Patented Mar. 14, 1939 2,150,177

UNITED STATES PATENT OFFICE

2,150,177

LUBRICATING OIL

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No Drawing. Application April 15, 1935, Serial No. 16,410

3 Claims. (Cl. 87—9)

This invention relates to lubricating oil and specifically to a composition of matter having many desirable characteristics for practical lubrication.

In the manufacture of lubricating oil designed for use in modern automotive equipment, the demands on the lubricants have increased markedly in recent years. While the low speed engines designed with Babbitt bearings operating with comparatively large clearances between the journals and bearings required no exceptional properties in the lubricating oil, the modern high speed engines using harder journals and bearings operating at much smaller clearances require that the lubricating oil possess a variety of unusual characteristics in order to lubricate this type of engine satisfactorily. Among these characteristics are increased stability toward heat and oxidation, reduced tendency to develop sludge and acidity in use, and most important of all, the ability to carry high loads without permitting metal-to-metal contact. The necessity of these properties, particularly that of high film strength in lubricating oils, is emphasized in all the literature treating of lubrication of modern automotive equipment. Thus, for example, in the National Petroleum News, vol. 27, #5, page 25 (January 30, 1935), numerous recommendations for the use of extreme pressure lubricants in modern automobiles are cited. The use of such addition agents may affect either favorably or adversely such other properties of the hydrocarbon oil as stability toward heat and oxidation, corrosiveness after use, cold test, and other important properties. In the design of the addition agent such other effects must be considered, since the hard alloy bearings are very susceptible to corrosion, for example, by acids derived from both the addition agent and the hydrocarbon base. Unless very soluble addition agents are used, the cold test of the blended oil may be raised. This is a distinct disadvantage, particularly in winter grade oils. Some addition agents may accelerate oxidation of the oil, while others may be without effect or even decrease the susceptibility to oxidation during use. All of the effects of the addition agent on the blend must therefore be considered in designing a material for the improvement of the load carrying ability of the oil.

In the previous art of preparing addition agents for the improvement of the film strength of lubricating oils, no cognizance has been taken of the relation between the molecular structure of the organic molecule and its effect on the properties of the oil with which it is blended. We have discovered that the presence of particular functional groups and their position in the organic molecule have a profound effect upon the ability of the material to raise the load carrying efficiency of the mineral oil with which it is blended.

We have discovered that the introduction of negative radicals, more particularly the phenyl or substituted phenyl group, into the molecule of a halogenated compound serves to activate the halogen in such a way that the arylated compound is many times more effective as an extreme pr s-sure compound than the unarylated compound. This improvement which arylation effects in extreme pressure character is not attended by any deleterious change in any other properties of the addition agent, but the introduction of the aryl group often improves the other properties of the essence so that the blended oil may have better stability with respect to heat and oxidation, better color after use, and other desirable characteristics. The presence of halogen in an aryl radical will increase its negativity. In view of this we have used the terms "aryl" and "substituted aryl" to include halogenated radicals. The total halogen in the molecule may be on an aliphatic carbon or carbons or on an aryl carbon or carbons or located on both kinds of carbon atoms.

We have further ascertained that in a halogenated, arylated aliphatic hydrocarbon designed to be used as an addition agent for lubricating oils, it is necessary to have more than one aryl nucleus to one aliphatic carbon atom. In compounds having fewer aryl groups, other properties become significantly objectionable. Benzyl chloride, for example, is a lachrymator and is corrosive; hence it is not suited to our purpose.

While our emphasis is on the use of chlorine compounds because of their ready availability and cheapness, we do not wish to be limited to this one halogen since the other halogens are suited to our purpose. Bromine and iodine are more costly than chlorine while fluorine is very active chemically.

The halogenated, arylated aliphatic hydrocarbons which we contemplate using may be prepared by any of the methods known to the art, such as the Friedel-Crafts reaction or other condensation reactions. They may be purified by distillation, crystallization or other suitable process. It is important, however, that these essences be free from any traces of hydrochloric or other acids, so that such corrosive substances will not be inadvertently introduced into the blend. These may be removed by washing the essence with dilute caustic, soda ash solutions or the like.

In order to test various addition agents, we have made blends consisting of one-half percent or one percent of the added material and 99.5 percent or 99 percent of a well refined mineral or hydrocarbon lubricant of the viscosity of S. A. E. 30. In practicing our invention, however, the hydrocarbon portion of the blend may be any material included in that class named, be it natural or synthetic in character. It may be, for example, a hydrogenated lubricant, or one obtained by any sort of chemical or catalytic action on hydrocarbons. These hydrocarbon oils may be of any classification since the invention is not limited to oils of the S. A. E. classification.

For the sake of comparison we have used 0.5% and 1% concentrations of addition agents in our exemplifying blends. However, it is to be understood that in practicing our invention any suitable concentration of addition agent from 0.2% to 5% or more may be used in order to obtain effects of the desired magnitude.

