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SULPHURIZED OIL

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This invention relates to sulphurized oils and new compositions of matter used in the preparation thereof and is a continuation-in-part of our co-pending application, Serial No. 11,588, filed March 18, 1935.

It has long been known that sulphur compounds, when added to lubricating oils, impart certain properties to the mixtures which are of great value when these mixtures are used as lubricants for very heavy duty such as is encountered in the lubrication of automotive gears of the hypoid and spiral bevel types and other power transmission gears and for the lubrication of cutting tools such as are used in cutting and threading steel pipe. The exact manner in which the sulphur compounds, with respect to the cutting lubricants, act to produce these results is not known with any degree of certainty. It is more than a matter of the increased film strength which sulphur compounds impart to lubricating oils, since, for each sulphur compound that may be added to a lubricating oil to increase its film strength, there is an optimum percentage above which there is no tendency to obtain further increase with greater percentages of the sulphur compound. On the other hand, there seems to be no limit to the improvement of a cutting oil that can be obtained by increasing its sulphur content, at least as far as the smoothness of the metal cut obtained with it is concerned.

All sulphur compounds do not have this beneficial effect on lubricants to the same degree for the same amount of sulphur, as will be brought out in the examples given hereinbelow; and to most of those now in use, there are certain definite objections. The most common sulphur compounds used for blending with lubricating oils are the sulphuretted glycerides of the unsaturated fatty acids. These usually contain about 12 percent sulphur. Sulphuretted lard oil is a typical example. These compounds are not entirely satisfactory for blending purposes for several reasons. The sulphuretted glycerides are very viscous and hard to handle and raise the pour point of the oil with which they are blended, have a very strong odor of hydrogen sulphide, are irritating to the skin of the operators working with them, are not as stable as desired when in use and do not give a good cut when used in a cutting lubricant, do not give a very high film strength when used in an extreme pressure lubricant, are not entirely oil soluble, and are not refinable to any extent.

Even with using a large percentage of these sulphur-base oils, cutting lubricants are obtained which are rather inefficient as far as cutting qualities are concerned, objectionable on account of odor, irritating to the skin of the operator and in case of slight cuts on the hand cause sores difficult to heal, are very viscous when cold, are not stable to high temperatures while in use, and break down and release H_2S.

An extreme pressure lubricant for gears which is made from the conventional sulphuretted glycerides, such as lard oil, has many defects. In the first place, this type of sulphur-base blend is not as stable as is desired to the copper strip corrosion test, which some automobile manufacturers now require for sulphur-base lubricants. Secondly, the film strength is not very high; and last, the pour point of the lubricant is raised five degrees to 25 degrees F., depending upon the type of petroleum base oil used.

We have discovered that the sulphuretted or sulphurized synthetic monohydric and dihydric alcohol esters of organic acids make excellent sulphur bases for blending with lubricants for preparing superior cutting oils and gear lubricants. By the term "sulphurize" we mean the introduction of sulphur in the form in which it is introduced into a synthetic ester by means of sulphur or a halide of sulphur. These compounds are superior to the conventional sulphuretted glycerides of unsaturated fatty acids in a number of ways. To begin with, they are in general much less viscous even when containing a much larger percentage of sulphur and are therefore easier to handle. They may be easily and permanently freed from the odor of hydrogen sulphide by blowing for a few minutes with sulphur dioxide after sulphuretting. They are, as a group, much more stable to heat than the sulphuretted glycerides and consequently do not break down and release H_2S in service as readily. When the glyceride breaks down, glycerine is released which forms gum and is generally objectionable.

When used in a cutting oil, they do not irritate the skin of the operators. They are cheaper because about twice as much sulphur may be added to this type of compound as can be added to the glycerides, and thus they give a more concentrated base. Another important advantage of these sulphuretted or sulphurized synthetic monohydric and dihydric alcohol esters is that they are more soluble in petroleum lubricants than their corresponding sulphuretted glycerides. The latter have a marked tendency to show a sludge-like deposit on the bottom of the container in which a blend of this type base and a

petroleum lubricant has stood for some time. The reason for this phenomenon is that glycerides tend to polymerize on sulphuretting and form oil insoluble polymers, whereas their corresponding synthetic monohydric esters show little or no tendency to polymerize on sulphuretting or sulphurizing. The pour point of blends made with a petroleum lubricant is higher by 10° to 25° F. (depending on the type of lubricant) when a sulphuretted glyceride is used than when the corresponding sulphuretted or sulphurized synthetic monohydric alcohol ester is used. The latter do not affect the emulsion characteristics and decrease the sludge-forming tendencies of the base oil with which they are blended. The sulphuretted glycerides cause emulsion trouble and increase sludge formation.

