Oct. 14, 1952 R. J. MOORE 2,614,079

LUBRICATING GREASE

Filed July 18, 1949

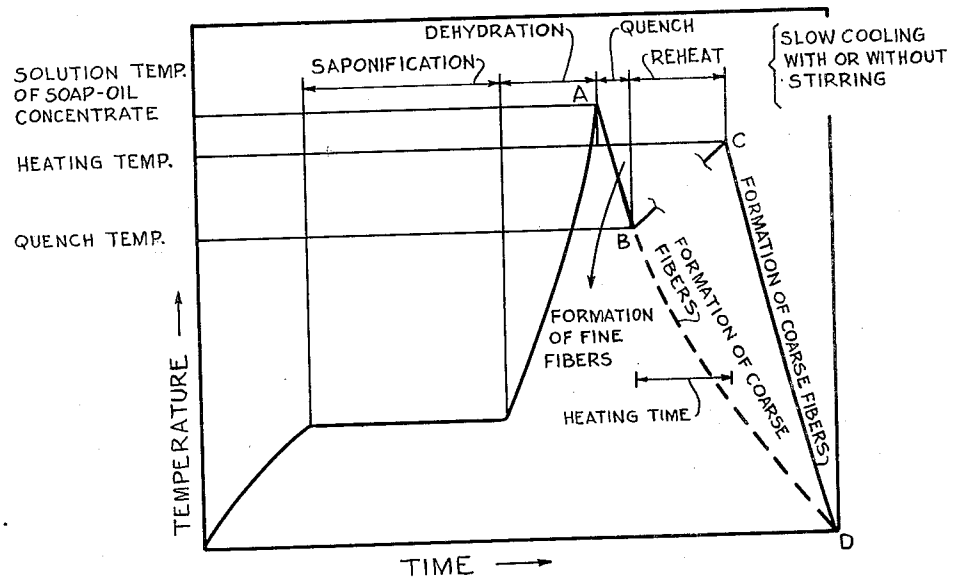

FIG. I

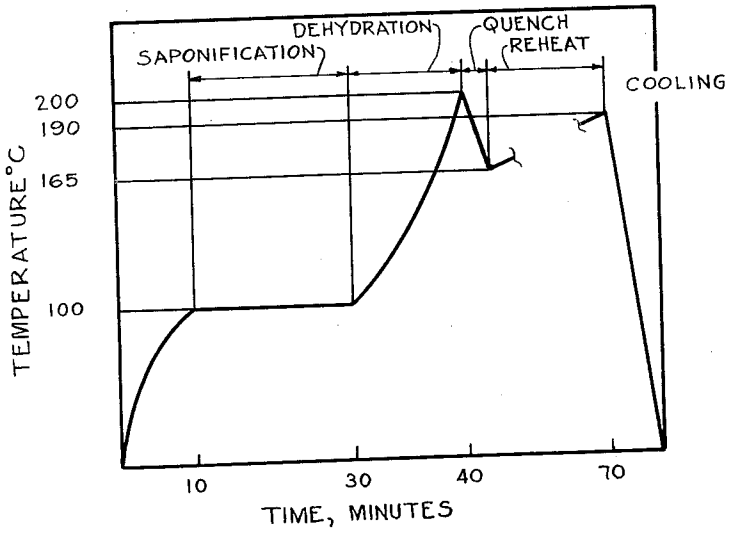

FIG. II

INVENTOR:
ROBERT J. MOORE.
BY James Todorovic
HIS ATTORNEY

Patented Oct. 14, 1952 2,614,079

UNITED STATES PATENT OFFICE

2,614,079

LUBRICATING GREASE

Robert J. Moore, Oakland, Calif., assignor to Shell Development Company, San Francisco, Calif., a corporation of Delaware

Application July 18, 1949, Serial No. 105,381

12 Claims. (Cl. 252—39)

1

This invention relates to improved grease compositions. More particularly, this invention pertains to improved grease compositions which are capable of maintaining their consistency under variable conditions, resist bleeding, possess good mechanical and dimensional stability and are thermally reversible.

