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LUBRICANTS

Paul R. McCarthy, Manor, and Henry A. Ambrose, Penn Township, Allegheny County, Pa., assignors to Gulf Research & Development Company, Pittsburgh, Pa., a corporation of Delaware

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This invention relates to lubricants and more particularly to the class of lubricants existing as plastic solids or jellies and advantageously possessing thixotropic characteristics.

Yet more particularly the present invention contemplates the provision of a lubricant as above for use under conditions in which conventional oils and greases are unsatisfactory. In the lubrication of movable parts of many known machines a condition is frequently encountered wherein a liquid oil would readily leak from the parts to be lubricated. Where relatively open mechanisms are to be packed with a lubricant and operated under the full range of atmospheric conditions met with in outdoor service, it is apparent that the product must necessarily maintain a stiff, non-fluid condition over a wide temperature range and at the same time be available to effectively lubricate the moving parts without a tendency to set or to otherwise introduce mechanical resistance impairing the operation of the mechanical device.

Petrolatum has a limited utility for this purpose for the reason that it tends to become quite viscous at extremely low temperatures and furthermore melts at a temperature in the vicinity of 123° F. It has been proposed to utilize a relatively low viscosity oil compounded with a relatively high melting point wax. This product tends to remain plastic at temperatures materially above those at which petrolatum will melt and has an apparent viscosity at low temperatures materially less than the petrolatum. It, however, possesses a tendency to set to a relatively hard consistency on standing, and whereas the set is readily overcome by mechanical action, the increased force required to initiate motion is in many instances objectionable.

Plastic lubricating jellies possessing the essential properties requisite to a general solution of the lubrication problem hereinbefore described may be prepared by the use of aluminum stearate suitably compounded with ordinary mineral lubricating oil in sufficient proportions to confer the necessary degree of plasticity. There are however a number of aluminum stearates differing materially in properties. Thus aluminum may combine with stearic acid to form three different compounds; the mono-stearate, di-stearate and tri-stearate and when compounded with oils with a view to producing a plastic product these three materials result in somewhat different products. In general the product containing the mono-stearate is unsatisfactory. The di-stearate confers a good thickening effect while the tri-stearate is relatively unsatisfactory in this respect. The tri-stearate moreover forms a jelly which is objectionably soft and of relatively low melting point, which is not increased even by large increases in proportioning of the tri-stearate. In general, however, the properties of both the di-stearate and tri-stearate jellies are somewhat below the desired optimum in respect to many characteristics as, for example, smoothness and consistency of the mixture, melting point, mechanical stability, and variation in consistency with temperature. In particular, jellies containing only the di-stearate are objectionable as to texture and consistency, mechanical stability, and starting torque in low temperature cold tests.

An important object achieved by the present invention is the provision of an aluminum stearate type plastic lubricating material particularly suited to the foregoing specialized lubrication problem, which composition possesses a high melting point, desirable stiff consistency with relatively low tendency to set upon standing, good mechanical stability and a smooth texture indicating improved homogeneity, and at the same time is characterized by a relatively small variation in consistency and lubricating quality, even over a wide range of temperature variation.

In accordance with the present invention a mineral lubricating oil is compounded with a mixture of pure or at least commercially pure, di- and tri-stearates, preferably each in substantial proportion, and both being present in an amount sufficient to confer the necessary degree of stiffness or plasticity upon the mass while forming a homogeneous admixture. The compositions are usually prepared by admixing the aluminum stearate and the oil, heating to an elevated temperature where the components are thoroughly intermingled and then cooling to room temperature. The resulting product is characterized first of all by a desirably improved homogeneity, smooth texture and consistency, superior to the corresponding product made by the use of the aluminum di-stearate alone. It has a consistency at room temperature somewhat comparable to that of petrolatum but retains its desirable stiffness far above the melting point of petrolatum and at substantially all elevated temperatures which may be met with under the most adverse conditions of atmospheric service. In short, the product has a melting point well above that of petrolatum, and in the region of 190° F., and at temperatures closely approaching this figure the material remains thickened to such a degree as

to cause it to remain in position effectively resisting leakage. Only a relatively minor change in consistency occurs upon a wide alteration of the temperature as for example between +100° F. to —50° F., and this change in consistency is relatively less than that which would be characteristic of similar plastics made using either the aluminum di- or tri-stearate separately.

