

UNITED STATES PATENT OFFICE

2,221,162

LUBRICATING OIL

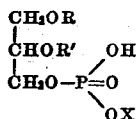
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18 Claims. (Cl. 252-42)

This invention relates to a lubricating oil, and particularly to a motor oil adapted for lubrication of the bearings and cylinders of internal combustion engines, such as automotive engines, airplane engines, Diesel engines and the like.

In the co-pending application of Frank W. Hall and Charles C. Towne Serial No. 223,487 filed of even date herewith, there is disclosed and claimed the addition to a motor oil of this type of a small proportion of a phosphatide or phospholipine, such as lecithin, to reduce or inhibit bearing corrosion and lacquer formation while affording other advantages as set forth more fully therein. The phosphatides, or the lecithins as they are frequently called, belong to the class of compounds having the general formula



where R and R' are similar or dissimilar fatty acyl radicals derived from stearic, palmitic, oleic acid, etc., and where X represents an amino alcohol group. In the case of lecithin, X, or the amino alcohol group, is choline— $\text{CH}_2\text{CH}_2\text{N}(\text{CH}_3)_3\text{OH}$; and in the case of cephalin X is colamine— $\text{CH}_2\text{CH}_2\text{NH}_2$. Other types of compounds falling within the class of phosphatides can be employed such as sphingomyelin. Also metal derivatives or salts of the lecithins can be employed. For example, the free acid group of the compound can be neutralized with alkali, alkaline earth and other bases to form the corresponding salts thereof.

A preferred composition for this purpose is commercial soybean lecithin, such as the product known commercially as "Lipoidol" which consists essentially of about equal proportions of lecithin and cephalin with a smaller proportion of soybean oil. In some cases it is found preferable to employ a bleached commercial soybean lecithin, such as the product sold commercially as "Coloidol BT" which is commercial soybean lecithin bleached with hydrogen peroxide and dibenzoyl peroxide, or the product sold commercially as "Coloidol HX" which is commercial soybean lecithin bleached with hydrogen peroxide. If desired, the commercial soybean lecithin can be

purified by extracting the soybean oil with acetone to obtain a product consisting essentially of lecithin and cephalin, which is also suitable for the purposes of the present invention. Also, the cephalin constituent can be separated from the lecithin by alcohol extraction, and either the purified lecithin or purified cephalin or mixtures of the two in any desired proportion may be employed for purposes of the present invention. However, it has been found that the purified constituents do not display any marked improvement over the bleached commercial soybean lecithin, and the latter is generally preferred for economical reasons.

Wherever the expression "phosphatide compound" is used throughout the description and claims, it is to be understood that this includes any of the purified compounds falling within this group as well as any of the comparatively impure mixtures such as the commercial grades mentioned above.

As set forth in the said application mentioned above, the phosphatide compound is added to the motor oil in a critical proportion range of about 0.01-2.0%. It is found that these percentages are critical in securing the desired improvement with respect to inhibiting bearing corrosion and lacquer formation and without affecting other desirable properties of the oil, while proportions above this range produce undue sludging. In the case of motor oils adapted for automotive use, a range of 0.01 to 0.25% appears most satisfactory, with about 0.1% preferred. Somewhat higher percentages may be employed in Diesel lubricating oil or airplane oil where it is desired to improve materially the ring sticking properties of the oil in addition to obtaining the benefits of inhibiting bearing corrosion and lacquer formation. A very satisfactory method for adding the phosphatide compound to the mineral lubricating oil is to first form a concentrate, such as a 50% solution of the lecithin or other phosphatide compound in a S. A. E. 30 oil or other lubricating oil within the motor oil viscosity range, and then add the concentrate to the mineral lubricating oil in an amount sufficient to give the desired percentage of phosphatide compound therein.

As set forth in said mentioned application, the phosphatide additive is particularly effective in

connection with highly solvent refined lubricating oils, such as modern motor oils which have been refined with a solvent having high selectivity between naphthenic and paraffinic constituents of the oil, such as furfural, beta beta dichlorethyl ether, nitrobenzene, phenol, cresylic acid, chlorphenol, and the like.

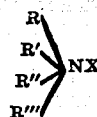
The modern development of internal combustion engines with extremely small clearances between piston and cylinder wall, together with the modern development of highly solvent refined lubricating oils for use in the crankcases of such engines, has given rise to the problem of so-called varnish or lacquer formation. This lacquer generally appears as a yellowish or reddish brown film which deposits upon the metal surfaces, piston rings and cylinder walls during operation of the engine over extended periods of time. In the newest engines having extremely small clearances and high compression, this problem is so severe as to frequently result in seizure of the pistons when the motor is stopped and allowed to cool.

