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ESTERS OF ALIPHATIC DIBASIC ACIDS AND ETHER-ALCOHOLS CONTAINING A BRANCHED CHAIN IN THE GLYCOL GROUP

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5 Claims. (Cl. 260—485)

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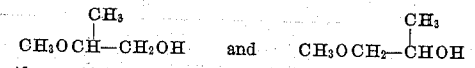
This invention relates to a new class of organic compounds consisting of esters of a type to be specified hereinafter, the same being found to possess properties which indicate that these compounds are particularly suitable for use as synthetic lubricants.

In the lubricant art, considerable progress has been realized in recent years in the production of lubricants characterized by one or more specific properties and adapted for particular uses. In the main, this progress can be attributed to two developments: the first, new refining procedures, and the second, addition agents capable of imparting particular properties to available lubricants. Thus, viscosity index improvers and pour depressants are added to automotive lubricants to render the lubricants more adaptable to wide changes in temperature conditions, while other agents are added to improve the load carrying properties of a lubricant which is to be employed, for example, under extreme pressure conditions.

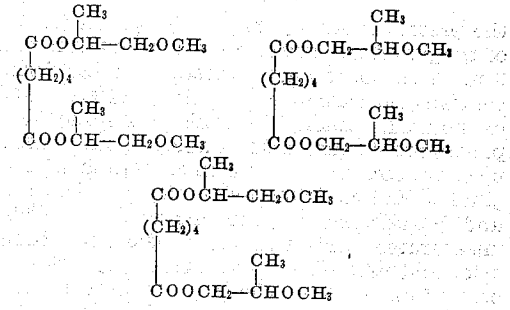
Recently, in an effort to obtain superior lubricants endowed with specific and superior characteristics, a new field has been explored, namely, the synthesis of lubricants from various materials. Esters represent one class of materials which have attracted unusual interest as synthetic lubricants. In general, they are characterized by higher viscosity indices and lower pour points than mineral oils of corresponding viscosity. The esters described in the present specification have been found to exhibit very low pour points and high viscosity indices. Lubricants possessing such properties are of special value to the lubrication of engines which are subjected to high temperatures such as combustion turbine engines, particulary those of the "prop-jet" type. Mineral oil lubricants containing added viscosity index improvers, thickeners or other highly nonvolatile additives are undesirable for use in such engines because of the tendency to leave a residue which would accumulate and interfere with the operation of the engine. A synthetic lubricant of the type described in the present specification is especially adapted to use under such conditions, since the lubricant contains no additives and thus tends to leave no residue upon volatilization.

The new compounds of the present invention, which are distinguished for exhibiting a high viscosity index and very low pour points, are esters of aliphatic dibasic acids, characterized by the presence of at least one oxygen atom and a branched chain hydrocarbon structure in each ester group.

Esters of the above type may be formed by esterifying the dibasic acids with ether-alcohols obtained by reacting aliphatic monohydric alcohols with alkylene oxides containing 3 or 4 carbon atoms. When, for example, one mol of methyl alcohol is reacted with one mol of propylene oxide, the resulting product is a mixture of alcohols having the compositions



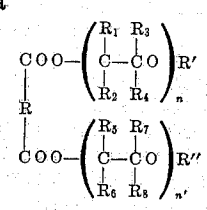
If, then, this product is reacted with a typical dibasic acid such as adipic acid, the resulting product will consist of mixtures of the following three compounds:



If more than one mol of alkylene oxide is reacted with the monohydric alcohol, ether-alcohols will be formed having more than one ether linkage in the molecule, and such compounds may be likewise employed in the formation of the esters of the present invention. One series of ether-alcohols formed in this manner are known to the trade as "Dowanols."

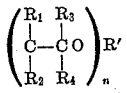
Since the alkylene oxide to be employed must contain at least three carbon atoms, a branched chain structure results in the ester group. Obviously, when a mixture of the ether-alcohols is reacted with a dibasic acid, a mixture of esters will be formed, but such mixtures will be suitable for use as synthetic lubricants in the same manner as pure esters.

The new class of esters forming the subject matter of the present invention may be defined by the formula

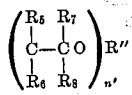


where R is an aliphatic hydrocarbon radical, either saturated or unsaturated, straight chain or branched, containing 0 to 26 carbon atoms; R_1, R_2, R_3, and R_4 each represent hydrogen or an alkyl group of 1 to 2 carbon atoms, at least one being an alkyl group; R_5, R_6, R_7, and R_8 likewise represent hydrogen or alkyl groups of 1 to 2 car-

bon atoms, at least one being an alkyl group; R′ and R″ each represent an aliphatic hydrocarbon radical, saturated or unsaturated, straight chain or branched; n and n' are integers; and the sum of the carbon and oxygen atoms in each group



and



is 5 to 26.

