United States Patent [19]

Green

[11] 3,844,955

[45] Oct. 29, 1974

[54] **EXTREME PRESSURE GREASE WITH IMPROVED WEAR CHARACTERISTICS**

[75] Inventor: **William B. Green,** Nederland, Tex.J

[73] Assignee: **Texaco Inc.,** New York, N.Y.

[22] Filed: **May 29, 1973**

[21] Appl. No.: **364,792**

[52] **U.S. Cl.**..... **252/21,** 252/25, 252/28

[51] **Int. Cl.**.... **C10m 5/22,** C10m 5/02, C10m 7/06

[58] **Field of Search**..... 252/21, 25, 28

[56] **References Cited**

UNITED STATES PATENTS

2,319,076	5/1943	McLennan et al.	252/21
2,684,944	7/1954	Zojac	252/25
3,117,085	1/1964	Rees et al.	252/21
3,344,065	9/1967	Gansheimer et al.	252/25
3,654,171	4/1972	Emond et al.	252/28

Primary Examiner—Daniel E. Wyman

Assistant Examiner—I. Vaughn

Attorney, Agent, or Firm—T. H. Whaley; C. G. Ries

[57] **ABSTRACT**

Grease composition:

a. lubricating oil base

b. grease thickener

c. 1–15 percent molybdenum disulfide

d. 1–15 percent calcium hydroxide.

4 Claims, No Drawings

EXTREME PRESSURE GREASE WITH IMPROVED WEAR CHARACTERISTICS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention concerns the field of grease compositions.

2. Description of the Prior Art

Greases are often required to possess properties in addition to lubricity. In operation of heavy equipment, such as the walking cam on a large drag-line, one of the more important properties is the ability to prevent welding, seizure and wear of metal surfaces sliding under extremely heavy loads. This property is referred to as the extreme pressure (EP) characteristic of the grease.

Many materials have been found which will improve the EP characteristics of a grease when added in small amounts. Some of these appear to function by reacting with the metal surfaces to form coatings which will not seize and weld when the pressure becomes so great that the oil film, which normally separates the surfaces, is broken. These additives generally are organic compounds containing reactive elements such as chlorine, sulfur and/or phosphorous. Some also contain metals such as lead or antimony which apparently enter into the surface coating. Antimony dialkyldithiocarbamate used in some of the grease compositions discussed herein is a material of this type. Although these additives are very effective EP agents, many of them tend to be corrosive and they frequently lead to high wear rates since the surface coatings they produce shear away rather than weld or seize as would be the case without the additive.

Another type of EP agents are finely ground, inorganic solids which apparently are not as easily forced from between the sliding surfaces as the oil film and therefore keep the metal surfaces from welding or seizing until the oil film can be restored. Unfortunately, these solids tend to be abrasive and therefore increase wear. One of the best and more widely used EP additives of this type is molybdenum disulfide; however, the art recognizes that even molybdenum disulfide increases abrasiveness, see U.S. Pat. No. 3,396,108 (1968) to Caruso.

Applicant has discovered a method of retaining the extreme pressure properties of molybdenum disulfide while greatly reducing the abrasiveness.

U.S. Pat. No. 3,344,065 (1967) to Gansheimer, et al., discloses what they consider to be a list of equivalent additives for greases including molybdenum disulfide and "hydroxides of calcium". Examples in this patent show calcium hydroxide and molybdenum disulfide used separately as additives in grease formulations.

Surprisingly, Applicant has discovered that molybdenum disulfide and calcium hydroxide are not equivalent as taught in the Gansheimer reference, and that, in fact, a combination of molybdenum disulfide and calcium hydroxide in a grease will impart excellent extreme pressure or load carrying characteristics and provide low abrasion and consequently excellent wear characteristics.

SUMMARY OF THE INVENTION

The invention is a grease composition comprising a lubricating oil, a thickener of soap or clay, and a combination of molybdenum disulfide and calcium hydroxide.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The grease composition of my invention contains conventional thickeners, and the unique additive combination of molybdenum disulfide and calcium hydroxide.

The lubricating oils forming the major component of grease compositions may be any oils having lubricating characteristics which are suitable for use in lubricating compositions generally. Such oils include the conventional mineral lubricating oils having Saybolt Universal viscosities in the range from about 75 seconds at 100°F. to about 225 seconds at 210°F., which may be either naphtenic or paraffinic in type or blends comprising both naphthenic and paraffinic oils. The preferred lubricating oils are those having Saybolt Universal viscosities in the range from about 300 seconds at 100°F. to about 100 seconds at 210°F., which may be blends of lighter and heavier oils in the lubricating oil viscosity range. Synthetic lubricating oils, which may be preferred in preparing greases having special properties required for special types of lubricating service, include oils prepared by cracking and polymerizing products of the Fischer-Tropsch process and the like as well as other synthetic oleaginous compounds such as polyethers, polyesters, silicone oils, etc. having viscosities within the lubricating oil viscosity range. Suitable polyethers include particularly polyalkylene glycols such as polyethylene glycol. Suitable polyesters include the aliphatic dicarboxylic acid diesters, such as di-2-ethylhexyl sebacate, di (secondary amyl) sebacate, di-2-ethyl-hexyl azelate, di-iso-octyl adipate, etc. The sulfur analogs of the polyalkylene esters and polyesters are also suitable.