In spite of the improved plasticity of the material the lubricating qualities remain unimpaired over the same range of temperatures and at 0° F. its frictional resistance in conventional bearings is not higher than that of the oil itself. Even at extremely low temperatures the starting torque required to initiate movement of rotating parts is not objectionable. In short, the present product is characterized by an advantageously high, worked, as well as unworked, penetration throughout a wide range of temperatures. Among other advantageous features are its improved mechanical stability, and stiffness appreciably superior in character to that of comparable products made from the conventional aluminum tri-stearate.

In accordance with the present invention, as is noted above, the proportion of stearate mixture should preferably be so selected as to confer the requisite degree of stiffness upon the plastic mass. The proportions required may vary somewhat in accordance with the viscosity and character of the mineral lubricating oil employed and for this reason it is inadvisable to designate any specific range of proportioning. When using an ordinary low viscosity refined mineral lubricating oil (58 SUV at 100° F.) the addition of 7.6 per cent of a mixture of equal parts of aluminum di-stearate and aluminum tri-stearate results in a composition having optimum characteristics for the purposes intended. It will be evident however that the proportion of the aluminum stearate mixture may be increased or decreased materially from the foregoing with a somewhat corresponding divergence from optimum. Probably the maximum amount of stearate which may be utilized in accordance with the present invention is 20 per cent on the basis of the total oil-stearate composition. Advantageously, however, the maximum is maintained lower than 15 per cent. The lower limit is, as indicated above, determined by the desired degree of stiffness or plasticity. In this connection the present products must be distinguished from the so-called mineral castor oils which are liquid in character and thus are totally unsuited for the specialized purpose of the present product, wherein a plastic solid lubricant is required. For these purposes it has been found that normally at least 4 per cent of the aluminum stearate addition is desirable and that any proportion less than three per cent of the final mass will fail to result in a solid jelly.

It is particularly important to note that while the optimum properties of the composition prevail when the aluminum stearate mixture comprises substantially equivalent portions of the di- and tri-stearates, nevertheless the objects of the present invention are in some measure obtainable when using mixtures of widely varying proportions. In its broadest aspect therefore the invention contemplates use of di- and tri-stearate mixtures wherein the di-stearate is present in at least a substantial or appreciable amount. An appreciable improvement occurs with increase of the di-stearate, which becomes more perceptible as the relative proportion increases. On the other hand, in accordance with the preferred practice it is advantageous to limit the minimum quantity of the di-stearate to 0.6 per cent of the total final composition and preferably the ratio to the tri-stearate should be not less than 1:12 and advantageously not less than 1:1.5. Thus a suitable plastic lubricant usually results when slightly above one per cent of the di-stearate is incorporated in a low viscosity lubricating oil, together with about 6 per cent of the tri-stearate component.

When the proportion of di-stearate to total soap is increased above about 75 per cent, the resultant product becomes definitely grainy in character. This undesirable texture, indicating a lack of homogeneity, therefore renders inadvisable for commercial purposes the employment of larger proportions of the di-stearate. This factor accordingly determines the lower limit of aluminum tri-stearate proportioning in respect to the total aluminum soap content of the final grease. Thus it is evident that when using the minimum requirement of aluminum soap admixture the quantity of the tri-stearate should not fall materially below one per cent of the total final grease composition, and in no event less than 0.75 per cent. When the total proportion of aluminum soaps is increased as stated above, the proportion of aluminum tri-stearate must be likewise increased so that it in no event amounts to less than 25 per cent of the total aluminum di- and tri-stearate content.