The viscosity of the sulphuretted glyceride blends is very much higher for the same amount of added sulphur at temperatures from 0 degrees to 50 degrees F. than similar blends where the sulphuretted or sulphurized synthetic monohydric alcohol esters of the same acids are used. This is a very important factor when considering either a cutting oil or a power transmission gear lubricant. In the case of the former, it is frequently difficult to obtain a good flow of the cutting oil from the sump of the machines on cold mornings in a shop that is not too well heated. Under these conditions, the machines do poor work; and the cutting tools are dulled. The disadvantages of a high pour test and high viscosity at cold weather temperatures in the case of gear lubricants cause excess loss of power in overcoming the internal friction of the lubricant and difficulty in shifting of gears in the case of automobile transmission gears.

A lubricating oil was made by blending the residue from a lubricating oil vacuum still with a light neutral oil. The oil was then blended with sufficient sulphurized lard oil to give a blend containing 4 percent sulphur. Similarly a blend was made with the same lubricating oil and sufficient sulphurized synthetic methyl oleate to give a blend containing 4 percent sulphur. The pour points were then determined.

Pour point

Lubricating oil base	−15 and flowing
Lubricating oil+sulphurized lard oil	+15
Lubricating oil+sulphurized methyl oleate	−15 and flowing

Tests to prove the relative stability to heat in the presence of copper were also made. The same base oil and sufficient of the sulphur bases were used to give blends containing 1.6 percent added sulphur.

Oil	Appearance of strip	
	After ½ hour at 210° F.	After 1½ hours at 210° F.
Lubricating oil base	Very good	Very good.
Lubricating oil + sulphurized lard oil.	Very dark	Very dark.
Lubricating oil + sulphurized methyl oleate.	Slightly discolored.	Slightly discolored.

A low cold test in all lubricants (except greases) is highly desirable because lubricants with high cold tests do not lubricate in cold weather until they warm up and flow, and much harm to parts may take place before the lubricant begins to flow.

An addition compound for use in a crankcase lubricant must not be corrosive to copper, since certain bearings, oil lines, and other parts will be affected. It also must not affect the emulsion, cloud, color, or other tests of the oil with which it is blended.

Such tests which prove the advantages of the sulphurized synthetic esters over sulphurized glycerides are the following:

Emulsion tests

	A. S. T. M. steam emulsion	U. S. Bureau of standards Herschel demulsibility
	Seconds	
SAE No. 10 mineral oil	30	1620
SAE No. 10 mineral oil+.2% of sulphurized methyl oleate	30	1620
SAE No. 10 mineral oil+.2% of sulphurized lard oil (glyceride)	90	420
SAE No. 10 mineral oil+.15% of sulphurized methyl corn oil acid esters	30	1620
SAE No. 10 mineral oil+.15% of sulphurized corn oil (glyceride)	120	400

Sludging tests

	Sligh oxidation number
SAE No. 30 mineral oil	9.0
SAE No. 30 mineral oil+.2% sulphurized lard oil (glyceride)	22.0
SAE No. 30 mineral oil+.2% sulphurized methyl oleate	6.0
SAE No. 30 mineral oil+.15% sulphurized corn oil (glyceride)	24.0
SAE No. 30 mineral oil+.15% sulphurized methyl corn oil acid esters	8.0

Oil solubility test

	After one month at room temperature	
	Cloud	Sediment
SAE 30 refined mineral oil	None	None.
SAE 30 refined mineral oil+.25% sulphurized methyl oleate.	Trace	Do.
SAE 30 refined mineral oil+.25% refined sulphurized methyl oleate.	None	Do.
SAE 30 refined mineral oil+10% sulphurized methyl oleate.	Trace	Trace.
SAE 30 refined mineral oil+10% refined sulphurized methyl oleate.	None	None.
SAE 30 refined mineral oil+10% sulphurized lard oil (glyceride).	Bad	Appreciable.
SAE 30 refined mineral oil+10% refined sulphurized lard oil (glyceride).	...do...	Do.

Sulphurized glycerides do not lend themselves to refining because they too readily polymerize with most refining agents such as sulphuric acid. The sulphurized synthetic esters may be easily refined with sulphuric acid because of their greater stability.