Further, the modern development of the highly refined motor oils together with the modern development of the new type bearings including the connecting rod and main bearings, of internal combustion engines, which has involved a departure from the old Babbitt bearings and has given rise to new alloy bearings of the type of cadmium-silver, has also presented the industry with the problem of bearing corrosion. This latter problem has been recognized for the last several years, and various materials have been heretofore suggested as additives for lubricating oil to inhibit such bearing corrosion. However, the materials heretofore suggested and used for this purpose, such as triphenyl phosphite, are ineffective in overcoming the more recent problem of lacquer formation. The phosphatide compound is unique in combining in one substance the properties of inhibiting or minimizing this objectionable lacquer formation and of also inhibiting bearing corrosion, reducing cylinder and piston wear, reducing oil ring and compression groove deposits and improving ring sticking of the motor oil to which the compound is added in the small proportion range specified above.

While the phosphatide additive is highly effective for the purposes stated, it is found that this addition seriously increases the emulsion difficulties of the oil when that oil comes in contact with water or salt water, as determined by the Navy emulsion test which is the United States Government Test No. 320.12 as found on page 76 et seq. of appendix 6, "Lubricants and Liquid Fuels," issued by the Navy Department August 1, 1928, with specifications set forth on page 7 of Naval Engineering Bulletin 31, "Lubricating Oil," published by the U. S. Government Printing Office in 1937.

We have discovered that this difficulty can be effectively overcome by incorporating along with the phosphatide a small amount of an emulsion preventing agent capable of improving the emulsion test of the oil in the presence of the phosphatide. We have further discovered that an oil soluble material which hydrolyzes in the presence of water to give an alkaline reaction is a very suitable agent for this purpose. For example, soaps of the alkali or alkaline earth metals, such as the stearates, palmitates, oleates, naphthenates, etc. of sodium, potassium, ammonium, lithium, calcium, etc., which can be dissolved in oil in small proportions, are ef-

fective for this purpose. The quaternary organic ammonium soaps of the general formula



in which R, R', R'', R''' represent the same or different alkyl, aralkyl or aryl groups or combinations thereof, and in which X is a fatty acid or naphthenic acid radical, are also highly effective for this purpose. Moreover, compounds formed by substituting one or more of the hydrogens of the alkyl, aralkyl or aryl groups of such quaternary organic ammonium soaps with halogen, oxygen or sulfur, are also included. As an example of this type of compound, there may be mentioned tetrone B naphthenate, which is a quaternary ammonium soap and is believed to be trimethyl phenyl ammonium naphthenate $(C_6H_5)(CH_3)_3N$ -naphthenate. We have found that agents of this type are effective in a small proportion range of about 0.02-0.9% by weight, higher percentages being employed in conjunction with the higher percentages of phosphatide additive. In the case of an automotive lubricant containing from about 0.01 to 0.25% of a phosphatide, the emulsion preventing agent is preferably used in the range of 0.02-0.5%. By way of example, a very satisfactory motor oil for automotive purposes is obtained by adding about 0.1% of a phosphatide, and about 0.1-0.2% of an emulsion preventing agent of the character of sodium naphthenate or tetrone B naphthenate.

We are aware that it has been heretofore suggested to add lecithin together with about 5% or less of a soap, such as sodium naphthenate, to a light lubricating oil having a Saybolt viscosity of less than 100 seconds at 100° F. to produce a textile fiber spraying oil (see U. S. Patent No. 2,002,885). The lecithin was employed here to improve the wetting or filming of the oil for the textile fibres and the soap was employed to assist in washing off the oil after the fibres had been processed. The present invention is distinguished in the addition of lecithin to a different type of lubricating oil (a motor oil adapted for lubricating the bearings and cylinders of an internal combustion engine) which is of a different viscosity range as falling within the motor oil viscosity range and having a Saybolt viscosity in excess of 100 at 100° F. and generally in excess of 150 at 100° F. By a motor oil viscosity range, it is understood that this embraces the motor oils falling within the S. A. E. 10 to 60 grades as well as certain heavier motor oils adapted for special use in heavy duty truck or bus engines, at higher atmospheric temperatures and having a viscosity range varying from about 90 seconds at 130° F. up to about 150 seconds at 210° F. Saybolt Universal, as shown on page 444 of the 1936 edition of the S. A. E. Handbook. The present invention is further distinguished in that the lecithin is employed for an entirely different purpose of inhibiting lacquer formation and bearing corrosion, which are entirely new and unexpected properties unrelated to the fibre wetting or filming action of the prior art. The present invention is further distinguished in the use of a different and critical proportion range of sodium naphthenate or other emulsion preventing agent for the different purpose of improving the emulsion test of the motor oil, which is remote from the detergent action of the soap of the prior art.

