Patented Aug. 20, 1940 2,211,921

UNITED STATES PATENT OFFICE

2,211,921

GEAR LUBRICANT AND METHOD OF MAKING IT

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No Drawing. Application May 17, 1937, Serial No. 143,126

12 Claims. (Cl. 252—36)

This invention relates to lubricants, and particularly to lubricants for gear cases, automotive transmissions and the like. The lubricants of our invention are characterized by the presence of an optimum amount of a particular type of asphalt along with other necessary constituents. The invention also relates to methods of making such lubricants.

It is an object of our invention to provide fluid or semi-fluid grease-like lubricants for gear cases, automotive transmissions and the like which will have the following properties: freedom from leakage of oil through shaft openings, freedom from foaming and freedom from soap separation difficulties. It is a further object of our invention to provide lubricants of the type mentioned which will give low torque characteristics when used in gear cases, transmissions, etc. at low temperatures.

A still further object of our invention is to provide, when this characteristic is wanted, a lubricant which will not "set up" in the presence of water. Another object of our invention is to provide a lubricant of the foregoing type which adheres to metal surfaces tenaciously. Still another object of our invention is to provide a gear case lubricant which will not change in consistency to an objectionable extent on aging.

It is also an object of our invention to provide methods of making such lubricants. Other and still further objects of our invention will become apparent as the description thereof proceeds.

Many difficulties have been encountered in providing satisfactory compounded lubricants for gear cases, transmissions and the like. A large number of different characteristics are desired and prior to our invention certain of these desired characteristics were believed to be incompatible with others. A lubricant which had optimum properties in one respect would be undesirable in another respect and a cure for one defect would produce another defect. We have found it possible by the use of certain constituents in certain proportions and by certain manufacturing procedures to produce lubricants having practically optimum properties in all the desired respects.

One difficult lubrication problem which we have solved is that of providing satisfactory lubricants for gear cases, particularly gear cases such as are used in certain washing machines. A lubricant for this purpose must be relatively fluid, so that it will get to the gears and lubricate them properly, must permit a very low starting torque at low temperatures, must adhere to the metal so that, in spite of its fluidity, it will not be thrown out of the gear case, must not leak past the shaft which protrudes from the gear case, must be substantially free from foaming when air is whipped into it by the gears, must not set up into a solid mass or otherwise increase in body if water leaks in, as often happens in washing machine practice, and must be free from soap separation difficulties. We have secured all of these properties simultaneously in one lubricant.

This is achieved by various new features, particularly the use of a certain kind of oxidized petroleum asphalt along with oil and calcium soap. It is highly desirable to include aluminum soap as well.

Examples of compositions in accordance with our invention are as follows:

	Example No. 1	Example No. 2
	Per cent	*Per cent*
Animal fatty acids	3.78	3.31
Lime	.523	.456
Dry sodium hydroxide	.027	.024
Oil gel (aluminum soap)	1.27	1.35
No. 1 Korite (oxidized Mid-Continent asphalt)	20.4	21.5
Low cold test 300° F. flash lubricating oil	26.21	23.0
S. A. E. 20 lubricating oil	47.4	50.02
Water	.39	.34

The fatty acids, lime and soda are, of course, reacted to form soap.

In order to achieve the combination of desirable characteristics represented by the above examples, years of research work were necessary since it was necessary to balance various factors against each other. A given change would produce one desirable result but also an undesirable result and this led to great difficulties.

For instance, leakage of oil past the shaft leading out of the gear case is affected by the amount of soap and by the amount and type of asphalt. The amount of soap affects the consistency or viscosity. To avoid leakage we use asphalt, preferably oxidized asphalt. This prevents leakage and at the same time prevents soap separation.

It also prevents foaming when water leaks into the gear case. Petroleum residuum, as distinguished from asphalt, causes excessive leakage. It also causes foaming both in the absence of water and in its presence. In order to secure absence of foaming when water leaks into the gear case, it is desirable to avoid the use of untreated distillate oils and low viscosity oils. Also in order to avoid soap separation and consequent foaming, it is desirable to use an additional solubilizer such as aluminum soap, in addition to the asphalt.