The sulphurized synthetic esters give a greater film strength improvement than do the sulphur-

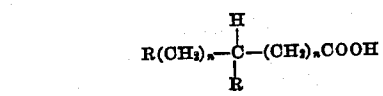
ized glycerides as the following Timken test reveals:

Timken test

	Film strength in pounds on loading arm
1. Mineral oil base 100 sec. at 210° F.—lbs.—	12
2. Mineral oil base+1.6% sulphur as sulphurized methyl oleate—lbs.—	33
3. Mineral oil base+1.6% sulphur as sulphurized lard oil (glyceride)—lbs.—	27

Copper strip tests at 210° F. on oils Nos. 2 and 3 showed only slight discoloration for the sulphurized synthetic ester blend and considerable discoloration for the sulphurized lard oil blend. This proves the former to be more stable.

The synthetic esters to be used in practicing this invention are usually prepared from the acids obtained from the glycerides of organic acids as found in animal and vegetable oils; however there are other sources, such as the aromatic acids, for example, cinnamic acid, monophenyl oleic acid, mononaphthyl oleic acid, monotolyl linoleic acid, etc. Aliphatic acids and substituted aliphatic acids in general may be used in preparing synthetic esters for this invention, for example, acids of the type



where R is a saturated or unsaturated open chain or closed chain group and n is zero or any whole number. Another type of acid which may be used in preparing the esters is the cyclic acids, for example, abietic acid. Sulphurized synthetic esters of organic acids in general may be employed in our invention. We have found, however, that the chemically saturated and preferably the chemically unsaturated open chain and/or aliphatic acids are highly suited for our use. The organic acids of the closed carbon chain type are better suited to our invention if they have one or more chemically unsaturated open chain radicals attached to the closed carbon ring nucleus. It is recognized that organic acids having five or less carbon atoms per molecule are considered acids of low molecular weight, while those having more than five carbon atoms per molecule are acids of high molecular weight.

Organic acid radicals for use in making synthetic esters for this invention may be obtained from substances, products, or compounds containing such radicals or from such mixtures if the acids are present as such in the mixture. But in employing such acids in this invention it is necessary that the acids as such must be separated and removed from all of the other extraneous compounds or materials all of which are considered as objectionable impurities in this invention. Obviously acids of commercial purity are satisfactory for this invention. There are a number of commercial methods of separating acids from such mixtures and acids resulting from the use of any of these methods on any of the various raw or base materials are satisfactory. It is not an object of this invention to cover any of these separating methods and the invention is not limited to acids for the production of synthetic esters that result from the use of any particular method of separation. The method of removing impurities by precipitating the acid as a soap is satisfactory. The soap may be purified by any suitable means, the organic acids released and separated and then esterified. Such esters after sulphurizing may be used in our invention.

The preferred monohydric alcohols for use in preparing the synthetic esters for this invention are methyl, ethyl, and propyl, butyl, amyl alcohols, and their isomers. The methyl esters are the most stable, cheapest, and most easily prepared and consequently give the most desirable synthetic esters; however, monohydric alcohols with 6 to 12 or 18 or higher carbon atoms per molecule may be used. High molecular weight monohydric alcohols, particularly those of a chemically unsaturated nature, may be used in this invention for the production of synthetic esters. These alcohols with relatively low molecular weight organic acids are desirable for some compositions. Oleyl acetate, for example, is suitable. Alcohols of five carbon atoms per molecular or less are considered of low molecular weight, and alcohols having more than five carbon atoms per molecule are considered of high molecular weight.

The synthetic esters of di-ethylene glycol and ethylene glycol and similar low molecular weight dihydric alcohols may be used in preparing the esters for our invention, with partial success, but are not as satisfactory for overall general use as the monohydric alcohols. Examples are glycol oleate, glycol linoleate, glycol diphenyl oleate, glycol dinaphthyl linoleate and the like, which are very satisfactory for use after sulphurizing.

The synthetic monohydric and dihydric alcohol esters of saturated acids may be used in this invention. It is more difficult to sulphurize these compounds than the unsaturated esters because the sulphur must be substituted for hydrogen. Temperatures above 400° F. are generally required to accomplish this.

Naturally occurring oils and waxes as such containing monohydric alcohol esters of organic acids have proved unsatisfactory for use in this invention. The reason for this appears to be that these naturally occurring substances are a mixture of esters with naturally occurring impurities such as glycerides, high molecular weight alcohols, hydrocarbons, often nitrogen compounds and other impurities. Some of the oils and waxes in this group are sperm oil and similar whale oils, wool fat or wool grease, beeswax, carnauba wax, and candelilla wax. Sperm oil contains from 5 percent to 25 percent of glyceride, which makes it unsatisfactory. It also contains an appreciable amount of free high molecular weight alcohols which are objectionable, since they also give relatively unstable derivatives on sulphurizing. The removal of the monohydric or dihydric alcohol esters as such from the glycerides, free alcohol, and other impurities in the naturally occurring material is not commercially feasible.

