United States Patent Office 3,106,533 Patented Oct. 8, 1963

3,106,533

OIL AND GREASE LUBRICATING COMPOSITIONS AND ADDITIVE THEREFOR

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No Drawing. Filed Nov. 14, 1958, Ser. No. 773,813
17 Claims. (Cl. 252—34.7)

This invention relates to improved oil and grease lubricating compositions, which are particularly adapted for the lubrication of metal surfaces in contact with each other at high pressures; more particularly this invention relates to an additive for extreme pressure lubricant compositions such as, cutting oils adapted for high-pressure machining applications, for example, broaching, threading, drilling, reaming, etc.; gear oils for the lubrication of gears operating under high pressures, and extreme pressure greases.

In machining operations involving high rubbing speeds, much heat is generated and thus the most important function of a cutting fluid adapted for such machining operations is cooling the workpiece and tool. For such high-heat producing operations, the mineral oil cutting fluids are mixed with water in what is called "soluble oils" to take advantage of the excellent heat transfer properties of water. These soluble oils, however, are not generally used in operations where high unit pressures are anticipated and where lubrication and anti-welding qualities of the cutting fluid are paramount. In extreme pressure machining operations the straight mineral type oil is most commonly used. It is this latter type oil, that is, straight mineral oils or "non-soluble oils" in which my present additive is particularly useful.

The desirability of using cutting fluids or cutting oils has long been known in the metal cutting art, and cutting lubricants have been improved from time to time to more completely fill the requirements of an effective cutting fluid or lubricant. In metal cutting processes, the shape of the workpiece is changed by progressively removing metal chips. The most important qualities of a cutting fluid are the ability to lubricate the tool and chip (enhanced by effective wetting action), the ability to prevent welding or other adherence of the chip to the tool, and the ability to cool the tool and workpiece. In some applications it is desirable that the cutting fluid inhibit corrosion or otherwise enhance the work-surface finish.

It has been known in the prior art, that various additives may be added to a lubricating oil base to enhance its lubricating and cutting performance. For example, sulfur and chlorine are added in various forms for their ability to react with the work surface to improve surface conditions. Fatty oils, fatty acids, soaps, esters, and many other substances have been added to cutting fluids and other lubricants in various combinations for the purpose of improving cutting and lubricating performance. The main deficiency of these prior art lubricant compositions is that they have not been able to provide the combination of qualities which are essential to extreme pressure operations. A cutting fluid additive is most effective if it has the property of enhancing the metal wetting properties of the oil so as to facilitate effective lubrication, as well as inhibiting corrosion of the tool and workpiece and providing for adequate heat transfer. Attempts to compound cutting oils exihibiting these three desirable characteristics have heretofore not been entirely successful as evidenced by the unsatisfactory overall cutting performance of sulfurized lard oils, vegetable oils, fish oils, sulfochlorinated mineral oils, and other E. P. cutting oils in the heavy-duty machining of hardened alloys.

The presence or absence of the important cutting fluid qualities in a given cutting fluid is reflected in cutting performance by tool wear and the surface appearance of the finished workpiece. Tool wear is quite often a prime consideration in the economics of machining operations and is determined to a greater or lesser extent by the efficiency of the cutting fluid. Consequently there has been a need for more effective cutting fluids in modern machining operations where machining is performed at increased speeds and pressures and on tougher metals. Similar considerations apply to gear oils and other extreme pressure lubricants.

It is, therefore, an object of this invention to provide an improved straight cutting oil composition which reduces tool wear and prevents surface finish blemish.

It is also an object of this invention to provide a straight cutting oil containing an additive which imparts good metal wetting properties, lubricity and corrosion inhibition to the cutting oil.

Another object of my invention is to provide extreme pressure lubricant compositions having good metal wetting and corrosion inhibiting properties.

A further object of my invention is to provide a straight mineral cutting oil having improved metal wetting properties, corrosion inhibiting properties, work cooling properties, and lubricity.

Other objects and a fuller understanding of this invention may be had by referring to the following description, examples and claims.

Briefly stated, my invention relates to a compounded additive useful in extreme pressure lubricants for the purpose of improving metal wetting characteristics while at the same time providing a cooling agent and a corrosion inhibitor. The essential ingredients of the additive are a mixture of processed coconut oil acids, naphthenic acid, and mixed isopropanolamines. It has been discovered that my additive is particularly useful in straight mineral type cutting oils in that it causes a striking increase in tool life and improves appearance of the metal finish. However, the additive of the present invention is also useful in other lubricants used where high pressure conditions prevail and where corrosion is a potential problem, such as in compounded greases and in gear oils.