A general deficiency encountered in greases is changes in consistency which are observed in greases on storage or after being worked for some time. On storage, greases generally tend to harden and this is believed to be due to the interaction of active groups associated with soap micelles which leads to the increase in the consistency of greases. Such hardening is extremely undesirable for it introduces numerous lubricating difficulties such as in pumping equipment, handling and the like.

Another deficiency encountered in greases is their lack of resistance to shear as well as other types of mechanical forces which are generally exerted upon greases under various working conditions. Thus, in the lubrication of ball and roller bearings, greases may be subjected to temperatures in excess of 250° to 300° F., which temperatures accelerate oxidation, and, coupled with high shearing stresses, the greases break down in structure. Thus, the greases are incapable of adhering to the lubricating surfaces, resulting in bearing corrosion, wear and failure. It is essential that good greases, therefore, resist shearing stresses and oxidation, particularly over wide temperature ranges.

Bleeding is another phenomenon which is frequently encountered in grease compositions. The causes for bleeding are at present not clearly understood. Generally it has been assumed that bleeding is the result of syneresis, but this belief does not appear to be entirely correct in view of the finding in the present invention and which will be set forth hereinafter. However, to inhibit bleeding various precautionary measures have been taken which are time-consuming, costly and are not very successful. A method of producing non-bleeding greases is by either reducing the soap content generally to less than about 5% by weight or by increasing the soap content to a maximum. These methods of stabilizing greases against bleeding have also proved to be unsatisfactory because in the case of reducing the soap content to less than 5%, such greases become limited in their use due to the low soap content, while increasing the soap content to a maximum makes the grease too costly and such products generally possess an undesirably high consistency.

It is an object of this invention to produce grease compositions having outstanding mechanical stability under dynamic and static conditions. It is another object of this invention to produce greases having good thermal reversibility and which are capable of resisting shearing stresses over wide temperature ranges. Still another object of this invention is to produce non-bleeding greases. Still another object of this invention is to produce novel greases of this invention by conventional grease-making techniques either by batch or continuous processes. Furthermore, it is an object of this invention to produce a multi-purpose grease of outstanding lubricating properties.

2

Broadly stated, the present invention resides in the discovery that an improved grease can be obtained by admixing into a suitable organic base or carrier the same or different gelling agents having anisometric fibers. Specifically, it has now been discovered that an improved grease composition can be prepared by incorporating into a desired liquid base a gelling agent or agents consisting of a mixture of fine and coarse fibers in such proportions that the coarse fibers are present in the mixture in an amount sufficient to render the grease mechanically stable. Generally the coarse gelling fibers should comprise at least 20% and preferably 50% to 80% of the mixture, the remainder being the fine gelling fibers. The ratio of the coarse to the fine-fibered soaps may vary from 1:4 to 4:1 and preferably from 1:3 to 3:1. By fine fibers it is meant to include fibers of roughly 0.1 or less microns wide and 4 or more microns in length, while coarse fibers include fibers of 0.5 or more microns wide and >10 microns in length. By gelling fibers in general it is meant to include soaps capable of forming fibers such as the alkali and alkaline earth metal soap, and organic gelling agents such as nylon fibers, cellulose materials and the like.

It has been observed that the grease structure of greases is dependent upon the gelling matrix which holds the oil or other suitable base in the grease, which in turn depends upon the fibers and contacts formed by said fibers lying across one another. Apparently oil is retained in a grease by the capillary attraction of the gelling agent (fibers) and bleeding takes place when the liquid head due to gravity exceeds the ability of the capillarity to hold the oil. Gelling agents consisting of only coarse fibers have considerable mechanical stability, but due to the relatively large spaces between fibers, oil tends to flow from the mass. Fine-fibered gelling agents, on the other hand, hold oil very well, but often have poor resistance to breakdown on working, and in extreme cases actually settle out due to lack of stiffness of the fine fibers, and little, if any, consistency is imparted to the greases in the sense that such

greases are capable of maintaining a given shape against gravity for any length of time. It has now been discovered that if a mixture of coarse and fine gelling fibers is used to form greases the anisometric fibers form a cross-linked matrix which not only has high mechanical stability but also is extremely resistant to bleeding or oil separation.