As illustrative of the effectiveness of the emulsion preventing agent of the present invention in improving the Navy Emulsion Test of lubricating oils containing a small proportion of a phosphatide, the following data is given:

Materials added to oil		Coloidal BT					
Material A.....							
Conc. of material A percent.....		0.1	0.1	0.1	0.1	0.1	0.1
Material B.....		Sodium naphthenate					
Conc. of material B percent.....		0.0	0.1	0.07	0.02	0.1	0.1
		*1	*2	*3	*4	*5	†6
Cc. oil separated:							
15 min.....		32	40	40	40	40	40
30 min.....		34	40	40	40	40	40
45 min.....		35	40	40	40	40	40
60 min.....		36	40	40	40	40	40
Cc. water separated:							
15 min.....		18	38	30	38	40	40
30 min.....		19	39	31	38		
45 min.....		21	39	31	39		
60 min.....		22	39	31	39		
Cc. actual emulsion:							
15 min.....		30	12	110	12	0	0
30 min.....		27	11	19	12		
45 min.....		24	11	19	11		
60 min.....		22	11	19	11		

*Reference oil was furfural refined dewaxed Mid-Continent distillate S. A. E. 30 grade.

†Reference oil was furfural refined dewaxed Mid-Continent distillate S. A. E. 20 grade.

‡Cuff.

The following table illustrates the effectiveness of quaternary organic ammonium soaps, such as tetrone B naphthenate in improving the Navy Emulsion Test of lubricating oil containing a small proportion of a phosphatide:

Oil		S. A. E. 30	S. A. E. 30	S. A. E. 30	S. A. E. 30
Material A added.....		Coloidal BT			
Material A..... percent.....		0.1	0.1	0.1	0.1
Material B added.....		Tetrone-B naphthenate			
Material B..... percent.....		0.2	0.15	0.1	0.05
Cc. oil separated:					
15 min.....		40	40	3	1
30 min.....		40	40	4	1
45 min.....		40	40	4	1
60 min.....		40	40	4	1
Cc. water separated:					
15 min.....		40	19	37	32
30 min.....		40	23	38	34
45 min.....		40	28	38	35
60 min.....		40	28	38	35
Cc. actual emulsion:					
15 min.....		0	*21	40	47
30 min.....			*17	38	45
45 min.....			*12	38	44
60 min.....			*12	38	44

*Cuff.

In addition to functioning as an emulsion preventing agent for improving the emulsion test of the lubricating oil compounded with a phosphatide, it is found that sodium naphthenate in the small proportion range employed also functions to some extent as a bearing corrosion inhibitor, so that the combination of the two additives provides high effectiveness in inhibiting

bearing corrosion, as illustrated in the table set forth below:

Concentration Coloidal BT..... percent.....	0.0	0.0	0.1
Concentration sodium naphthenate percent.....	0.0	0.1	0.1
Hours run.....	Weight loss		
	Milli-grams	Milli-grams	Milli-grams
5.....	8	14	2
10.....	12	14	3
15.....	100	14	3
20.....	805	15	4
25.....	510	19	9
30.....	713	24	9
35.....		47	10
40.....		115	13

The bearing corrosion test by which these data were obtained was carried out as follows:

A bushing lined with the same cadmium-silver or other alloy as employed in connecting rod bearings in some automotive engines, was immersed in a pot of oil to be tested, the oil being heated to a temperature of the order of 325-350° F. The oil was circulated between the bushing and its journal by a suitable propeller or "whirligig" for a period of five hours. The bushing was removed from the pot at intervals of five hours, weighed and returned. The loss in weight is expressed in milligrams and is considered the corrosion loss. The reference oil employed was furfural refined dewaxed Mid-Continent lubricating oil of S. A. E. 30 grade.

In addition to the advantages enumerated above, it is found that these phosphatide compounds and particularly the purified compounds or the bleached soybean lecithin, and the emulsion preventing agents, such as the naphthenates prepared from purified naphthenic acids, can be added to high grade typical motor oils without objectionably affecting desirable properties or tests of these oils as illustrated in the following table:

Sample	Reference oil	Reference oil plus additives
Material A, added.....		Coloidal BT.
Material A..... percent.....		0.1
Material B, added.....		Sodium naphthenate.
Material B..... percent.....		0.1
Gravity, A. P. I.....	28.2	28.2
Flash, C. O. C..... °F.....	485	475
Fire, C. O. C..... °F.....	540	540
Viscosity, 100° F.....	521	526-528
Viscosity, 210° F.....	62	63-63
Color Lovibond 6".....	270	300
Pour..... °F.....	-5	0
Carbon residue..... percent.....	0.09-0.10	0.13-0.11
Neut. Number.....		0.01
Sap. Number.....		0.7-0.6
Ash..... percent.....		.01

Obviously many modifications and variations of the invention herein 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:

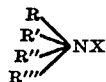
1. A motor oil for lubricating the bearings and cylinders of an internal combustion engine comprising a mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing about 0.01-2.0% of a phosphatide to inhibit bearing corrosion and lacquer formation and less than 1% of an emulsion preventing agent capable of improving the emulsion test of the oil in the presence of the phosphatide.