As a result of my invention, I have discovered that the combination of commercially available lower fatty acids derived from coconut oil, petroleum naphthenic acid and mixed isopropanolamines forms an excellent lubricant additive. The processed coconut oil acids referred to in this specification and which have been found particularly valuable in lubricant additives are caproic acid, caprylic acid and capric acid. I prefer to use a commercially available mixture of these acids sold by Vegetable Oil Products Co., under the designation "Vopcolene" C3 acids. This mixture which is derived from coconut oil contains approximately 5% caproic acid, 55% caprylic acid and 40% capric acid. Natural coconut oils contain principally lauric and myristic acids with lesser amounts of lower acids such as caproic, caprylic and capric acid. The processed coconut oil acids used in my lubricant have been separated from the lauric and myristic acids. Coconut oils refined in this country vary somewhat in the proportions of their constituent acids, according to their geographical origin; accordingly the proportions of the refined "Vopcolene" C3 acid may vary from batch to batch. The mixture of 5% caproic, 55% caprylic, 40% capric is an average composition.

The naphthenic acid used in my additive is not positively identifiable by chemical structure since it is a petroleum naphthenic acid which is actually a mixture of acids produced in part by oxidation of certain readily oxidized cycloparaffins (naphthenes) during distillation or other petroleum-refining operations. These naphthenic acids are identified in the petroleum industry by their acid number rather than their chemical formulae. The acid number of a particular substance is defined as 1000 times the

number of milligrams of potassium hydroxide required to neutralize one gram of the substance.

A mixture of isopropanolamines is commercially available from the distillation process whereby the mono, di, and tri isopropanolamines are separated from each other. The "bottoms" from this separation process are a mixture of approximately 10–15% mono, 40–50% di, and 40–50% tri isopropanolamines. This "bottoms" mixture was found to combine effectively with the naphthenic acid and processed coconut oil acids whereas the individual mono, di, and tri isopropanolamines did not give the desired result.

The additive constituting my invention is formulated by adding the processed coconut oil acids and naphthenic acid to a suitable mixing kettle at room temperature and stirring until clear. The mixed isopropanolamines are then added to the acids while stirring and the batch is stirred until clear. The additive thus prepared is readily combined with the lubricating oil by simple addition to the oil and stirring, without the application of external heat, until the mixture is clear.

Preferably, the ratio by weight of processed coconut oil acids to naphthenic acid is maintained within the approximate range of 2.5–3.0:1. The total amount of processed coconut oil acids and naphthenic acid added is in excess (preferably about 10%) of the amount of acid required stoichiometrically to neutralize the amine. Generally, my additive contains about 45 to 60% mixed coconut oil acids, 15 to 25% naphthenic acid and 20 to 30% mixed isopropanolamines. Although my new additive is particularly suitable in cutting oils, this same additive has also been found to be effective as a corrosion inhibitor in gear oils and greases.

The following specific examples are illustrative of the compositions of the present invention, but it is to be understood that the invention is not to be limited thereto.

Example 1

A lubricating oil additive was prepared by adding 54% of a mixture of acids derived from coconut oil comprising approximately 5% caproic, 55% caprylic, and 40% capric acid, and 20% naphthenic acid (acid number 230) to 26% mixed isopropanolamines comprising a mixture in the following approximate amounts: 10% mono, 45% di, and 50% tri isopropanolamines. This additive was added to a 60 ml. oil sample in the amount of 1% additive. The lubricating oil was a sulfurized mineral oil containing 5% chlorinated paraffin "HV" (manufactured by Diamond Alkali Co. and comprising a chlorinated crude or refined paraffin wax with an average chain length of 22–26 carbon atoms and containing 42–45% chlorine) and 2% lead naphthenate. The 60 ml. sample was tested in the Falex E. P. machine in which skin temperature measurements of metals under simulated machine conditions are made. In this testing apparatus a horizontally loaded pin is rotated on two V-blocks through which thermocouple leads indicate the skin temperature of the test block. A 1500 pound test load applied at room temperature for 10 minutes showed a skin temperature rise from room temperature to 165–170° F. By way of comparison, the same oil without the additive produced a temperature rise of 425–450° F., and the same oil containing additives heretofore proposed produced a temperature rise of at least 345° F.

Example 2

To a straight cutting oil lubricant consisting of approximately 94% mineral oil and 5% chlorinated paraffin "HV," 1% of the following additive was added: A mixture of caproic, caprylic, capric acids derived from coconut oil acids, naphthenic acid (acid number 230), and mixed isopropanolamines. This cutting oil with the above additive was used in a machining operation wherein #347 stainless steel was turned. The tool life was found to be 70 parts per tool. Under the same test conditions using the same oil without the additive the tool life was 30–40 parts per tool.

Example 3

To the base oil of Example 2 was added 2% lead naphthenate and the same additive as in Example 2. The tool life when #347 stainless steel was machined was found to be 80–85 parts per tool.

Example 4

A SAE 4140 steel heat-treated to a Rockwell C hardness of 39–40 was machined with the identical lubricant of Example 3 with the same tool life resulting.