Silicone polymer oils may also be employed, preferably having viscosities in the range from about 70 to 900 seconds Saybolt Universal at 100°F. Suitable compounds of this type include dimethyl silicone polymer, diethyl silicone polymer, methyl cyclohexyl silicone polymer, diphenyl silicone polymer, methylethyl silicone polymer, methyltolyl silicone polymer, etc.

Generally two types of thickeners for the oils are used to form greases: soaps and/or clays.

By the term "soap-base thickening agent," as used herein, is meant metal soaps of fatty acids which are capable of providing a stable gel structure to lubricating base oils. The term is intended to include conventional metal soaps, complex soaps, mixed base soap greases, and the like, and includes the following particular types of soap thickeners:

Metal base:
- Aluminum base
- Barium base
- Calcium base
- Lithium base
- Sodium base
- Lead base
- Strontium base

Mixed bases:
- Sodium-calcium base
- Sodium-barium base
- Calcium-aluminum base
- Sodium-aluminum base

Magnesium-aluminum base
Lithium-aluminum base
Lithium-calcium base
Metal complex:
Hydrated calcium soap
Hydrated aluminum soap
Hydrated barium soap
Hydrated lithium soap
Hydrated sodium soap
Hydrated strontium soap
Complex aluminum soap
Complex barium soap
Aluminum-barium complex
Aluminum-sodium complex
Complex calcium soap
Calcium soap-calcium acetate complex
Calcium soap-calcium chloride complex
Calcium soap-strontium hydrate complex
Calcium-barium soap complex
Complex lithium soap
Lithium soap-lithium acetate
Lithium soap-lithium azelate complex
Magnesium soap complex
Lead soap complex
Sodium soap-sodium acetate complex
Sodium soap-sodium acrylate complex
Sodium-barium complex
Strontium-calcium acetate complex

Though the lubricating base oil component of the invention can be either a natural or synthetic oil, as a practical matter, the base oil will usually be a natural oil, e.g., a petroleum-derived mineral oil. Many synthetic oils such as silicone oils and various esters can be thickened effectively with soap thickeners; however, the thermal stability of soaps is usually considerably lower than that of the synthetic oils. Therefore, there is usually no point in using expensive synthetic oils with soap greases. Exceptions to this, however, are some of the complex greases which possess considerably higher thermal stability than the conventional soap-base greases.

The clays which are useful as thickeners for the preparation of greases are oleophilic clay products exhibiting a substantial base exchange capacity. The clays particularly contemplated herein include especially the montmorillonites, such as sodium, potassium, lithium, and the other bentonites, particularly of the Wyoming bentonite type. Still more preferred are the magnesium bentonites, sometimes referred to as "Hectorites." These clays are characterized by unbalanced crystal structure and are believed to have negative charges which are normally neutralized by inorganic cations.

The term "oleophilic clay product" is meant to include such clays when they have absorbed thereon or reacted therewith sufficient organic ammonia base to form an oleophilic product. The so-called "onium-clays" comprise reaction products of oleophilic ammonium bases (or their salts) and clay.

The clays are more preferably modified by absorption of one or more oleophilic cationic surface-active agents such as those described in U.S. Pat. Nos. 2,831,809, and 2,875,152.The clays are preferably present in an amount sufficient to cause grease formation of the lubricating oil to occur. This will usually occur in the range of 2.5–10 percent by weight of the high base exchange clay (based on the inorganic clay portion of the oleophilic clay product) depending somewhat upon the precise clay employed, the chemical constitution of the major lubricating oil components and the proportions of other components present in the grease formulation.

In addition to the additive combination of my invention, other additives of the types ordinarily employed in lubricating compositions may be employed in these greases, such as oxidation inhibitors, corrosion inhibitors, tackiness agents and other extreme pressure additives. Oxidation inhibitors which may be employed include particularly those of the amine type, such as phenylalphanaphthylamine, diphenylparaphenyldiamine, tetramethyldiaminodiphenyl methane, and bis-(2-hydroxy-3t-butyl-5-methylphenyl) methane. With particular advantage, a surface active agent of the type which imparts water resistant properties to the composition may be employed, such as quaternary ammonium salts of fatty acids, polyglycol ethers, metal alkyl sulfates or sulfonates, imidazolines of the type of 1-betahydroxyethyl-2-tallowimidazoline, etc. Other extreme pressure additives include, for example, sulfurized or chlorinated fatty oils, sulfurized diisobutylene, chlorinated paraffins, lead naphthenate, lead diamyldithiocarbamate, antimony dialkyldithiocarbamate, antimony phosphorodithioate. Additives of each of the above types are ordinarily employed in the composition in amounts from about 0.1 to about 5.0 percent, and most suitably in amounts from about 0.2 to about 2.0 percent by weight.