When sperm oil is sulphurized, a product is obtained which does not lend itself to refining as do the sulphurized relatively pure synthetic esters; consequently it cannot be used in a crankcase lubricant as an oiliness and film strength improver or as a sludge inhibitor because of its adverse effect on color, emulsibility, and cloud test. The objectionable characteristics of the glycerides as described previously are in general also pertinent to the sulphurized naturally occurring esters with only a few exceptions. The following tests prove the unsuitability of a sul-

phurized naturally occurring substance containing monohydric esters for use in our invention:

	Steam emulsion test A. S. T. M.	U. S. Bureau of mines demulsibility test	Cloud after four weeks at room temperature	Color A. S. T. M.
	Seconds			
1 SAE 10 mineral	30	1620	None	1½
2 SAE 10 mineral+.3% of refined sulphurized sperm oil	240	80	Yes	2
3 SAE 10 mineral+.3% of refined sulphurized synthetic methyl oleate	30	1620	None	1½

The sulphur addition agents in oils Nos. 2 and 3 contained the same amount of added sulphur and were refined in the same manner.

Wool fat or wool grease contains monohydric alcohol esters but is not satisfactory for use in our invention because of naturally occurring impurities found therein. These consist of alkali salts of fatty acids and free high molecular weight alcohols which yield relatively unstable sulphur derivatives. Sulphurized wool fat is not a satisfactory lubricating oil addition agent because it is not stable enough to allow refining; and when added to mineral oils, the resultant blend will not give a satisfactory emulsion or cloud test. Sulphurized wool fat darkens the color of the oil. It also breaks down at relatively low temperatures (compared with sulphurized synthetic esters) and releases H_2S, which is objectionable. Hence wool fat would not give a satisfactory lubricating oil addition agent after sulphurizing.

Beeswax contains 10 to 20 percent free fatty acid and 10 to 15 percent hydrocarbons and is therefore unsuited for the production of a sulphurized addition agent for lubricating oils.

Candelilla wax contains, besides monohydric alcohol esters, about 10 percent or more free fatty acid and about 50 percent hydrocarbons. Carnauba wax contains some monohydric alcohol esters, but these are mixed with a complex variety of impurities such as free fatty acids, hydrocarbons, and free high molecular weight alcohols; and therefore neither candelilla nor carnauba wax is suitable for use as lubricating oil addition agents after being sulphurized.

A number of examples of the sulphuretted or sulphurized synthetic ester type of blends are listed below for the purpose of clarifying the invention.

Example No. 1.—Commercially pure methyl oleate prepared by esterifying methanol and oleic acid was heated to 380° F. and sulphur was slowly added with stirring. After sufficient sulphur had been added to give a compound containing 20 percent of sulphur, the temperature was raised to 420° F. for a short period. The product was blown with SO_2 at 380° F. for two minutes to remove H_2S. On cooling, the ester was found to be much less viscous than the corresponding glyceride after sulphurizing. The glyceride cannot be made to take up more than 12 or 13 percent of sulphur satisfactorily and cannot be heated to so high a temperature without breaking down. The sulphuretted ester on blending with a 100 S. S. U. viscosity black oil to the extent so that two percent of sulphur is added to the petroleum base gives a superior cutting lubricant which is very stable to heat, does not thin out with use, has practically no odor, does not irritate the skin of the operator, and when used with a cutting machine gives a very smooth cut. The same type of cutting oil made with the corresponding sulphurized glyceride in which enough of the sulphuretted glyceride (16 percent of sulphuretted lard oil and 84 percent black oil) is used to give the same amount of added sulphur has a very obnoxious odor caused by hydrogen sulphide that is released, is less stable to heat, is thicker when cold, and gives a rougher surface when used with a cutting machine, which in turn means a quicker dulling of the cutting tool and is extremely irritating to the skin. A cutting oil made with the same viscosity of black oil and sufficient sulphurized methyl oleate to impart 4 or 5 percent of added sulphur to the blend gives a most extraordinarily efficient cutting lubricant. When such a blend is used with a thread cutting machine, a thread of almost velvety smoothness is obtained.

