

Patented Mar. 11, 1947

2,417,283

UNITED STATES PATENT OFFICE

2,417,283

LUBRICANT

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No Drawing. Application December 23, 1942,
Serial No. 469,914

8 Claims. (Cl. 252—48.6)

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The present invention relates to an improved extreme pressure lubricant and sulfurized cutting oil base and the method of preparing the same. More specifically the present invention is concerned with the simultaneous sulfurizing of particular oil blends to yield a sulfurized mineral oil-soluble base which can then be incorporated in mineral lubricating oil for use as an extreme pressure lubricant or cutting oil. As a cutting oil, the mineral lubricating oil and sulfurized blend can be used without modification or emulsified with water.

Experience has shown that many oils will, on heating, react with or absorb elemental sulfur, and that the addition of sulfur to oil will improve the lubricating qualities of the oil, particularly when subjected to heavy loading. Generally speaking, the load-carrying characteristics of an oil improve in proportion to the increased amount of reactive sulfur content. About 10% of the sulfurized oil is blended in about 90% of mineral lubricating oil to form a cutting oil. A good cutting oil should carry 15 weights gradual loading and a minimum of 7 weights shock loading on the Almen machine. Full details of the Almen machine test are to be found in Proceedings American Petroleum Institute, 13th annual meeting, Nov. 14-17, 1932. Considerable objection to the sulfurized cutting oils of the prior art has been raised due to the fact that they exhibit a decided tendency to deposit sulfur or sulfur reaction products.

One type of oil which has found considerable application as a sulfurized cutting oil base is tall oil, which is a mixture of fatty and rosin acids occurring in pine and other non-deciduous woods, and is obtained as a by-product in paper manufacture. For conversion to a cutting oil base the tall oil may be used either in its crude form or purified by distillation. Tall oil, either crude or refined, will absorb about 40% of sulfur. At about 20% sulfur content the product is absolutely non-reactive to copper, however, the Almen loads are very low for a product containing this amount of sulfur, due to complete reaction between the sulfur and tall oil. The addition of about 40% of sulfur to tall oil is required to give satisfactory Almen loads, but such a product is quite insoluble in mineral oil. Oil-solubility is determined by blending about 10% of the sulfurized product in 90% of a Mid-Continent 100 viscosity S. S. U. at 100° F. mineral oil, letting the blend stand for 7 days at either 0° F., 45° F. or room temperature, and determining the amount of sediment. Some tests include all three temperatures. A completely soluble sulfurized base will form no sediment. A 9:1 blend of mineral oil and tall oil containing 40% of sulfur will, on standing, show a sediment of from 5 to 10% which denotes that 50% or more of the sulfurized tall oil is mineral oil insoluble. The mineral oil insolubility of sulfurized tall oil is quite perceptible when

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the tall oil contains as little as 30% of sulfur. Fatty oils, such as lard oil, sperm oil, etc. have been successfully used as sulfurized cutting oil bases, however oils of this type are getting progressively scarce, and are more costly, and an acceptable substitute therefor is very much needed.

The principal object of the present invention is the production of a sulfurized product, soluble in mineral oil and which can be blended with mineral lubricating oil to give a product suitable for use as either an extreme pressure lubricant or a sulfurized cutting oil base. This and other objects will be apparent to those skilled in the art upon reading the following description.

It has now been discovered that an admixture of tall oil, either crude or refined, and an ester of a high molecular weight fatty acid and a monohydric alcohol of at least 10 carbon atoms, when sulfurized will give a product which readily pours at room temperature and which will readily dissolve in mineral lubricating oil. In general the method consists in admixing tall oil, ester and sulfur monochloride S_2Cl_2 and heating until all of the sulfur has gone into solution, which reaction will require from about 1-5 hours.

The present invention contemplates the use of a mixture of oils, one being tall oil, and the other being an ester of a fatty acid and a monohydric alcohol in which the mixture is composed of from 40-60% of tall oil and from 60-40% of the ester. As previously stated the esters are oleagenous materials, resulting from the combination of a monohydric alcohol and a high molecular weight fatty acid and may be obtained either as a natural product or produced synthetically. It is preferred to use such esters either naturally occurring or synthetic as contain an excess of alcohol. Specific examples of such esters are sperm oil, lauryl oleate and cetyl oleate although many other esters of a similar nature may be employed. Sperm oil is a naturally occurring oil obtained from the sperm whale and is composed chiefly of cetyl palmitate.

Sulfur is incorporated into the oil mixture by reacting the oils with either sulfur or sulfur monochloride. The reaction is conducted so as to incorporate from 15-25% of sulfur in the oil. When using sulfur preferably as flowers of sulfur, the sulfurizing reaction occurs at from 350-400° F. and preferably from 370-390° F. If sulfur monochloride is utilized as the source of sulfur the temperature of the reaction must be materially reduced and carefully controlled to prevent undue polymerization and the sulfurized product must be purified as by water washing to remove chlorine by-products. For reaction with sulfur monochloride the temperature should be held within the limits of 100-200° F., preferably 150-180° F.

