recoil fluids require specific physical characteristics among which are viscosity and oiliness. The benzoates may be blended with, or are mutually soluble in, the above mentioned esters and provide the desired physical characteristics for hydraulic fluids.

The preferred form of the invention having been thus described, what is claimed as new is:

1. A lubricant comprising a major portion of an alkyl benzoate as a base lubricant and a small amount of a lithium soap blended therewith to produce a stable grease.

2. A lubricant comprising a major portion of benzyl benzoate as a base lubricant and a small amount of a lithium soap blended therewith to produce a stable grease.

3. A lubricant comprising a major portion of an ester of benzoic acid as a base lubricant and having a small amount of a lithium soap blended therewith to produce a stable grease.

4. A lubricant comprising an ester of benzoic acid 85% to 95% blended with a lithium soap 15% to 5%.

5. A lubricant comprising an ester of benzoic acid 93%, lithium soap 6%, extreme pressure additive 1%.

6. A lubricant comprising a major portion of an ester of benzoic acid as a base lubricant and blended with sodium stearate and aluminum stearate to form a stable grease.

7. A lubricant consisting of a major portion of an ester of benzoic acid blended with alkyl esters of the group consisting of tributyl phosphate, ethyl oxalate, ethyl lactate and dibutyl phthalate.

8. A lubricant comprising an ester of benzoic acid 92%, lithium soap 6%, aluminum soap 1%, extreme pressure additive 1%.

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