Example No. 2.—The synthetic ester ethyl abietate was heated to 370° F. and sulphur was slowly added with stirring and raising of the temperature to 400° F. until a product was obtained containing about 27 percent sulphur. This sulphur base, blended with a 100 S. S. U. black oil to the extent that 4 or 5 percent of sulphur (equal to about 20 percent sulphur base) was added to the blend, giving an excellent cutting oil which is practically odorless and which has a very low cold test and flowed readily at 0° F. It is stable to heat, does not thin out in use, and does not irritate the hands.

Example No. 3.—Cyclic acids similar to abietic acid, were separated from rosin oil and these acids were esterified (under pressure) with methyl alcohol, and the methyl esters were sulphuretted by heating to 380° F. and slowly stirring in sulphur until a compound containing 25 percent sulphur was obtained. This sulphur base was blended with a 100 S. S. U. viscosity black oil to the extent that about 4 percent of sulphur (equal to 16 percent of sulphur base) was added to the blend and made an economical and very efficient cutting oil.

Example No 4.—Synthetic ethyl oleate was sulphurized by reacting with sulphur monochloride at about 200° F. and then heated to a temperature above 300° F. until the sulphurized compound was fairly stable. Considerable chlorine was lost as hydrochloric acid on heating to the higher temperature. This sulphurized ester materially increases the Timken film strength.

The sulphurized ethyl oleate, like the sulphurized methyl oleate, is characterized by its low viscosity, stability, lack of objectionable odor, low cold test, and high film strength properties.

This specification has thus far pointed out the advantages of the use of sulphuretted or sulphurized synthetic esters for cutting oils, gear oils, lubricating oils, etc. when blended with hydrocarbon oils in a relatively high proportion. Another very important application of our invention is the addition of relatively small quantities of these synthetic monohydric and dihydric esters to crankcase lubricants and other highly refined oils.

When added to crank case lubricants to the extent of .001 percent or a little less up to .25 percent added sulphur, they increase the film

strength, oiliness, and resistance to oxidation and reduce the tendency of certain metals, such as are found in some bearings, to corrode. For crankcase use, the sulphurized synthetic ester may be thoroughly refined to advantage. This may be accomplished by acid treating with sulphuric acid and neutralizing with alkaline substances or clay, or in any other manner which will give a product of good color.

A large number of tests were run on various test machines using many different sulphurized synthetic esters, blended with mineral oil. All these tests indicated the anti-corrosive action of the sulphurized synthetic esters. A corrosion test is given by way of illustration only:

Example No. 6.—The Underwood machine is a device for testing the corrosiveness of lubricating oils. It was developed by the General Motors Corporation and is fully described in the literature. The test oil is heated to 340° F. and circulated through a system which impinges it on a half bearing insert. The bearing inserts are usually the cadmium alloy and copper-lead compositions. They are weighed before and after the test. If the loss in weight is less than .05 gram per bearing insert, the corrosion is said to be negative. If it is more, the oil is classified as corrosive.

Underwood corrosion test

	Loss in grams/bearing insert	
	Cadmium type	Copper-lead type
	Grams	*Grams*
SAE 30 mineral oil	1.1	.9
SAE 30 mineral oil +.2 percent of sulphurized methyl oleate (.02% S)	.02	.03

A comparison of two samples of sulphurized methyl oleate prepared by sulphurizing with straight sulphur and with sulphur chloride was made to demonstrate the equivalency of sulphurized synthetic esters made by sulphurizing with sulphur and with sulphur chloride.

An oxygen absorption test has been developed for measuring the efficiency of addition agents for use as oxidation and corrosion inhibitors. The apparatus consists of Slight flasks which are supported in a constant temperature bath held at 350° F. Ten grams of each oil to be tested is pipetted into each flask. The flasks are filled with oxygen at atmospheric temperature and pressure, fitted to mercury manometers and inserted in the bath. The pressure rises quickly to a maximum and then after some time begins to fall. The time required for a drop of 60 m. m. from the maximum is used as a measure of the efficiency of the oxidation and corrosion inhibitor. Usually, in order to speed up the rate of oxygen absorption, an accelerator such as lead naphthenate is added to the oils being tested.