2. A motor oil according to claim 1 in which the emulsion preventing agent is an oil soluble material that hydrolyzes in the presence of water to give an alkaline reaction.

5 3. A motor oil according to claim 1 in which the emulsion preventing agent is an oil soluble soap of an alkali or alkaline earth metal.

4. A motor oil according to claim 1 in which the emulsion preventing agent is a quaternary organic ammonium soap.

10 5. A motor oil according to claim 1 in which the emulsion preventing agent is a compound having the formula



15 in which R, R', R'', R''' represent the same or different alkyl, aralkyl or aryl groups or combinations thereof, or halogen, oxygen and sulfur substituted derivatives thereof, and in which X represents a fatty acid or naphthenic acid radical.

20 6. A motor oil according to claim 1 in which the emulsion preventing agent is an alkali metal naphthenate.

7. A motor oil according to claim 1 in which the emulsion preventing agent is sodium naphthenate.

30 8. A motor oil according to claim 1 in which the emulsion preventing agent is potassium naphthenate.

9. A motor oil according to claim 1 in which the emulsion preventing agent is trimethyl phenyl ammonium naphthenate.

35 10. A motor oil for lubricating the bearings and cylinders of an internal combustion engine, comprising a mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing about 0.01–2.0% of a lecithin, and about 0.02–0.9% of an emulsion preventing agent capable of improving the emulsion test of the oil in the presence of the lecithin.

40 11. A motor oil for lubricating the bearings and cylinders of an internal combustion engine, comprising a highly solvent refined mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing about 0.01–0.25% of a phosphatide and about 0.02–0.5% of an emulsion preventing agent which is oil soluble and which hydrolyzes in the presence of water to give an alkaline reaction.

45 12. A motor oil for lubricating bearings and cylinders of an internal combustion engine, comprising a mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing about 0.1% of a phosphatide and about 0.1–0.2% of an oil soluble soap of an alkali or alkaline earth metal which acts as an agent capable of improving the emulsion test of the oil in the presence of the phosphatide.

50 13. A motor oil for lubricating bearings and cylinders of an internal combustion engine, comprising a mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing about 0.1% of a bleached commercial

soybean lecithin and about 0.1% of sodium naphthenate.

14. The method of lubricating bearings and cylinders of an internal combustion engine, which comprises supplying to the bearings and cylinders of said engine a mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing a small proportion of a phosphatide of the order of about 0.01–2.0% sufficient to inhibit bearing corrosion and lacquer formation, and containing less than about 1% of an agent capable of improving the emulsion test of the oil in the presence of the phosphatide.

15. The method of lubricating bearings and cylinders of an internal combustion engine, which comprises supplying to the bearings and cylinders of said engine a mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing less than about 1% of a phosphatide and containing less than about 1% of an oil soluble soap of an alkali or alkaline earth metal capable of improving the emulsion test of the oil in the presence of the phosphatide.

16. The method of lubricating the bearings and cylinders in an internal combustion engine, which comprises supplying to the bearings and cylinders of said engine a highly solvent refined mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing about 0.01–0.25% of a phosphatide to inhibit bearing corrosion and lacquer formation, and about 0.02–0.5% of an agent capable of improving the emulsion test of the oil in the presence of the phosphatide.

17. The method of lubricating the bearings and cylinders in an internal combustion engine, which comprises supplying to the bearings and cylinders of said engine a highly solvent refined mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., containing about 0.1% of a phosphatide to inhibit bearing corrosion and lacquer formation and about 0.01–0.2% of an oil soluble soap of an alkali or alkaline earth metal capable of improving the emulsion test of the oil in the presence of the phosphatide.

18. The method of lubricating the bearings, cylinders and pistons of an internal combustion engine, which comprises supplying to the bearings, cylinders and pistons of said engine a mineral lubricating oil within the motor oil viscosity range having a Saybolt viscosity of from about 90 at 130° F. to about 150 at 210° F., which lubricating oil of itself would normally cause corrosion of said bearings and lacquer formation on said pistons, incorporating in said mineral lubricating oil about 0.01–2.0% of a phosphatide to inhibit said bearing corrosion and lacquer formation but which is sufficient to increase the emulsion difficulties of the oil in the presence of water as determined by the Navy emulsion test, and also incorporating in said oil about 0.02–0.9% of an alkali metal naphthenate to improve the said oil containing the phosphatide with respect to said emulsion test.

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