Fine and coarse gelling fibers may be prepared by any suitable means known to the art such as well-known crystallization processes. Slow cooling of materials capable of forming crystals or fibers leads to the formation of rather large, coarse crystals or fibers. Also, as in the case of crystallization, the presence of but a few crystal nuclei on which the solid phase may be deposited leads to the formation of coarse crystals or fibers. Sudden cooling on the other hand of solutions containing crystallites or nuclei leads to the formation of fine crystals or fibers.

Grease compositions of this invention may be made in a variety of ways. For example, premade soap of fine fiber and pre-made soap of coarse fiber may be admixed in desired proportions, dispersed into a suitable oil or organic base and the mixture thereafter heated, cooled and processed according to conventional grease-forming techniques to form a desired final grease product. The fiber mixture may be derived from the same or different soaps. Thus a mixture of fine and coarse-fibered lithium soap can be used or a mixture of fine-fibered lithium soap and coarse fibered soda soap can be used to form a grease composition of this invention.

In cases where the grease is made from the same soap stock, a technique developed and which is particularly suitable for making greases of this invention may be employed. In essence the process comprises admixing with a portion of the base oil used to make a grease the saponifiable materials and saponifying agents and heating the soap in oil solution formed until the soap has been dehydrated. The soap-oil mixture is then heated to above the melting point of the soap or mixtures thereof until a homogeneous mass has been obtained. To form the desired coarse fibers this concentrate can be cooled slowly to below 100° C. and the coarse fibers thus formed admixed with fine-fibered soap prepared in a similar manner, but instead of slowly cooling the hot homogeneous soap-oil solution, quenching said hot solution to a desired temperature. Sudden cooling or lowering of the temperature to a desired quench point leads to the formation of small, fine crystals or fibers. The temperature to which the hot grease concentrate is quenched is governed by the fineness which is desired and the starting material from which such fibers are being formed.

A modification of the above process, which in reality is a combination of above processes, comprises forming a grease concentrate, said concentrate containing the soap necessarily present in the final grease, by heating the saponifiable and saponifying agents in about 30% oil above the melting point of the soap until a homogeneous mass has been obtained. The hot soap-oil solution is then quenched to a desired temperature by adding at a controlled rate the remaining oil. By this operation the soap can form fine fibers. The composition is then slowly cooled so as to allow a portion of the soap to recrystallize to form coarse fibers. During the slow cooling step the grease may be stirred down to room temperature, homogenized and packaged. If desired the quenched grease can be reheated to an elevated temperature which is only slightly below the temperature from which the grease concentrate has been quenched, and maintained for a desired period of time at this temperature, and thereafter slowly cooled with or without stirring in order to convert a portion of the fine fibers into coarse-fibered soap. The temperature profile for the above-described process is shown in Figure I. In Figure I the soap-oil concentrate is heated to A and maintained in the temperature range of A until a homogeneous mass has been obtained. The concentrate is then quenched along AB to form some fiber soap. The coarse fibers can then be formed by slowly cooling along BD or reheating the grease containing already fine-fibered soap along BC and thereafter slowly cooling the grease along CD to form the final product.

The gelling agents used to form the grease may be soaps of fatty acids and/or their glycerides. The saponifiable material may be fatty acids having from 12 to 32 carbon atoms and they may be saturated, unsaturated or polar-substituted fatty acids, such as capric, lauric, myristic, palmitic, stearic, arachidic, behenic, lignoceric, myristoleic, palmitoleic, oleic, linoleic, ricinoleic, erucic acids, cottonseed oil fatty acids, palm oil fatty acids, hydrogenated fish oil fatty acids, and their mixtures and/or their glycerides, such as lard, beef, rapeseed, palm, menhaden, herring oils, etc. Other acids may be included, among which are: acid produced by oxidation of petroleum oil and waxes, rosin acids, tall oil acids, abietic acids; naphthenic acid, petroleum sulfonic acids and the like.