Although a wide range of lubricating oils may be improved in their lubricating and load-bearing

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ing characteristics by the addition thereto of the sulfurized oils of the present invention, in general the lubricating oils comprise oils having a viscosity at 100° F. in the range of from about 90-900 seconds, an A. P. I. gravity of 23°-33°, and a flash point above 300° F. However, it is preferred to use paraffinic and naphthenic base oils

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furized cutting oil base and tested for load-carrying ability, solubility and copper corrosion. In the copper test, a strip of polished copper was suspended in a bath of the cutting oil blend maintained at a temperature of 210° F. for a period of 3 hours. The results of these tests are given in the following table.

Table

Sulfurized cutting oil base	Almen weights		Solubility, per cent sedimentation	Copper test
	Gradual loading	Shock loading		
Sulfurized tall oil (10% S).....	8	-----	None	Pass.
Sulfurized tall oil (20% S).....	13	-----	2	Do.
Sulfurized tall oil (30% S).....	15	5	4-6	Slight stain.
Sulfurized tall oil (40% S).....	15	11	8-10	Blackened.
40% tall oil, 40% sperm oil, 20% sulfur ¹	15	11	None	Pass.
37.5% tall oil, 37.5% sperm oil, 25% sulfur ¹	15	11	None	Do.
30% tall oil, 45% sperm oil, 25% sulfur ¹	15	9	2.7	Do.
40% tall oil, 45% sperm oil, 15% sulfur ²	15	9	0.8	Do.

¹ These sulfurized bases were compounded in the manner described in the example above.

² This sulfurized base was compounded by mixing equal parts of tall oil containing 40% S and sperm oil containing 10% S.

³ This sulfurized base was compounded by mixing equal parts of tall oil containing 20% S and sperm oil containing 10% S.

having a gravity in the range of from 23° A. P. I. to 28° A. P. I., and a viscosity at 100° F. of from 90 to 300 seconds.

In making up the E. P. lubricant and sulfurized cutting oil base of the present invention the oils are first placed in a cooking vessel and heated to the reaction temperature which for elemental sulfur is from 300°-400° F. and for sulfur monochloride from 100°-200° F. depending largely upon the time available for completing the reaction, and the sulfur or sulfur halide is then added. The temperature is maintained and the reactants stirred for a period of from 1-5 hours to insure satisfactory sulfur retention. After the reaction is complete, determined by rapidly cooling a small portion and determining if sulfur separates, heating is discontinued and the sulfurized product is permitted to cool to room temperature. Where sulfur monochloride is used as the source of sulfur the product should then be air blown for 30 minutes to remove chlorine and chlorinated products. The product at room temperature is liquid, flows or pours readily and is soluble in paraffinic mineral lubricating oils in all proportions. It is then ready for blending with a mineral lubricating oil to yield an E. P. lubricant or cutting oil. For blending purposes it is preferred to use from 5-20% of the sulfurized cutting oil base, the percentage being calculated on the basis of the total composition.

The following specific example is given for the purpose of illustrating the invention, thus leading to a better understanding thereof.

EXAMPLE

	Per cent
Tall oil acids.....	37.5
Sperm oil.....	37.5
Sulfur.....	25.0

The tall oil acids and sperm oil were placed in an externally heated kettle equipped with a stirrer and heated to a temperature of 370° F. The sulfur was then stirred in and the temperature held between 370° F. and 390° F. for one hour. Heating was then discontinued and the sulfurized oil was permitted to cool to room temperature.

Several cutting oil blends were made up using 9 parts by weight of a mineral lubricating oil, 110 vis. at 100° F. for each part by weight of sul-

What is claimed is:

1. As a composition of matter, a mineral oil-soluble sulfurized cutting oil base comprising a cosulfurized blend of tall oil and an ester of a monohydric alcohol of at least 10 carbon atoms and a high molecular weight fatty acid.

2. As a composition of matter, a mineral oil-soluble sulfurized cutting oil base comprising a cosulfurized blend of tall oil and sperm oil.

3. The composition as defined in claim 1 in which the ester of a monohydric alcohol of at least 10 carbon atoms with a high molecular weight fatty acid is lauryl oleate.

4. A composition as defined in claim 1 in which the ester is cetyl oleate.

5. As a composition of matter a mineral oil-soluble cosulfurized cutting oil base comprising from 5-25% of sulfur and from 95-75% of a blend of tall oil and an ester of a monohydric alcohol of at least 10 carbon atoms with a high molecular weight fatty acid, in which blend the percentage of tall oil ranges from 60-40%.

6. The method of producing a sulfurized cutting oil base which comprises blending tall oil with an ester of a monohydric alcohol of at least 10 carbon atoms with a high molecular weight fatty acid, heating the blend to a sulfurizing temperature and reacting the blend with sulfur.

7. The method of producing a sulfurized cutting oil base which comprises blending tall oil with sperm oil, heating the blend to a sulfurizing temperature and reacting the blend with sulfur.

8. A sulfurized cutting oil comprising a mineral lubricating oil and a cosulfurized blend of tall oil and an ester of a monohydric alcohol of at least 10 carbon atoms with a high molecular weight fatty acid.

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