These blends were then tested by recommended methods on the machine manufactured for the purpose by the Timken Roller Bearing Company and hereafter referred to as the "Timken" machine. Its construction and operation are fully described in the literature of the art.

In order to examine the effect of introducing various substituents into organic molecules so as to increase the film strength of their blends, we have found it helpful to express the efficiency of the halogens, for example, in the case of a halogenated addition agent, as a ratio of the Timken film strength in pounds per square inch to the percent of chlorine present in the addition agent.

$$\text{Efficiency index} = \frac{\text{Increase in film strength (pounds per sq. in.)}}{\text{Percent of chlorine in the addition product.}}$$

This ratio, which we have chosen to call the "efficiency index", does not constitute an essential part of our invention, but does serve to make more obvious the effect of differences in molecular structure which will make our invention clear to those skilled in the art.

Our invention may be made evident by the effect of introducing phenyl or other substituted or unsubstituted aromatic radicals of negative character into various organic molecules. Thus alkyl halides of low molecular weight have a much smaller effect on the film strength of blends with mineral oil compared with similar compounds in which part or all of the hydrogen atoms of the alkyl halide have been substituted by the phenyl group. It is particularly advantageous in these phenylated alkyl halides to have the phenyl group or groups attached either to the carbon atom which bears the halogen or to the next carbon atom. This proximity is essential in order that the activating influence of the negative phenyl group be effective. If the latter be further removed, its influence decreases rapidly with the increase in the number of carbon atoms intervening between the phenyl group and the halogen atoms.

The specific examples given herein serve to show how we practice our invention, and are not to be considered as limitations.

Example I

Number	Blend	Timken test lbs./sq. in.	Efficiency index
1	Mineral oil	6000–7000	
2	Ethylene dichloride (0.5%)	13,160	183.5
3	Tetraphenyl ethylene chloride (0.5%)	23,010	1348.9

It is apparent from this comparison that while the introduction of the four phenyl groups in the ethylene dichloride increases the effectiveness of the latter in improving the film strength, it also reduces the chlorine content of the molecule so much that in order to make a fair comparison of the two compounds it is necessary to take this into account. The efficiency index indicates that such halogen as is contained in the phenylated compound is more than seven times as effective in improving the load carrying characteristics in the blend.

The blend of tetraphenyl ethylene dichloride was as stable toward oxidation as the hydrocarbon oil from which it was prepared and corrosiveness and cold test were not adversely affected.

Example II

Number	Blend	Timken test lbs./sq. in.	Efficiency index
1	Mineral oil	6000–7000	
2	Hexyl chloride (1%)	6160	208.8
3	Octadecyl bromide (1%)	5110	212.9
4	Triphenyl methyl chloride (1%)	51,010	4,095.0
5	Beta-phenyl ethyl chloride (1%)	34,500	1,364.3

The effect of phenylation is shown here both in the Timken test and in the efficiency index, but more strikingly in the latter. While hexyl chloride makes but relatively poor use of its halogen, beta-phenyl ethyl chloride produces five times the film strength in spite of its lower chlorine content. This is shown in the efficiency index which is about six and one-half times greater in the case of the more efficient compound.

The high value shown for the blend of triphenyl methyl chloride prove the advantage of having one or more of the aryl groups attached to the same carbon bearing the halogen. This compound is three times as efficient as beta-phenyl ethyl chloride, but beta-phenyl ethyl chloride is much more efficient than either of the alkyl halides.

All of these blends were satisfactory in other respects, such as cold test, stability, color corrosiveness, and other properties.

Example III

To 99 parts of S. A. E. 30 mineral oil of high quality, one part by weight of benzophenone dichloride was added and the two components thoroughly blended together. A load of 59,000 pounds per square inch was carried satisfactorily by this blend on the Timken machine, while the unblended oil carried 6,000 to 7,000 pounds per

square inch pressure. The efficiency index of this addition agent is 1966.7. All other properties of this blend were satisfactory.

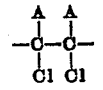
Having thus described our invention, what we claim is:

1. A lubricating oil comprising in combination a hydrocarbon oil and a small percentage of an oil soluble, phenylated, chlorinated, aliphatic hydrocarbon containing the following structure:



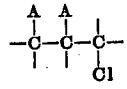
in which A represents an aryl group.

2. A lubricating oil comprising in combination a hydrocarbon oil and a small percentage of an oil soluble, phenylated, chlorinated, aliphatic hydrocarbon containing the following structure:



in which A represents an aryl group.

3. A lubricating oil comprising in combination a hydrocarbon oil and a small percentage of an oil soluble, phenylated, chlorinated, aliphatic hydrocarbon containing the following structure:



in which A represents an aryl group.

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