A particularly preferred class of saponifiable materials are the hydroxy fatty acids and their glycerides, such as dimethyl hydroxy caprylic acid, dimethyl hydroxy capric, hydroxy physetoleic acid, ricinoleic acid, ricinelaidic acid, 12-hydroxystearic acid, 9,10-dihydroxystearic acid, 4-hydroxypalmitic acid, linusic acid, sativic acid, lanoceric acid, dihydroxygadoleic, dihydroxybehenic acid, quince-oil acid and the like. The preferred hydroxy fatty acids are those in which the hydroxy group is at least 12 carbon atoms removed from the carboxyl group. Also, it is preferable to use hydroxy fatty acids having at least 10 carbon atoms and up to about 32 carbon atoms and preferably those having between 14 and 32 carbon atoms in the molecule. Instead of using the free fatty acids containing a hydroxy radical their glycerides can be used such as castor oil or hydrogenated castor oil or mixtures of free hydroxy fatty acids and their glycerides can be used. Mixtures of hydroxy and non-hydroxy fatty acids can be used to form soaps.

The saponifying agent used to make the soap may be metal compounds of Na, K, Li, Cs, Ca, Sr, Ba, Cd, Zn, Pb and Co. Mixtures of soaps can be used and the soaps can be made in situ or pre-made soaps can be used to form the grease. Specific examples of preferred soaps and mixtures thereof are: lithium stearate, lithium hydroxystearate, lithium ricinoleate, lithium soap of hydrogenated fish-oil fatty acids, lithium soap of mixed stearic and hydroxystearic acid, sodium stearate, sodium hydroxystearate, sodium oleate, potassium oleate, potassium rosinate, calcium stearate, calcium hydroxystearate, barium hydroxystearate, barium stearate, lithium soap of mixed stearic and hydroxystearic acids, lithium soap of mixed oleic and hydroxystearic acid, sodium soap of stearic and hydroxystearic acid; barium soap of stearic and oleic acid, lead ricinoleate; mixed soaps of lithium stearate and sodium

stearate; mixed soaps of lithium hydroxystearate and sodium stearate; mixed soaps of lithium hydroxystearate and calcium stearate, etc. Amine soaps, such as triethanolamine oleate can be used in combination with metal soaps or as the gelling agent.

Instead of using only soaps as the gelling agent mixtures of soaps and other gelling agents, such as organic or inorganic aerogels, e. g. silica aerogels, alumina aerogels, nylon or cellulose fibers can be used or the aerogels and fibers can replace the soap entirely as the gelling agent.

The soap content of grease compositions of this invention may vary over wide limits and may be as high as 50%. In practice, it is possible by choice of suitable grease-forming lubricant bases to manufacture satisfactory lubricating greases containing only about 10% or less by weight of the soap mixtures. Very satisfactory products are obtained with a total soap content of about 8% by weight on the finished grease.

The grease-forming lubricant bases used in preparing the greases of the present invention may vary widely in character and include mineral oil of wide viscosity, the range varying from about 100 SUV at 100° F. to about 2000 SUV at 100° F. The viscosity index of the oil can vary from below zero to about 80 and have an average molecular weight ranging from about 250 to about 600. It may be highly refined and solvent treated if desired by any known means. A preferred mineral oil is one which has a viscosity of 300 to 700 SUS at 100° F., a viscosity index of from 40 to 70 and an average molecular weight of 350 to 750. Instead of using straight mineral oil as the base, synthetic oils and lubricants may be substituted in part or wholly for the mineral oil. Among the synthetic lubricants which can be used are: polymerized olefins; copolymers of alkylene glycols and alkylene oxides; organic esters, e. g., 2-ethyl-hexyl sebacate, dioctyl phthalate, tri(ethylhexyl)phosphate; polymeric tetrahydrofuran; polyalkyl silicone polymers, e. g., dimethyl silicone polymer, etc. Under some conditions of lubrication, minor amounts of a fixed oil such as castor oil, lard oil, etc., may be admixed with the hydrocarbon oil and/or synthetic oil used in making grease compositions of this invention.