It is important to note that the preparation of the present product requires some care since the technique of manufacture is related to the plastic qualities of the final product. It is advantageous to thoroughly incorporate and admix the ingredients at a temperature above their melting point and while in quite fluent condition. To this end the selected proportion of aluminum di- and tri-stearates may be added to the oil which is then heated with constant stirring to about 260° F. Admixture is permitted to continue at this temperature until the product appears thoroughly homogeneous, at which time the mixture is permitted to cool. A substantial saving in additive may be accomplished at this point by subjecting the mixture to a low temperature curing for a substantial period of time. For example, the temperature of the mass is lowered by cooling to a point, substantially below room temperature, preferably about 30° F. This temperature is maintained for an ageing period of several hours preferably at least 12 hours. Following this practice it has been found that the resulting plastic possesses a relatively increased degree of stiffness which would be otherwise obtained only by the use of 3 to 4 per cent additional aluminum stearate mixture.

The following examples illustrate the compositions prepared in accordance with the present invention:

Example 1

	Parts by weight
A highly refined mineral lubricating oil having a viscosity of 58 SUV at 100° F.	92.4
Aluminum di-stearate	3.8
Aluminum tri-stearate	3.8

The foregoing materials were admixed at a temperature of 260° F. The mixture was then cooled and aged at 30° F. for 12 hours, following which it was pumped at about 50° F. through a filter pad comprising for example ¼ inch of tightly packed steel wool. The resulting product was a smooth, plastic lubricating composition having all of the above discussed advantageous properties.

Its melting point was approximately 187° F. but up to this temperature it retained a desirably high viscosity apparently due to the thickening of the oil by the aluminum stearate. The product possessed an unworked penetration of 265 and worked penetration of 300.

Example 2

	Parts by weight
A highly refined mineral lubricating oil having a viscosity of 58 SUV at 100° F	92.4
Aluminum di-stearate	4.6
Aluminum tri-stearate	3.0

The components were compounded exactly as in Example 1. This product possessed a slightly higher melting point and a slightly lower worked and unworked penetration.

Example 3

	Parts by weight
A highly refined mineral lubricating oil having a viscosity of 58 SUV at 100° F	92.4
Aluminum di-stearate	3.0
Aluminum tri-stearate	4.6

This preparation compounded as above, was similar in character to the two foregoing examples but had a higher penetration, both worked and unworked.

Each of the foregoing exemplary preparations is characterized by a highly desirable smoothness and homogeneity of texture. They are all stiff plastic materials capable of remaining in situ upon relatively open mechanical parts requiring the presence of a substantial mass or coating of lubricants. They moreover retain this desirable stiffness under practically all conceivable conditions of atmospheric service. Compared with corresponding preparations formed from the tri-stearate alone they possess a stiffer consistency and a higher melting point. When tested under a temperature range varying from −50° F. to +100° F., they show less variation in consistency and a substantial improvement in mechanical stability.

When compared with a grease formed of a corresponding weight percentage of di-stearate alone, the improvement in texture and consistency is immediately noticeable. Here likewise it was evident that the new product possessed a comparatively lower change in consistency as the temperature was varied. In this connection the improvement in lubricating characteristics at extremely low temperatures was particularly noticeable, the product showing a lower starting torque in cold tests than the corresponding di-stearate preparation. From the foregoing it will be apparent that the present invention provides a plastic lubricating jelly with a new and improved utility for specialized uses wherein a lubricant must necessarily be continuously maintained in contact with mechanically moving parts under the relatively intense heat of direct tropical sunlight or the extremely low temperatures met with in Arctic climates. Under these extremes, the present preparation is effective to continually lubricate mechanical parts without excessive variation in the loss of the essential lubricating characteristics. These characteristics do not alter materially in service over extended periods of time.