As can be seen from the formula, the esters of the present invention may be prepared from any of the paraffin dicarboxylic acids containing from 2 to 28 carbon atoms. Where R of the formula contains no carbon atoms, the acid employed is oxalic acid. Among the acids which may be employed are, for example, oxalic, malonic, succinic, pyrotartaric, dimethylsuccinic, trimethylsuccinic, glutaric, adipic, trimethyladipic, suberic, sebacic, and hexadecane dicarboxylic acids, as well as unsaturated acids such as maleic acid, fumeric acid, and alkenyl succinic acids, the last named being formed by condensing olefins with maleic anhydride.

The alcohols which may be employed in the esterification of the dicarboxylic acids are of the type which are formed by reacting any of the monobasic aliphatic alcohols, whether primary, secondary, or tertiary, with propylene oxide, 1,2- or 2,3-butylene oxide, or isobutylene oxide, the chain length of the alcohol and the number of molecular proportions of alkylene oxide for each molecular proportion of alcohol being limited by the provision, in accordance with the general formula shown above, that the total of carbon and oxygen atoms in each ester group should not exceed 20. Among the alcohols which are of most particular interest in the preparation of the new esters may be mentioned methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, sec.-butyl, tert.-butyl, n-amyl, iso-amyl, sec.-amyl, tert.-amyl, 2-ethylbutyl, n-octyl, tert.-octyl, 2-ethylhexyl, n-decyl, cetyl, lauryl, and oleyl alcohols.

The esterification process can be carried out by the usual methods, preferably employing an esterification catalyst such as p-toluenesulfonic acid and a water-entraining agent.

In the table below will be shown data obtained in tests of the properties of seven typical esters illustrating the present invention, these esters having been formed by first preparing an ether-alcohol by reacting methyl or isopropyl alcohol with one, two and three molecular proportions, respectively, of propylene oxide, and then preparing di-esters of sebacic or adipic acid by esterifying the acid with the alcohols prepared as described. The esterification process was carried out in each case by the following procedure:

A mixture of 1 mol of dibasic acid, 2.2 mols of ether-alcohol, 0.5 weight percent of p-toluenesulfonic acid monohydrate, and 100 to 200 mols of a water entraining agent such as naptha, benzene, toluene, or the like is refluxed until no more water is collected in an esterification water trap. The product is washed until neutral with a saturated aqueous Na_2CO_3 solution and then with water. After drying over a desiccant, such as anhydrous $CaSO_4$, the material is stripped at a pressure of 5 mm. to a bath temperature of 200–225° C.

The data obtained in the tests of properties of the esters obtained as described are shown in the table.

Table

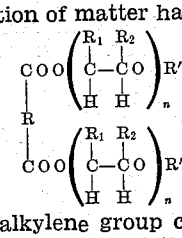
Alcohol	Mols Oxide per Mol Alcohol	Oxide	Acid	Flash Point (°F.)	ASTM Pour Point (°F.)	Kinematic Viscosity		ASTM Slope	Viscosity Index
						100° F.	210° F.		
Isopropyl	1	Propylene	Sebacic	400	<−35	10.694	3.000	0.703	154
Do	2	do	do	440	<−35	21.030	4.772	0.666	162
Do	3	do	do	475	<−35	52.647	8.929	0.624	139
Methyl	2	do	Adipic	390	<−75	11.005	2.821	0.760	113
Do	3	do	do		−65	19.720	4.296	0.705	146
Isopropyl	2	do	do	380	−65	14.701	3.520	0.724	137
Do	1	do	do	325	<−75	6.990	2.084	0.796	102

The above data show that the esters which were tested possess unusually valuable properties with respect to their usefulness as synthetic lubricating oils.

The esters of the present invention may be employed not only as such but also in mixtures with mineral oils to produce lubricants of superior properties with respect to viscosity index, pour point, and other desirable characteristics.

What is claimed is:

1. A composition of matter having the formula



where R is an alkylene group containing 4 to 8 carbon atoms; where one of the groups R_1 and R_2 in each esterifying radical is a methyl group and the other is hydrogen; where R′ is an alkyl group containing 1 to 3 carbon atoms; and where n is an integer from 1 to 3.

2. A composition according to claim 1 in which R is the group $-(CH_2)_8-$, and where R′ is an isopropyl radical.

3. A composition according to claim 2 in which n of the formula is 1.

4. A composition according to claim 2 in which n of the formula is 2.

5. A composition according to claim 1 in which R is the group $-(CH_2)_4-$, in which R′ is a methyl radical, and in which n is 3.

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