The comparison of the two samples of sulphurized methyl oleate is given in the following example which is given by way of illustration only:

Example No. 7.—300 g. of synthetic methyl oleate were sulphurized with 74 g. of S_2Cl_2 by holding the ester at a temperature below 200° F. and slowly adding the S_2Cl_2 with stirring. After all the S_2Cl_2 had been added, the mixture was heated to 350° F. for two hours in order to stabilize it. Considerable chlorine was driven off as HCl at this higher temperature. The sulphurized ester was then blown with CO_2 to remove any HCl left in solution. It was then refined by treating with 80 percent H_2SO_4 and neutralizing with clay. It was then analyzed for sulphur and showed 8.9 percent to be present. This will be called "A".

Three hundred g. of synthetic methyl oleate were reacted at 350° F. with 33 g. sulphur until it completely combined therewith. It was then refined in the same manner as was the product in the previous paragraph. A sulphur analysis showed 9.1 percent sulphur to be present. This will be called "B".

Blends were made with a refined SAE 30 mineral oil and each of the two foregoing products so that each contained exactly 0.05 percent added sulphur. Various amounts of lead naphthenate were then added to each blend and tests made on the above described oxygen absorption test with the following results:

Lead naphthenate as percent PbO	Min. to drop a total of 60 m. m.		
	Inhibitor A	Inhibitor B	Mineral oil
.05	106	107	46
.03	125	121	50
.01	151	147	103

The results prove the sulphur activity of the two samples of sulphurized inhibitors to be equivalent in reducing oxidation and corrosion.

While there is no specific limitation to the amount of added sulphur in the form of sulpurized synthetic esters that should be used in preparing different lubricants, usually 1 to 4 percent or more may be used for cutting oils; and about .5 to 2.5 percent or more will usually be sufficient for gear and other extreme pressure lubricants. As little as .001 percent or a little less and up to .25 percent or more may be used in oils for use in automobile crankcases.

The above ratios of sulphur to the petroleum base oil for its different uses are not intended to limit the scope of this invention, since smaller or larger quantities may be used in any case with results which are partially satisfactory. They are given because generally speaking the optimum results can be obtained by using the ratios within the limits that are suggested.

The hydrocarbon oils which are used in blending with the sulphurized synthetic esters are not limited to the hydrocarbon oils cited in the examples but are to include any oil of any type or viscosity such as may be required by the lubricant in question. These different types of oils may be unrefined mineral oil or oil refined by any method such as by the use of acids, alkalis, or solvents or any combination of said refining processes. Other types are synthetic oils made by polymerization or similar processes and hydrogenated oils.

Sulphur dioxide and carbon dioxide have been mentioned as agents for blowing sulphurized synthetic esters and it is to be understood that the inventors are in no way limited to any particular refining process and that other gaseous or liquid refining agents as nitrogen or alkali solutions and acid solutions may be used in refining sulphurized synthetic esters of certain character and for certain purposes.

Having thus described our invention, we claim:

1. A lubricant comprising in combination a lubricating oil and a small percentage of the sulphurized synthetic ester of a low molecular weight monohydric or dihydric alcohol and a high molecular weight organic acid.

2. A lubricant comprising in combination a lubricating oil and a small percentage of the sulphurized synthetic ester of a high molecular weight monohydric or dihydric alcohol and a low molecular weight organic acid.

3. A lubricant comprising in combination a lubricating oil and a small percentage of the sulphurized synthetic ester of a high molecular weight monohydric or dihydric alcohol and a high molecular weight organic acid.

4. A lubricant comprising in combination a lubricating oil and a small percentage of the sulphurized synthetic ester of a low molecular weight monohydric or dihydric alcohol and a high molecular weight organic acid, the proportion of sulphurized synthetic ester to the lubricating oil being such that the total sulphur content in the finished lubricant is increased by .001 percent to 4 percent.

5. A lubricant comprising in combination a lubricating oil and a small percentage of a sulphurized synthetic ester of a low molecular weight monohydric or dihydric alcohol and a high molecular weight unsaturated aliphatic acid.

6. A lubricant comprising in combination a lubricating oil and a small percentage of a sulphurized synthetic ester of a high molecular weight monohydric or dihydric unsaturated aliphatic alcohol and a low molecular weight aliphatic acid.

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DISCLAIMER

2,186,646.—*Bert H. Lincoln* and *Waldo L. Steiner*, Ponca City, Okla. SULPHURIZED OIL. Patent dated January 9, 1940. Disclaimer filed October 24, 1940, by the assignee, *Continental Oil Company*.

Hereby disclaims from the ambit of each of the claims of said patent, all lubricants containing sulphurized monohydric or dihydric esters of linoleic acid, and sulphurized monohydric or dihydric esters of organic acids, the glycerides of which are normally present in corn oil.

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