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PETROLEUM LUBRICATING JELLY

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This invention relates to improved petroleum lubricating jellies; and it is particularly concerned with providing thixotropic petroleum jellies having improved viscosity-temperature characteristics and improved lubricating properties, said jellies consisting essentially of a mixture of a petroleum lubricating oil with wax having a wax melting point above about 150° F. and having incorporated therein an aluminum soap in such amount that the ratio of soap to wax by weight is less than 1:1, said jellies having high penetration at low temperatures, and low running torques; all as more fully hereinafter set forth and as claimed.

In certain types of lubrication there are encountered conditions under which neither grease nor liquid oil are entirely satisfactory lubricants. For example, in the lubrication of ball bearings and other open bearing surfaces, particularly in relatively fine and intricate mechanisms such as cash registers and measuring instruments including airplane instruments, it is desirable that the lubricant be of such consistency that it will remain between the working surfaces and not be lost by dripping or leakage. At the same time it is desirable that the lubricant be of relatively low viscosity under operating conditions so as not to impede the operation of the mechanism. Liquid oil is not suitable because it will leak, while greases are too viscous.

For this type of lubrication petrolatums have been used extensively in the past but are subject to the disadvantage that they have relatively low melting points and turn liquid at about 123° F. In addition, they show at low temperatures a high resistance to shear. Plastic petroleum jellies having melting points higher than petrolatum and having thixotropic properties, that is, of jelly-like consistency when quiescent and liquid when agitated, have more recently been recommended for such uses in United States Patent No. 2,056,594 of Henry A. Ambrose. These thixotropic petroleum jellies are mixtures of lubricating oils, advantageously lubricating oils having high viscosity indices with waxes having melting points above about 150° F. and they have proved to be advantageous substitutes for petrolatum lubricants under most conditions. However, they are relatively stiff at low temperatures and under such conditions their lubricating properties are not entirely satisfactory.

It is an object of the present invention to improve the temperature-viscosity characteristics and running torque of thixotropic wax-oil mixtures and to provide thixotropic petroleum jellies having melting points above that of petrolatum which have high penetration and low running torque properties at low temperatures.

We have discovered that when aluminum soap such as aluminum stearate or aluminum oleate is incorporated in thixotropic mixtures of wax and oil in such amount that the ratio of soap to wax is substantially less than 1:1, the soap is completely taken up by the wax and does not act as a thickening agent for the oil. The resulting composition is a product which while retaining its thixotropic properties has a higher penetration and a lower running torque at low temperatures than the original wax-oil mixture. This combination of properties makes these compositions particularly valuable for certain types of lubrication, such for example as in the lubricating of aircraft instruments and control bearings. Because of their thixotropic properties these compositions are better retained in the bearings at elevated temperatures, and because of their relative softness at low temperatures as indicated by their high penetration and low running torque at low temperatures they function satisfactorily as lubricants over the broad temperature range to which such bearings are subjected.

In preparing the improved thixotropic jellies of my invention, wax of high wax melting point, advantageously wax substantially free from oil and having an A. S. T. M. wax melting point above about 150° F. is used. Ceresin wax such as is obtained from ozokerite having an A. S. T. M. wax melting point of about 160° F. has proved particularly satisfactory, although other waxes may be used such as petroleum ceresin or refined rod wax, montan wax, shellac wax or mixtures of these waxes with oil-free petroleum waxes having melting points above about 150° F. The amount of wax used may be varied widely depending on the particular wax used and the properties desired in the lubricant. In general, the amount of wax used should be sufficient to provide an oil-wax mixture having a cloud point above about 145° F. In order to obtain this cloud point, at least about 4.0 per cent by weight of wax having a melting point above about 150° F. is usually required.

The oil used in forming the thixotropic jellies

may vary widely in properties. In general, substantially any oil properly designated as a lubricating oil may be used depending upon its intended application. Thus oils having viscosities as low as 80 S. U. V. and as high as 3500 S. U. V. at 100° F. may be used under appropriate circumstances. The viscosity index of the oil may vary from —50 to 125 or more. In general, however, we have found oils having viscosity indices above about 90 are most advantageous. For this reason we find aluminum chloride refined lubricating oils and other highly parafinic oils to be most suitable. The percentage of oil in the jelly may be varied to regulate the temperature consistency characteristics of the lubricant.