Conventional gear greases tend to set up into a solid mass or otherwise increase in body in the presence of water. To prevent this it is necessary to avoid high soap contents, to avoid certain types of oils, to use a definite amount of asphalt, preferably between about 20% and about 25%, to use a particular type of asphalt which will be described hereinafter, to avoid neutralization of the asphaltogenic acids contained in the asphalt and to avoid the use of sodium soap in quantities over 10% of the calcium soap used.

To secure low temperature starting characteristics and low torque at low temperatures, it is desirable to use a low viscosity oil, preferably one having a viscosity less than 100,000 seconds Saybolt at the lowest starting temperature. A low cold test or low pour point oil is also desirable from the torque viewpoint.

In order to secure desirable fluidity, the oil should have a high viscosity since high viscosity oils produce increased fluidity in the grease. It is also desirable to use the so-called Oil Gel (a commercial aluminum soap) in place of other aluminum soaps for this purpose. To secure desirable aging characteristics Oil Gel, aluminum stearate or other aluminum soap is also desirable and the optimum is about 20% to 25% of the total soap. This prevents undesirable increase in consistency on aging, particularly if the soap base is noticeably on the acid side.

A further desirable property is absence of "throwing" or, in other words, freedom from the condition in which grease is thrown to the top of the gear case and sticks thereto. This is avoided by producing a high viscosity but nevertheless fluid type grease rather than a gel type grease. This in turn is accomplished by using an oil-asphalt blend of as high viscosity as possible without producing undesirable high starting torques at low temperatures.

Of course, where, in the case of any particular lubricant, certain properties are not essential certain of the above considerations can be ignored.

Not only is the composition of the grease highly important but its method of manufacture is also important. The asphalt is one of the key components and it has been found that there is a very marked difference between various asphalts. Some are highly undesirable in our compositions. Oxidized asphalts are preferable and we prefer asphalts such as those from Mid-Continent crude residuums having melting points within the range 60° F. to 100° F. which have been oxidized to asphalt by air blowing to increase the melting point by an increment of from 80° F. to 200° F. It is also highly desirable in the manufacturing operation to avoid neutralization of the so-called asphaltogenic acids contained in the asphalt. Lime or other basic material is sometimes used in refining operations to avoid corrosion. Asphalt thus produced contains neutralized asphaltogenic acids and is unsuited for use in our compositions.

Furthermore, in order to accomplish this freedom from neutralized asphaltogenic acids it is important to make a neutral or very slightly alkaline grease base before adding the asphalt in manufacturing our lubricants.

The asphalt which we have found most satisfactory is known as No. 1 Korite. This is an asphalt made by taking a 10–11% bottoms from Mid-Continent crude (70° F. melting point) and blowing it with air to a 180° F. melting point. The oxidized asphalt (No. 1 Korite) has an A. S. T. M. penetration of 35 at 77° F. and contains about 26–27% of material insoluble in hexane.

The preferred method of manufacturing our lubricant compositions is to make a neutral cup grease from the water, oil, calcium soap and sodium soap, if any, and then gradually grade into this cup grease a blending oil containing the asphalt, oil and aluminum soap. The cup grease base should be neutral or at most slightly alkaline when titrated in the presence of 95% alcohol. Any appreciable excess of alkali reacts with the asphaltogenic acids of the asphalt and the resulting grease "sets up" into a solid mass or at least increases seriously in body in the presence of water. On the other hand, the cup grease base should not be acid. If it is, the final grease tends to foam and its consistency is unstable, particularly if aluminum soap is not used.

It is important that the aluminum soap be added as a separate soap-oil mixture rather than incorporated directly in the base. The desired structure is completely lost when the aluminum soap is incorporated directly in the base. The preferred manufacturing procedure, as above indicated, is to add the aluminum soap with the blending oil but it can be added as a separate grease or soap-oil mixture, the remainder of the total oil together with the asphalt being separately graded into the composition.