Highly desirable grease compositions can be prepared by using formulations within the following range:

	General Range	Preferred Range
	Percent	*Percent*
Gelling Agents:		
Fine fiber gelling agent	0.5 to 10	2 to 5
Coarse fiber gelling agent	3 to 30	4 to 10
Stabilizers: Anti-oxidants, Corrosion Inhibitors, etc.	0.01 to 2	0.1 to 1
Base: Mineral Oil and/or Synthetic Oil	Balance	Balance

Specific examples of grease compositions of this invention are:

Composition A

	Lb./100 lb. grease
Fine fiber sodium soap of hydrogenated fish oil acids and hydrogenated castor oil	1.5
Coarse fiber sodium soap of hydrogenated fish oil acids and hydrogenated castor oil	4.5
Polyethylene glycol (mol. wt., 1500)	0.045
Mineral oil (500 SUV at 100° F.)	Balance

Composition B

	Lb./100 lb. grease
Fine fiber lithium soap of 12-hydroxystearic acid	2
Coarse fiber lithium soap of 12-hydroxystearic acid	6
Polyethylene glycol (mol. wt. 1500)	0.1 percent
Paraffin base oil (100 SUV at 100° F.)[1] / Naphtheic base oil (2000 SUV at 100° F.)	Balance

[1] The mixture of the two oils used is approximately 1 part paraffin base oil to 2 parts naphthenic base oil.

Composition C

A grease composition was prepared in accordance with this invention containing a mineral lubricating oil gelled into a grease by an anisometric fibrous sodium soap of a high molecular weight fatty acid consisting of fine and coarse fibers in the ratio of 1:3 respectively and having incorporated therein 0.01 to 1% of sodium alpha-hydroxyvalerate as a stabilizing agent.

Composition D

This grease is the same as the grease of Composition C but the stabilizer is sodium alpha-hydroxypropionate.

The following table illustrates other specific grease compositions of this invention, each component of which may be used in the range indicated above in the general formulation:

Composition Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Fine Fiber Gelling Agent:														
Li 12-hydroxy stearate	x		x						x			x	x	
Na soap of hydrogenated fish oil acids		x			x		x			x				x
K ricinoleate				x										
Ca stearate						x								
Ba stearate											x			
Pb oleate							x							
Nylon fiber								x						
Coarse Fiber Gelling Agent:														
Li 12-hydroxystearate	x		x					x	x	x				
Na soap of hydrogenated fish oil acids		x					x					x		x
K ricinoleate														
Ca stearate					x	x								
Ba ricinoleate				x							x			
Stabilizers:														
Polyethylene glycol										x		x	x	
Phenyl-α-naphthylamine									x	x				x
2,4-dibutyl-6-methylphenol											x	x		
Li-γ-hydroxyvalerate	x													
Li-α-hydroxypropionate			x											
Base:														
Mineral oil	x	x			x	x	x	x			x	x		
Dioctyl sebacate			x										x	
Mineral oil+alkylated naphthalene				x					x					x

A grease composition of this invention consisting of the ingredients of Composition B was prepared by the following process, the details of which are shown in Figure II as a temperature profile.

The required amount of 12-hydroxystearic acid and lithium hydroxide necessary to make an 8% soap base on the total weight of the grease composition were admixed with about 30% mineral oil and the mixture heated until the fatty material melted. The mixture was stirred and the temperature increased sufficiently to drive off the water. During the heating a modicum of dimethyl silicone polymer can be added if foaming occurs. The temperature is then increased to about 200 to 210° C. and the grease concentrate is maintained at this temperature until a homogeneous solution mass has been attained. If desired polyethylene glycol can be introduced at this point. The grease is then quickly quenched to temperature of about 165° C. so that a portion of the soap forms into fine crystals or fibers. Quenching is accomplished by adding the balance of the mineral oil required to form the final grease at a rate so as to allow for maximum formation of desired fine fibers. The grease is then reheated to a temperature of 180 to 190° C. and then slowly cooled to below 100° C. to allow a portion of the soap to grow into the desired coarse fibers.