It will be apparent from the foregoing that the present improved petroleum jelly may possess wide utility for uses other than the lubrication of metallic parts. In fact, the product forms a suitable unguent base for salves and similar medicaments. In other words, when mixed or combined with any suitable therapeutic or medicating agents, it provides an ideal ointment for application to affected tissue and is adapted to thus maintain the therapeutic agent in situ to promote healing or other medicinal treatment. When so employed the resistance to change in consistency over a wide variation in atmospheric conditions is of value in maintaining the salve or jelly-like consistency of the product and resisting separation of the ingredients. When so used, however, it is desirable that the product be prepared under conditions assuring high purity and sterility and advantageously with the use of a highly refined "white" oil.

While the present invention has been described as herein with reference to certain specific embodiments hereof by way of example, it is to be understood that the invention is not so limited except as defined in the appended claims.

What we claim is:

1. A plastic lubricating composition having the property of maintaining a relatively stiff consistency over a wide range of atmospheric temperatures, and having a melting point substantially exceeding that of petrolatum, comprising essentially a normally liquid lubricating oil and a mixture of aluminum di-stearate and aluminum tri-stearate containing not more than 75 per cent of aluminum di-stearate and having a ratio of aluminum di-stearate to aluminum tri-stearate not less than 1:12, said aluminum stearate mixture being present in an amount corresponding to about 3 to 20 per cent of the oil-stearate composition.

2. A plastic lubricating composition having the property of maintaining a relatively stiff consistency over a wide range of atmospheric temperatures and having a melting point substantially exceeding that of petrolatum, comprising essentially a normally liquid lubricating oil and a mixture of aluminum di-stearate and aluminum tri-stearate containing not more than 75 per cent of aluminum di-stearate and having a ratio of aluminum di-stearate to aluminum tri-stearate not less than 1:12, said aluminum stearate mixture being present in an amount corresponding to about 4 to 15 per cent of the oil-stearate composition.

3. A plastic lubricating composition having the property of maintaining a relatively stiff consistency over a wide range of atmospheric temperatures and having a melting point substantially exceeding that of petrolatum, comprising essentially a normally liquid lubricating oil and a mixture of aluminum di-stearate and aluminum tri-stearate containing not more than 75 per cent of aluminum di-stearate and having a ratio of aluminum di-stearate to aluminum tri-stearate not less than 1:1.5, said aluminum stearate mixture being present in an amount corresponding to about 4 to 15 per cent of the oil-stearate composition.

4. A plastic lubricating composition having the property of maintaining a relatively stiff consistency over a wide range of atmospheric temperatures and having a melting point substantially exceeding that of petrolatum, comprising essentially a normally liquid lubricating oil and a mixture of aluminum di-stearate and aluminum tri-stearate containing substantially equal proportions of aluminum di-stearate and aluminum tri-stearate, said aluminum stearate mixture being present in an amount corresponding

to about 7.6 per cent of the oil-stearate composition.

5. A method of producing plastic lubricating compositions comprising incorporating in a normally liquid petroleum lubricating oil a mixture of aluminum di-stearate and aluminum tri-stearate containing not more than 75 per cent of aluminum di-stearate and having a ratio of aluminum di-stearate to aluminum tri-stearate not less than 1:12, said aluminum stearate mixture being present in an amount corresponding to about 3 per cent to 20 per cent of the oil-stearate composition, at a temperature above their melting points, cooling and ageing the mixture at a temperature substantially below room temperature for a period of at least several hours.

6. A method of producing plastic lubricating compositions comprising incorporating in a normally liquid petroleum lubricating oil a mixture of aluminum di-stearate and aluminum tri-stearate containing substantially equal proportions of aluminum di-stearate and aluminum tri-stearate, said aluminum stearate mixture being present in an amount corresponding to above 7.6 per cent of the oil-stearate composition, at a temperature above the melting points of said stearates, cooling and ageing the mixture at a temperature of about 30° F. for a period of at least twelve hours.

PAUL R. McCARTHY.
HENRY A. AMBROSE.

CERTIFICATE OF CORRECTION.

Patent No. 2,364,151. December 5, 1944.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 8, claim 6, for the word "above" read --about--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of February, A. D. 1945.

Leslie Frazer

(Seal) Acting Commissioner of Patents.

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