Examples Nos. 1 and 2 above are preferred embodiments of our invention. These products are fluid and do not have any pronounced gel structure. For most purposes a gel structure is undesirable but for some uses it is desirable. An example of a grease in accordance with our invention which has a gel structure is as follows:

Example No. 3	Per cent
Calcium fatty acid soap	5.38
Sodium fatty acid soap	.28
Oil Gel (aluminum soap)	1.23
No. 1 Korite	20.6
Low cold test 300° F. flash lubricating oil	72.1
Water	.41

This gel structure is due largely to the fact that Example No. 3 uses a relatively low viscosity oil-asphalt blend, the overall viscosity of the total oil and asphalt being 55 seconds Saybolt at 210° F. as compared with 70 seconds for Example No. 1 and 78 seconds for Example No. 2. For our preferred fluid type lubricants we prefer to use oil and asphalt which when blended together will have a viscosity of from about 60 to about 90 seconds Saybolt at 210° F. Lower viscosities tend to produce gel structures while higher viscosities cause high torque characteristics. Another factor tending to cause gel

structure is high soap content. To avoid gel structure it is preferable to keep the calcium and sodium soap content under 5%.

Still further examples of greases in accordance with our invention are shown in the following table:

	Example No. 4	Example No. 5	Example No. 6	Example No. 7
	Per cent	*Per cent*	*Per cent*	*Per cent*
Calcium soap	2.77	2.38	2.95	4.42
Aluminum soap	1.01	1.13	1.12	1.29
No. 1 Korite	22.6	22.6	25.2	20.1
S. A. E. 20 oil from Winkler crude	73.46	73.75	16.7	27.5
Low cold test 300° F. flash lubricating oil			53.76	46.53
Water	.16	.14	.27	.16

It is not absolutely essential to use aluminum soaps in making greases in accordance with our invention. The aluminum soap does prevent soap separation and is desirable in order to avoid pronounced changes in consistency on aging. However, if the aging consideration is not important for a given grease and if the defined type of asphalt is used to help avoid soap separation, aluminum soap can be eliminated. The following are examples of compositions which do not include aluminum soap:

	Example No. 8	Example No. 9
	Per cent	*Per cent*
Calcium soap	2.73	3.39
No. 1 Korite	39.6	19.8
Lubricating oil	57.42	76.62
Water	.25	.19

Lubricants can also be made in accordance with our invention which are particularly adapted to use in automobile transmissions. Examples of such products are as follows:

	Example No. 10	Example No. 11
	Per cent	*Per cent*
Calcium fatty acid soap	3.6	3.7
Sulfurized lard oil	15.0	
Low cold test 300° F. flash lubricating oil	20.76	20.6
S. A. E. 20 lubricating oil		45.2
S. A. E. 50 lubricating oil	40.56	
No. 1 Korite	19.84	30.1
Water	.24	.4

It is desirable that the sulfurized lard oil used in Example No. 10 be neutralized in order to improve the consistency of the lubricant.

In any of the above compositions not containing sodium soap, up to 5% or even 10% of the calcium soap can be replaced by sodium soap.

To summarize the situation with regard to the compositions of our products the following generalized compositions can be listed:

	Maximum range	Optimum range
	Per cent	*Per cent*
Calcium soap	2–6	2.5–5
Sodium soap	0–.6	0–.5
Aluminum soap	0–2	1.0–1.6
Asphalt	15–30	19–25
Water	0–1	.15–.5
Lubricating oil	To make 100	To make 100

The viscosity of a blend of the total oil and asphalt should be within the range 50 to 120 seconds Saybolt at 210° F. and, particularly for my preferred type washing machine gear case lubricants, preferably within the range 60–90 seconds Saybolt at 210° F.

While we have described our invention in connection with certain specific embodiments thereof, numerous other embodiments within the scope of our invention will occur to those skilled in the art in the light of our teachings.

We claim:

1. A gear lubricant containing not more than about 6% calcium soap, sodium soap in amounts not greater than about 10% of the calcium soap, asphalt containing unneutralized asphaltogenic acids, and oil, together with a critical amount of aluminum soap ranging from about 20% to about 25% of the total soap.

2. A gear lubricant containing about 2–6% calcium soap, sodium soap in amounts not greater than about 10% of the calcium soap, aluminum soap in amount equal to about 20–25% of the total soap, about 15–30% asphalt free from neutralized asphaltogenic acids, and lubricating oil to make 100%.

3. A gear lubricant comprising:

	Per cent
Calcium fatty acid soap	2–6
Sodium fatty acid soap	0–.6
Aluminum soap	0–2
Asphalt containing unneutralized asphaltogenic acids	15–30
Water	0–1
Lubricating oil	to make 100

said lubricant being free of neutralized asphaltogenic acids.