The aluminum soap may be aluminum mono- di- or tri-stearate, oleate, palmitate or other compound of aluminum with a high molecular weight fatty acid. Mixtures of aluminum soaps may also be used and we have obtained very good results with mixtures for example of aluminum di-stearate and aluminum tri-stearate. The aluminum soap is always used according to our invention in amounts such that the weight ratio of soap to wax in the finished jelly is less than 1:1 and we have obtained satisfactory results using ratios of soap to wax as low as 1:15. In most cases we have found it advantageous to use ratios of soap to wax between 1:1.5 and 1:5 by weight. The jellies become less thixotropic with higher ratios of soap to wax while their melting points increase and their mechanical stability is improved.

In compounding these thixotropic lubricants the wax and oil are customarily first melted together. The aluminum soap is then added to the wax-oil mixture at a temperature below the gel point of the mixture, usually below about 170° F. and the whole mixture is then heated to a temperature of 200° F. or higher to melt it. The melted mixture may then be poured and cooled under regulated conditions. Unlike greases, these thixotropic mixtures return to jellylike consistency after being heated above the melting point of the wax and cooled. The rate of cooling is advantageously carefully regulated. The melting point and consistency of the jelly obtained vary somewhat depending on the rate of cooling and in order to reproduce properties as nearly as possible in successive batches or the same composition it is desirable that the batches be cooled at about the same rate. Slow cooling produces somewhat softer products than more rapid cooling. The harder products obtained with more rapid cooling are less stable than slow cooled products.

The thixotropic petroleum lubricating jellies containing aluminum soaps thus produced are characterized by being softer than corresponding thixotropic mixtures of wax and oil without soap and they have higher penetration values and lower running torques, particularly at low temperatures. These improved viscosity-temperature characteristics permit the use of these jelly lubricants in cases where very wide temperature differences are encountered with improved lubrication throughout the range.

The following examples illustrate the advantageous properties obtained by incorporating aluminum soaps in thixotropic petroleum jellies according to our invention.

In the following table there is shown the effect of the addition of 3.0 per cent by weight of aluminum stearate to a thixotropic petroleum jelly made up of an aluminum chloride refined lubricating oil having a viscosity of 58 S. U. V. at 100° F., and ceresin wax:

Oil A	Composition, per cent by weight		Properties penetration, A. S. T. M.		
	Ceresin	Aluminum stearate	Unworked, 77° F.	Worked, 77° F.	Drop point, A. S. T. M.
58.0	42.0		128	400+	163
55.0	42.0	3.0	164	400+	152

The softening effect of the aluminun stearate is apparent from the increase in penetration of the unworked jelly and the decrease in dropping point. The penetration and drop point values were determined by the standard methods of the American Society for Testing Materials.

The effect of aluminum stearate additions on the running torque of thixotropic jellies is illustrated in the results shown in Table 2. These values were determined on a B. E. C. machine, named for the Bearing Engineers Committee, as described in "Product Engineering," volume 7, page 255 (1936), the only deviation being the use of dry ice and acetone to maintain the low temperature.

In these tests the bearing was packed with 4.5 grams of jelly and cooled to the lowest possible temperature. At intervals as the machine warmed up the motor was started and torque data was recorded. The machine was then stopped and allowed to increase further in temperature and again started, and another set of torque data was recorded.

The running torque values at various temperatures were determined on an aluminum chloride refined lubricating oil of 58 S. U. V. at 100° F., on a thixotropic petroleum jelly containing aluminum stearate and on an oil-wax jelly containing no soap. A comparison of the values determined is given in Table 2.

Temp., ° F.	Oil A	Oil A+4% Al distearate+19% white ceresin wax	Oil A+10% ceresin
80	140	140	210
60	200	200	250
40	280	280	380
20	440	440	640
0	640	640	920
—20	920	860	1200
—40	1350	1100	1480
—60	1900	1360	1750

It is apparent from these results that aluminum stearate has a very beneficial effect on the running torque of wax-oil mixtures, particularly at low temperatures. It will be seen from a comparison of the results obtained on oil alone, on the same oil plus 10% ceresin wax and on a jelly containing both ceresin wax and aluminum stearate in admixture with the same type oil, that at ordinary temperature the running torque of the jelly is about the same as that of the oil and lower than that of the oil-wax mixture, and at lower temperatures, that is below zero Fahrenheit, is substantially lower than that of the wax-oil mixture or of oil alone.

In the following Table 3 there are shown the physical properties of thixotropic petroleum jellies containing varying proportions of aluminum soap and wax, oils of different viscosities and mixtures of aluminum di- and tri-stearate as

compared with thixotropic petroleum jellies containing no aluminum soap.

