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## METAL FABRICATING LUBRICANT

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The present invention relates to improvements in the art of producing lubricating oils and more specifically to oils capable of withstanding heavy loads such as are used in the cutting of metals and other types of metal fabrication and likewise for power transmission oils, gear oils and the like. The invention will be fully understood from the following description:

For many years it has been recognized that organic materials, such as fatty and mineral oils, could be sulfurized and that the sulfurized materials had very high load bearing capacity, particularly for steel to steel bearings, gears and the like. The sulfurization has ordinarily been carried out in either of two ways, for example, by cooking elementary sulfur into the oil or by treatment of the oil with a sulfur chloride. Both of these methods have objections, namely, if the reaction is vigorous enough to bind a large amount of sulfur into the oil permanently, it is found that the oil is badly discolored, while if less vigorous action is used the amount of sulfur taken up by the oil is not sufficient, and moreover the sulfur is not permanently bound and continues to settle from the oil during storage and use.

It has been found that one class of organic compounds are much superior to others which have been treated because of the fact that a sufficient amount of sulfur can be incorporated in order to give valuable load bearing capacity, and at the same time there would be little or no darkening in color, with the result that a suitable compound is produced which is clear and transparent.

The particular class of substances referred to comprises the abietic acid compounds which include not only abietic acid itself but also esters of the acid such as aliphatic alcoholic esters, and also aromatic esters such as phenolic esters. Abietic acid, as is well known, is obtained from colophony or resin, but it contains certain impurities of a tarry nature which should be removed in order to get a clean clear product. These materials may be removed in a variety of different ways such as by careful vacuum distillation, but the extraction processes are the most desirable and an excellent product can be obtained by extraction of rosin with propane, butane, pentane, or mixtures of these hydrocarbons. These hydrocarbons may be used to purify the abietic acid from the crude rosin by dissolving the abietic acid from the impurities or the rosin may be completely dissolved at a more elevated temperature and by reduction of temperature the tarry materials may be precipitated and thus separated from the abietic acid which is retained in solution. Partially hydrogenated abietic acid compounds may also be used.

It has been generally stated that alcoholic esters of abietic acid may be used. It is preferred to use monobasic aliphatic alcohols for this purpose, such as methyl, ethyl, the propyl and the butyl alcohols; but cyclo alcohol may also be used, such as cyclohexanol, or aromatic alcohols, such as benzyl alcohol, or phenols, such as the ordinary phenol, cresols, or various naphthols. Glycolic esters or glycerides of the hydrogenated acid may also be used, but generally the monobasic alkyl esters are preferable.

After the purified abietic acid compound has been obtained it is sulfurized by either of the two methods referred to above. If elementary sulfur is used, 5 to 15%, say about 10%, is usually added to the ester or acid as the case may be and the mixture is heated to about 350° F. and maintained at this temperature until the reaction is completed. When sulfur chloride is used for sulfurization, it is ordinarily added in the proportion of about 10 to 15% to the abietic acid compound, and the mixture is heated to about 250° F. which is sufficient for reaction. The mixture should be kept in agitation, and in order to remove the chlorine, air or other gas may be blown through the mixture while in a heated condition. If chlorine is not objectionable for the particular use intended, a small amount may be allowed to remain.

The sulfurized stock produced by either of the above methods may be used directly as a compounding agent for gear oils or other oils, particularly those used in metal fabrication. The sulfurized material is a clean, clear, transparent, viscous oil which has not darkened appreciably and will not darken to any substantial extent on standing. Furthermore, it will be found that a substantial quantity of sulfur may be so incorporated and that it is in stable condition. No separation of sulfur occurs. This material may be added to any type of petroleum oils without detriment to color or general appearance, except, of course, in the case of the so-called "white" oils. Those particular products are water white in color and will, of course, be given a yellow appearance.

*Example I*

A methyl ester of a highly purified abietic acid was polymerized by adding thereto 10 parts by weight sulfur to 90 parts of the said ester and heating to 350 to 370° F. for several hours and

then allowing to cool. The product was of good color and clear. It was added in 10% concentration to an ice machine lubricating oil which was free of wax. The mixture was cooled to 0° F. and kept at this temperature for 5 days. No sulfur separated but the oil became slightly milky. This milky appearance disappeared on reheating to room temperature.

*Example II*

The methyl ester of abietic acid was heated with 10% sulfur monochloride at 250° F. The product foamed largely but the reaction was not too vigorous to be controlled. This product is a deep red. On adding 10% to a lubricating oil, a good extreme pressure oil was obtained, of good color and capable of carrying a shock load of 11 weights on the Almen machine. This product was a good transparent cutting oil.

*Example III*

The product was made as in Example II except that 15% sulfur monochloride was used and 5 parts of a heavy saturated rubber-like hydrocarbon polymer was added to the ester before addition of the $S_2Cl_2$. The reaction was quite violent but the final mixture was similar to that of Example II except somewhat darker. A 10% solution in mineral oil carried 13 weights shock load on the Almen machine.

We claim:

1. An improved lubricant comprising a mineral oil and, as an extreme pressure agent, a hydrogenated sulfurized abietic acid substance.

2. An improved lubricant comprising a mineral lubricating oil and, as an extreme pressure agent, a hydrogenated derivative of an abietic acid substance containing both sulfur and chlorine.

3. An improved lubricant comprising a mineral lubricating oil and, as an extreme pressure agent, a hydrogenated sulfurized ester of abietic acid.

4. An improved lubricant comprising a mineral lubricating oil and, as an extreme pressure agent, a hydrogenated derivative of an ester of abietic acid which contains both sulfur and chlorine.

5. An improved lubricant according to claim 3 in which the ester is an ester of an aliphatic alcohol.

6. An improved lubricating oil according to claim 3 in which the ester is an ester of methyl alcohol.

7. An improved lubricant comprising a mineral lubricating oil and, as an extreme pressure agent, a hydrogenated abietic acid ester which has been reacted with sulfur chloride so as to produce a product containing both chlorine and sulfur.

8. Product according to claim 9 in which the ester is an ester of an aliphatic alcohol.

9. An extreme pressure lubricant comprising a hydrocarbon lubricant and, as an extreme pressure agent, a dissolved, hydrogenated, sulfurized, methyl ester of abietic acid.

10. An extreme pressure lubricant comprising a hydrocarbon lubricant and, as an extreme pressure agent, a dissolved, hydrogenated, sulfurchlorided, methyl ester of abietic acid.

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