By the above process a mixture of anisometric grease fibers of roughly 0.1 and 0.5 micron wide, respectively, and having a length/diameter ratio of about 50 are obtained and the resultant grease is statically and dynamically stable and is resistant toward bleeding. This grease had an ASTM penetration at 300 strokes of 300 and after two weeks showed substantially no sign of bleeding.

In order to illustrate the marked improvement obtained with greases consisting of mixed fine and coarse fibers, the following experiment was made. To a 6% coarse-fibered lithium 12-hydroxystearate grease small amounts of fine-fibered lithium 12-hydroxystearate grease also containing 6% soap were added and the amount of bleeding was observed.

Percent Fine Fibered Soap Added	Oil Separation, g.
0	10.9
10	9.8
25	1.8
50	1.3
75	0.8

Grease identified as Composition A was prepared and tested for bleeding and mechanical stability. Similarly, two other greases were prepared comprising the same chemical composition, but one contained only coarse fibers and the other contained only fine fibers. The test results for these three greases were as follows:

Grease	Mechanical Stability (hr.)	Bleeding
Composition A	400	None.
Coarse-Fibered Composition	500	Excessive.
Fine-Fibered Composition	10	None.

Greases identified as Compositions 1 and 3 in the table above which contain 6% of lithium 12-hydroxystearate consisting of anisometric soap fibers and 0.12% Li γ-hydroxyvalerate and 0.10% Li α-hydroxypropionate, respectively, and a commercial Li soap grease were subjected to the Shell Roller Stability Test. The roll stability tester consists of a 90 mm. I. D. x 180 mm. long cylinder inside of which is a 5 kg. weighted roller, 60 mm. diam. x 176 mm. long. The grease being tested is placed in the free space and the outer cylinder is rotated on its axis at 160 R. P. M. The grease is worked by rolling action of the inner cylinder. The stability of a grease is expressed as hours of rolling before its breakdown.

Composition	Mechanical Stability (hr.)
Composition 1 (present invention)	>1,000
Composition 3 (present invention)	500
Commercial Li soap grease	100

To improve grease compositions made by the present method minor amounts of stabilizing agents can be added at a desired stage of the process.

A particularly desirable stabilizing agent which can be used with grease compositions of this invention are the alkylene glycol and/or alkylene thio glycol polymers as well as their monoesters and ether polymeric derivatives. The alkylene glycol polymeric materials can be represented by the following general structural formula:

$$\text{I} \qquad HO\{C_nH_{2n}-O-C_mH_{2m}-O\}_aH$$

wherein m and n and a are integers. Preferably the polymeric alkylene glycols as represented by the above general formula should be such that the factor "a" times the number of carbon atoms within the brackets should be at least 6 and more.

The polymeric alkylene glycols can be made by polymerizing in the presence of a catalyst such as iodine, hydriodic acid and the like, ethylene, propylene, isobutylene, n-butylene oxides and/or their mixtures. Such polymers can also be produced by reacting a monohydric alcohol with an alkylene oxide. Thus, a suitable product can be made by reacting n-butanol with propylene oxide at between about 212 to 230° F. under pressure and in the presence of an alkali catalyst.

The polymerized higher polyalkylene glycols having between 2 and 6 carbon atoms in the alkylene group are most effective as additives of this invention and those containing the ethylene and propylene groups are preferred. The average molecular weight of the polyalkylene glycols may be from about 200 to about 7000 and the preferred molecular weight being from about 600 to 6000.

It is desired to point out that the higher polyalkylene glycols are composed of mixtures of several polymers, for example, a polyethylene glycol having an average molecular weight of 400 consists of various glycols varying from a minor amount of monoethylene glycol and increasing up to the pentadecaethylene glycol. Therefore, it is the average molecular weight which is specified and where in the present specification, polyalkylene glycols or polyethylene glycols are referred to, they define the higher glycols having an average molecular weight in excess of 200 and preferably in excess of 400, those with an average molecular weight of between 600 to 1500 being very effective in carrying out the present invention.