Example 5

A calcium dual-duty E.P. grease consisting of calcium 12 hydroxy stearate soap suspended in conventionally treated western oil (base oil) was mixed with the additive of Example 1. The grease containing this additive passed the CRC (Coordinating Research Council) static water corrosion test. The same grease without the additive failed the CRC test.

Example 6

To a lithium hydroxy stearate soap suspended in a mixed western and Mid-Continent solvent base mineral oil was added the additive of Example 1. This greased passed the same CRC rust test referred to in Example 5.

Example 7

The additive of Example 1 was added to a sample of 90 S.U.S. viscosity gear oil meeting MIL–L–2105 specifications which contained Monsanto E.P. additive 23 RI and an antifoam agent in a Mid-Continental solvent treated base oil. This gear oil compounded with the additive of Example 1 passed the ASTM D–665 corrosion test. The same gear oil without my additive failed the ASTM D–665 corrosion test.

Example 8

A 140 S.U.S. viscosity gear oil meeting MIL–L–2105 specifications was admixed with the additive of Example 1 and passed ASTM D–665 corrosion test.

The following data was obtained by varying the amount of additive of Example 1 in a cutting oil. From this data it is apparent that the proportion of additive is critical in that unexpectedly superior results are obtained by increasing the amount of additive from 0.5% to 1%; that the optimum additive content for cutting oils is between 1 and 1.5% and that further increases above 1.5% do not improve cutting performance:

Operation	Steel Machined	Percent by weight of additive							
		0	0.5	1.0	1.5	2.0	3.0	4.0	5.0
		Parts per Tool							
Broaching	SAE 1020	8	50	160	-----	-----	-----	-----	-----
General machining.	SAE 1020 (shot body).	80	95	250	-----	-----	-----	-----	-----
Do	4140 HT (shot body).	0	20	120	360	360	360	360	360
Threading	A–286 T.S	6	10	15	40	40	45	40	40

Having fully described my invention, it is to be understood that I do not wish to be limited to the details set forth, but my invention is of the full scope of the appended claims.

I claim:

1. A lubricant composition comprising a mineral oil base and at least 1% additive, said additive consisting essentially of mixed coconut oil acids, naphthenic acid, and mixed isopropanolamines wherein said mixed coconut oil acids comprise caproic acid, caprylic acid, and capric acid, and said mixed isopropanolamines comprise mono,

di, and tri isopropanolamines the total amount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

2. A lubricant composition comprising a mineral oil base and at least 1% additive, said additive consisting essentially of 45–60° mixed coconut oil acids, 15–25% naphthenic acid, and 20–30% mixed isopropanolamines wherein said mixed coconut oil acids comprise caproic acid, caprylic acid, and capric acid and said mixed isopropanolamines comprise mono, di, and tri isopropanolamines.

3. A straight cutting oil comprising a mineral oil, chlorinated paraffin and at least 1% additive, said additive consisting essentially of mixed coconut oil acids, naphthenic acid, and mixed isopropanolamines wherein said mixed coconut oil acids, comprise caproic acid, caprylic acid, and capric acid, and said mixed isopropanolamines comprise mono, di, and tri isopropanolamines the total amount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

4. A straight cutting oil comprising a mineral oil, lead naphthenate and at least one percent additive, said additive consisting essentially of mixed coconut oil acids, naphthenic acid and mixed isopropanolamines wherein said mixed coconut oil acids comprise caproic acids, caprylic acid, and capric acid, and said mixed isopropanolamines comprise mono, di, and tri isopropanolamines the total amount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

5. The straight cutting oil of claim 4 wherein said mineral oil is a sulfurized mineral oil.

6. A lubricant composition comprising a mineral oil base and at least 1% additive, said additive consisting essentially of mixed coconut oil acids, naphthenic acid, and mixed isopropanolamines wherein said mixed coconut oil acids comprise 5% caproic acid, 55% caprylic acid, and 40% capric acid, and said mixed isopropanolamines comprise 10–15% mono, 40–50% di, and 40–50% tri isopropanolamines the total amount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

7. A straight cutting oil comprising a mineral oil, chlorinated paraffin, lead naphthenate, and at least 1% additive, said additive consisting essentially of mixed coconut oil acids, naphthenic acid, and mixed isopropanolamines wherein said mixed coconut oil acids comprise 5% caproic acid, 55% caprylic acid, and 40% capric acid, and said mixed isopropanolamines comprise 10–15% mono, 40–50% di, and 40–50% tri isopropanolamines the total amount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

8. A straight cutting oil comprising a mineral oil, chlorinated paraffin, lead naphthenate, and at least 1% additive, said additive consisting essentially of 45–60% mixed coconut oil acids, 15–25% naphthenic acid, and 20–30% mixed isopropanolamines wherein said mixed coconut oil acids comprise 5% caproic acid, 55% caprylic acid, and 40% capric acid, and said mixed isopropanolamines comprise 10–15% mono, 40–50% di, and 40–50% tri isopropanolamines.