4. A gear lubricant comprising:

	Per cent
Calcium soap	2.5–5
Sodium soap	0–.5
Aluminum soap	1.0–1.6
Asphalt containing unneutralized asphaltogenic acids	19–25
Water	.15–.5
Lubricating oil	to make 100

said lubricant containing unneutralized asphaltogenic acids.

5. A gear lubricant comprising:

	Per cent
Calcium fatty acid soap	2.5–5
Sodium fatty acid soap	0–.5
Aluminum soap	1.0–1.6
Asphalt	19–25
Water	.15–.5
Lubricating oil	to make 100

in which the asphalt is made from crude residuum having a melting point within the range from about 60° F. to about 100° F. which has been oxidized to increase its melting point by an increment of from about 80° F. to about 200° F.

6. A gear lubricant comprising:

	Per cent
Calcium soap	2.5–5
Sodium soap	0–.5
Aluminum soap	1.0–1.6
Asphalt	19–25
Water	.15–.5
Lubricating oil	to make 100

in which the asphalt contains unneutralized asphaltogenic acids and is made from crude residuum having a melting point within the range from about 60° F. to about 100° F. which has been oxidized to increase its melting point by an increment of from about 80° F. to about 200° F.

7. A gear lubricant having approximately the following composition:

	Per cent
Animal fatty acids	3.78
Lime	.523
Dry sodium hydroxide	.027
Oil Gel (aluminum soap)	1.27
No. 1 Korite (oxidized Mid-Continent asphalt)	20.4
Low cold test 300° F. flash lubricating oil	26.21
S. A. E. 20 lubricating oil	47.4
Water	.39

in which the asphaltogenic acids in said lubricant are not neutralized.

8. A gear lubricant having approximately the following composition:

	Per cent
Animal fatty acids	3.31
Lime	.456
Dry sodium hydroxide	.024
Oil Gel (aluminum soap)	1.35
No. 1 Korite (oxidized Mid-Continent asphalt)	21.5
Low cold test 300° F. flash lubricating oil	23.0
S. A. E. lubricating oil	50.02
Water	.34

in which the asphaltogenic acids in said lubricant are not neutralized.

9. A method of making a gear lubricant having the following formula:

	Per cent
Calcium soap	2–6
Sodium soap	0–.6
Aluminum soap	0–2
Asphalt containing unneutralized asphaltogenic acids	15–30
Water	0–1
Lubricating oil	to make 100

which comprises making a substantially neutral cup grease with the calcium soap and part of the oil and then grading in the asphalt, the aluminum soap, and the remainder of the oil, thereby avoiding the neutralization of asphaltogenic acids.

10. A method of making a gear lubricant having the following formula:

	Per cent
Calcium soap	2–6
Sodium soap	0–.6
Aluminum soap	0–2
Asphalt containing unneutralized asphaltogenic acids	15–30
Water	0–1
Lubricating oil	to make 100

which comprises making a substantially neutral cup grease with the calcium soap and part of the oil and then grading in a blend of the asphalt, aluminum soap and the remainder of the oil, thereby avoiding the neutralization of asphaltogenic acids.

11. A method of making a gear lubricant having the following formula:

	Per cent
Calcium soap	2.5–5
Sodium soap	0–.5
Aluminum soap	1.0–1.6
Asphalt containing unneutralized asphaltogenic acids	19–25
Water	.15–.5
Lubricating oil	to make 100

which comprises making a substantially neutral cup grease with the calcium soap and part of the oil and then grading in the asphalt, the aluminum soap, and the remainder of the oil, thereby avoiding the neutralization of asphaltogenic acids.

12. A method of making a gear lubricant having the following formula:

	Per cent
Calcium soap	2.5–5
Sodium soap	0–.5
Aluminum soap	1.0–1.6
Asphalt containing unneutralized asphaltogenic acids	19–25
Water	.15–.5
Lubricating oil	to make 100

which comprises making a substantially neutral cup grease with the calcium soap and part of the oil and then grading in a blend of the asphalt, aluminum soap and the remainder of the oil, thereby avoiding the neutralization of asphaltogenic acids.

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