In lieu of the polyalkylene glycols, the ester and ether derivatives can be used. The esters can be made from a variety of acids having be-

tween 1 to about 22 carbon atoms and preferably between about 10 to 18 carbon atoms. Acids which may be used are the aliphatic, aromatic, cyclic, sulfonic acids and the like. Fatty acids and especially the higher fatty acids are preferred and include such acids as lauric, myristic, palmitic, stearic, arachidic, behenic, oleic, ricinoleic, hydroxystearic, phenylacetic, phenylstearic acids and the like. However, such acids as naphthenic acid; oil-soluble, petroleum sulfonic acids; tall oil fatty acids; aromatic acids, e. g. salicylic and phthalic acids and the like may be used to form the esters. Specific examples of esters of this type are the polyethylene glycol monostearate, polyethylene glycol monooleate and the like.

Ether derivatives of polyalkylene glycols may be made by any conventional method and the aromatic ethers of polyalkylene glycols having the general formula:

II

$$HO\{C_nH_{2n}-O-C_mH_{2m}-O\}_a Ar-R'$$

wherein Ar is an aromatic radical having attached thereto at least one alkyl radical denoted by R' having from 1 to about 8 carbon atoms and wherein Y is a fatty acid derivative, n, m, and a are integers as in I and q is a number selected from the group consisting of zero or 1.

To greases of this invention there may be added small amounts of other soaps or salts, generally in amounts of less than 2% for additional benefits. For example, there may be incorporated into sodium soap grease as described above a minor amount of aluminum soap or alkali and alkaline earth metal naphthenates, acetates, hydroxybenzoate, α-hydroxystearate, α-hydroxypropionate, β-hydroxypropionate, γ-hydroxyvalerate, Ca salt of alkylphenol-formaldehyde condensation product, Zn dibutyldithiocarbamate, etc.

Minor amounts of oxidation inhibitors can be added to grease compositions of this invention such as N-butyl paraphenylene diamine. Also effective as oxidation inhibitors are alpha or beta naphthylamine, phenyl-alpha or beta naphthylamine, alpha-alpha, beta-beta dinaphthylamine, diphenylamine, tetramethyl-diamino-diphenylmethane, petroleum alkyl phenols, and 2,4-ditertiary-butyl-6-methyl phenol.

Corrosion inhibitors which are particularly applicable with compositions of this invention are N-primary amines containing at least 6 and more than 18 carbon atoms in the molecule such as hexylamine, octylamine, decylamine, dodecylamine, octadecylamine, heterocyclic nitrogen-containing organic compounds such as alkyl substituted oxazolines and oxazoline salts of fatty acids.

Extreme pressure agents can be added to such grease and the preferred agents comprise esters of phosphorus acids such as triaryl, alkylhydroxy, alkyl, aralkyl phosphates, thiophosphates, or phosphites, etc., neutral aromatic sulfur compounds such as diaryl sulfides and polysulfides, e. g. diphenyl sulfide, dicresol sulfide, dibenzyl sulfide, methyl butyl diphenol sulfide, etc., diphenyl selenide and diselenide, dicresol selenide and polyselenide, etc., sulfurized fatty oils or esters of fatty acids and monohydric alcohols, e. g. sperm oil, jojoba oil, etc., in which the sulfur is tightly bound; sulfurized long-chain olefins obtained by dehydrogenation or cracking of wax; sulfurized phosphorized fatty oils, acids, esters and ketones, phosphorus acid esters having sulfurized organic radicals, such as esters of phosphoric or phosphorous acids with hydroxy fatty acids, chlorinated hydrocarbons such as chlorinated paraffins, aromatic hydrocarbons, terpenes, mineral lubricating oils, etc., or chlorinated esters of fatty acids containing the chlorine in positions other than the alpha position.