9. A straight cutting oil comprising 90–95% mineral oil, 2–7% chlorinated paraffin, 1–3% lead naphthenate, and at least 1% additive, said additive consisting essentially of mixed coconut oil acids, naphthenic acids, and mixed isopropanolamines wherein said mixed coconut oil acids comprise caproic acid, caprylic acid and capric acid,

and said mixed isopropanolamines comprise mono, di, and tri isopropanolamines the total amount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

10. A straight cutting oil comprising 90–95% mineral oil, 5% chlorinated paraffin, 1–3% lead naphthenate, and at least 1% additive, said additive consisting essentially of 45–60% mixed coconut oil acids, 15–25% naphthenic acid and 20–30% mixed isopropanolamines wherein said mixed coconut oil acids comprise 5% caproic acid, 55% caprylic acid and 40% capric acid, and said mixed isopropanolamines comprise 10–15% mono, 40–50% di, and 40–50% tri isopropanolamines.

11. A lubricant additive consisting essentially of mixed coconut oil acids, naphthenic acid, and mixed isopropanolamines wherein said mixed coconut oil acids comprise caproic, caprylic, and capric acid and said mixed isopropanolamines comprise mono, di, and tri isopropanolamines the total amount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

12. A lubricant additive consisting essentially of mixed coconut oil acids, naphthenic acid, and mixed isopropanolamines wherein said mixed coconut oil acids comprise 1–10% caproic acid, 50–60% caprylic acid, 35–45% capric acid and said mixed isopropanolamines comprise mono, di, and tri isopropanolamines the total amount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

13. A straight cutting oil comprising 92% sulfurized mineral oil, 5% chlorinated paraffin, 2% lead naphthenate, and 1½% additive, said additive consisting essentially of 54% mixed coconut oil acids, 20% naphthenic acid, and 26% mixed isopropanolamines, wherein said mixed coconut oil acids comprising 5% caproic acid, 55% caprylic acid, and 40% capric acid and said mixed isopropanolamines comprise 10–15% mono, 40–50% di, and 40–50% tri isopropanolamines.

14. A grease composition comprising a major proportion of a mineral lubricating oil, a grease thickening amount of a metal soap of a long-chain fatty acid, and a corrosion inhibiting amount of an additive, said additive consisting essentially of mixed coconut oil acids, naphthenic acid, and mixed isopropanolamines wherein said mixed coconut oil acids comprise caproic, caprylic, and capric acids and said mixed isopropanolamines comprise mono, di, and tri-isopropanolamines the total mount of said acids being in excess of the amount required stoichiometrically to neutralize said amines, and the ratio of said coconut oil acids to said naphthenic acid being approximately 2.5–3.0:1.

15. A grease composition comprising a major proportion of a mineral lubricating oil, a grease thickening amount of a metal soap of a long chain fatty acid, and a corrosion inhibiting amount of an additive, said additive consisting essentially of 45–60% mixed coconut oil acids, 15–25% naphthenic acid, and 20–30% mixed isopropanolamines wherein said mixed coconut oil acids comprise 1–10% caproic, 50–60% caprylic, and 35–45% capric acids, and said mixed isopropanolamines comprise 10–15% mono, 40–50% di, and 40–50% tri-isopropanolamines.

16. A lubricant additive consisting essentially of 45–60% mixed coconut oil acids, 15–25% naphthenic acid, and 20–30% mixed isopropanolamines wherein said mixed coconut oil acids comprise 1–10% caproic, 50–60% caprylic, and 35–45% capric acids, and said mixed isopropanolamines comprise 10–15% mono, 40–50% di, and 40–50% tri-isopropanolamines.

17. A gear oil composition comprising a well-refined

mineral lubricating oil, an extreme pressure additive, an antifoam agent and a corrosion inhibiting amount of an additive, said additive consisting essentially of 45–60% mixed coconut oil acids, 15–25% naphthenic acid, and 20–30% mixed isopropanolamines wherein said mixed coconut oil acids comprise caproic, caprylic, and capric acids, and said mixed isopropanolamines comprise mono, di, and tri-isopropanolamines.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,106,533 October 8, 1963

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It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 8, for "45-60°" read -- 45-60% --; column 6, line 52, for "mount" read -- amount --; column 5, lines 1, 20, 31, 44 and 45, and 56, and column 6, lines 2, 20 and 21, and 30, after "isopropanolamines", each occurrence, insert a comma; same column 6, line 52, after "tri-isopropanolamines" insert a comma.

Signed and sealed this 21st day of April 1964.

(SEAL)

Attest:

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