Sample	1	2	3	4	5	6	7
Composition, per cent wt.							
Oil A—58 S. U. V. at 100° F.	65.7		78	83.0		88.4	
Oil B—105 S. U. V. at 100° F.		65.7			83.1		73.8
Aluminum di-stearate			4	3.55	3.5	2.3	3.6
Aluminum tri-stearate				3.55	3.5	2.3	3.6
Ceresin wax	34.3	34.3	19	9.9	9.9	7.0	19.0
Properties:							
Melting point—° F. Ubbel	165		170	184		178	
Penetration, unworked—							
77° F	205	190	286	295	221	372	215
32° F	120	63	108	192	120	238	100
0° F	65	40	88	118	85	190	70
—25° F	40	30			65		55
—100° F					53		43
Penetration, worked, 77° F	400+		400+	302		400+	

From these results the beneficial effect of aluminum soaps in increasing the melting point, and the penetration, particularly at low temperatures, of thixotropic oil-wax jellies is apparent.

While our invention has been described herein with reference to certain specific embodiments thereof by way of example, it is to be understood that my invention is not limited thereto except as hereinafter defined in the appended claims. The striking properties of the product obviously render it eminently suitable for use in substantially all of the relationships wherein petroleum jellies are customarily employed. It will be understood that when the jelly is to be employed as a base for salves or unguent medicaments, it is advantageously prepared under conditions assuring high purity and sterility.

What we claim is:

1. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil with a wax having a wax melting point above about 150° F., and having incorporated therein an amount of aluminum soap such that the ratio of soap to wax by weight is less than 1:1 but at least approximately 1:15, whereby the jelly is rendered substantially softer at low temperatures.

2. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil with a wax having a wax melting point above about 150° F. in amount sufficient to provide a wax-oil mixture having a cloud point above about 145° F., and having incorporated therein an amount of aluminum soap such that the ratio of soap to wax by weight is less than 1:1 but at least approximately 1:15, whereby the penetration of the jelly at low temperatures is substantially increased, and the running torque of the jelly at low temperatures is substantially decreased.

3. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil having a viscosity index above about 90, with a wax having a wax melting point above about 150° F. in an amount sufficient to provide a wax-oil mixture having a cloud point above about 145° F., and having incorporated therein an amount of aluminum soap such that the ratio of soap to wax by weight is less than 1:1 but at least approximately 1:15, whereby the penetration of the jelly at low temperatures is substantially increased, and the running torque of the jelly at low temperatures is substantially decreased.

4. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil having a viscosity index above about 90 with ceresin wax, and having incorporated therein an amount of aluminum soap such that the ratio of soap to wax by weight is less than 1:1 but at least approximately 1:15, whereby the penetration of the jelly at low temperatures is substantially increased, and the running torque of the jelly at low temperatures is substantially decreased.

5. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil with a wax having a melting point above about 150° F. in an amount sufficient to provide a wax-oil mixture having a cloud point above about 145° F., and having incorporated therein a substantial amount of aluminum stearate such that the ratio of aluminum stearate to wax by weight is less than 1:1, whereby the penetration of the jelly at low temperatures is substantially increased, and the running torque of the jelly at low temperatures is substantially decreased.

6. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil with a wax having a wax melting point above about 150° F. in an amount sufficient to provide a wax-oil mixture having a cloud point above about 145° F., and having incorporated therein an amount of aluminum stearate such that the ratio of aluminum stearate to wax by weight is between 1:1 and 1:15.

7. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil having a viscosity index above about 90, with ceresin wax in an amount sufficient to provide a wax-oil mixture having a cloud point above about 145° F., and having incorporated therein a substantial amount of aluminum stearate such that the ratio of aluminum stearate to wax by weight is less than 1:1, whereby the penetration of the jelly at low temperatures is substantially increased, and the running torque of the jelly at low temperatures is substantially decreased.

8. A thixotropic petroleum lubricating jelly,

having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil having a viscosity index above about 90, with ceresin wax in an amount sufficient to provide a wax-oil mixture having a cloud point above about 145° F., and having incorporated therein an amount of aluminum stearate such that the ratio of aluminum stearate to wax by weight is between 1:1 and 1:15.

9. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil with a wax having a wax melting point above about 150° F. and having incorporated therein an aluminum soap in substantial amount which amount is less than the quantity which bears a ratio of 1:1 by weight to the wax present, whereby the jelly is rendered substantially softer at low temperatures.

10. A thixotropic petroleum lubricating jelly, having improved viscosity-temperature characteristics and improved lubricating properties at low temperatures, consisting essentially of a mixture of a petroleum lubricating oil with a wax having a wax melting point above about 150° F. in amount sufficient to provide a wax-oil mixture having a cloud point above about 145° F. and having incorporated therein an aluminum soap in substantial amount which amount is less than the quantity which bears a ratio of 1:1 by weight of the wax present, whereby the jelly is rendered substantially softer at low temperatures.

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