The additive combination of my invention: molybdenum disulfide and calcium hydroxide should be employed in the following weight percentages of the grease and ratios to each other. Both broad acceptable ranges and more narrow preferred ranges are given.

Molybdenum disulfide	broad range	1 to 15 weight percent
	preferred range	2 to 10 weight percent
Calcium hydroxide:	broad range	1 to 15 weight percent
	preferred range	2 to 6 weight percent
$MoS_2/Ca(OH)_2$ weight ratio	broad range	0.5 to 10.0
	preferred range	1.0 to 5.0

EXPERIMENTAL

Example 1

Four bentonite thickened mineral oil greases were prepared containing molybdenum disulfide alone, molybdenum disulfide and calcium carbonate and molybdenum disulfide and hydrated lime or calcium hydroxide. The greases were tested for load bearing ability and wear resistance. The results show clearly that load wear index and weld point values measure of extreme pressure properties were not affected adversely by lime addition but that the wear tests were greatly improved when both molybdenum disulfide and lime were used.

BATCH NO.	3318-RL	3316-RL	PA-1881	PA-2262
Composition, Wt%				
Dimethyldiocta-decyl ammonium bentonite	4.2	4.3	5.7	8.0
Mineral Oil	84.8	81.7	80.3	78.0
Antimony dialkyl-dithiocarbamate	4.0	4.0	4.0	4.0
Molybdenum disulfide	7.0	7.0	7.0	7.0
Calcium carbonate	—	3.0	—	—
Hydrated Lime	—	—	3.0	3.0
Penetration Worked, 60 strokes	360	367	384	375
Load Carrying Ability				
Load Wear Index	70.3	82.2	61.8	74.8
Weld Point, Kg	282	282	282	282
Wear				
Modified Timken Wear Test				
Ampco C-3 Block - Scar, MM	8.3,7.3	7.3,6.4	3.6,3.6	2.9,3.4
Navy Gear Wear Brass On Steel				
5 lb Load - my loss/1,000 cycles	1.15	0.47	0.30,0.15	0.30
10 lb Load - my loss/1,000 cycles	2.4	1.7	0.53,0.30	1.25
Four Ball Wear Scar, MM	0.60	0.49	0.54	.53

Example 2

A grease composition as shown below was prepared and tested in field operations as a walking cam lubricant. The lubricant has successfully performed for eight months.

Composition, Wt.%	
Mineral oil	80.2
Dimethyldioctadecyl ammonium bentonite	5.7
Hydrated lime	3.1
Molybdenum disulfide	7.0
Antimonydialkyl-dithiocarbamate	4.0
	100.0
Load Wear Index, Kg	61.8
Weld Point, Kg	282.0
Four Ball Wear 1800 RPM, 130°F., Scar, MM	0.54
Navy Gear Wear 5 lb load, wt. loss/1,000 cycles, mg.	0.30,0.15
10 lb load, wt. loss/1,000 cycles, mg.	0.53,0.30

I claim:

1. A grease lubricating composition comprising a lubricating oil vehicle, a thickener therefor, and an extreme pressure and wear reducing amount of a combination of molybdenum disulfide and calcium hydroxide wherein the weight ratio of molybdenum disulfide to calcium hydroxide is from about 0.5 to about 10.

2. A grease as in claim **1** wherein the molybdenum disulfide comprises from about 1 to 15 weight percent of the total grease composition and the calcium hydroxide comprises from about 1 to 15 weight percent of the total grease composition.

3. A grease as in claim **2** wherein the molybdenum disulfide comprises from about 2 to 10 weight percent of the total grease and the calcium hydroxide comprises from about 2 to 6 weight percent of the total grease and the weight ratio of molybdenum disulfide to calcium hydroxide in the grease composition is from about 1.0 to 5.0.

4. A grease as in claim **3** which comprises

a mineral lubricating oil comprising about 80 weight percent of the total grease,

dimethyldioctadecyl ammonium bentonite thickener comprising about 6 weight percent of the total grease,

calcium hydroxide comprising about 3 weight percent of the total grease,

molybdenum disulfide comprising about 7 weight percent of the total grease and

antimony dialkyldithiocarbamate comprising about 4 weight percent of the total grease.

* * * * *