Additional ingredients which can be added are anti-wear agents such as oil-soluble urea or thiourea derivatives, e. g., urethanes, allophanates, carbazides, carbazones, etc.; or rubber, polyisobutylene, polyvinyl esters, etc.; V. I. improvers such as polyisobutylene having a molecular weight above about 800, voltolized paraffin wax, unsaturated polymerized esters of fatty acids and monohydric alcohols, etc.; oiliness agents such as stearic and oleic acids and pour point depressors such as chlorinated naphthalene to further lower the pour point of the lubricant.

The amount of the above additives can be added to grease compositions of this invention in around about 0.01% to less than 10% by weight and preferably 0.1 to 5.0% by weight.

Greases of this invention are applicable for general automotive uses, and are excellent aircraft greases, industrial greases and the like.

I claim as my invention:

1. A grease composition comprising a major amount of a mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, an anisometric fibrous lithium soap, said fibers being a mixture of fine and coarse fibers, respectively, in the ratio of from 3:1 to 1:3.

2. A grease composition comprising a major amount of a mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, an anisometric fibrous sodium soap, said fibers being a mixture of fine and coarse fibers, respectively, in the ratio of from 3:1 to 1:3.

3. A grease composition comprising a major amount of a mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, an anisometric fibrous calcium soap, said fibers being a mixture of fine and coarse fibers, respectively, in the ratio of from 3:1 to 1:3.

4. A grease composition comprising a major amount of a mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, an anisometric fibrous lithium soap of hydroxy fatty acid of high molecular weight, said fibers being a mixture of fine and coarse fibers, respectively, in the ratio of from 3:1 to 1:3.

5. A grease composition comprising a major amount of mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, an anisometric fibrous lithium 12-hydroxystearate soap consisting of fine and coarse fibers, respectively, in the ratio of from 3:1 to 1:3, and from 0.01 to 1% of lithium γ-hydroxyvalerate.

6. A grease composition comprising a major amount of mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, an anisometric fibrous lithium 12-hydroxystearate soap consisting of fine and coarse fibers, respectively, in the ratio of from 3:1 to 1:3, and from 0.01 to 1% of lithium α-hydroxypropionate.

7. A grease composition comprising a major amount of mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, an anisometric fibrous sodium

soap of a high molecular weight fatty acid consisting of fine and coarse fibers, respectively, in the ratio of from 3:1 to 1:3, and from 0.01 to 1% of sodium γ-hydroxyvalerate.

8. A grease composition comprising a major amount of mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, an anisometric fibrous sodium soap of a high molecular weight fatty acid consisting of fine and coarse fibers, respectively, in the ratio of from 3:1 to 1:3, and from 0.01 to 1% of sodium α-hydroxypropionate.

9. A grease composition comprising a major amount of a mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, a single anisometric fibrous soap selected from group consisting of alkali and alkaline earth metal soap having dissimilar fibers, said fibers being a mixture of fine and coarse fibers, respectively, in the ratio of from 4:1 to 1:4.

10. A grease composition comprising a major amount of a mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, a single anisometric fibrous soap selected from the class consisting of alkali and alkaline earth metal soap having dissimilar fibers, said fibers being a mixture of fine and coarse fibers, respectively, in the ratio of from 4:1 to 1:4.

11. A grease composition comprising a major amount of an oleaginous vehicle having incorporated therein in an amount sufficient to form a grease, a single anisometric fibrous soap selected from the class consisting of alkali and alkaline earth metal soap having dissimilar fibers, said fibers being a mixture of fine and coarse fibers, respectively, in the ratio of from 4:1 to 1:4.

12. A grease composition comprising a major amount of mineral lubricating oil having incorporated therein in an amount sufficient to form a grease, a single anisometric fibrous sodium soap of a mixture of hydrogenated fish oil acids and hydrogenated castor oil consisting of fine and coarse fibers, respectively, in the ratio of 3:1 to 1:3 and about 0.045% of polyethylene glycol.

ROBERT J. MOORE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,257,945	Fraser	Oct. 7. 1941
2,468,098	Morway et al.	Apr. 26, 1949
2,475,589	Bondi	July 12, 1949
2,487,080	Swenson	Nov. 8, 1949