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P A R T I I I
R E S E A R C H O N L U B R I C A T I N G G R E A S E S

by

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SUMMARY

Research on special greases having the following characteristics was carried on.

1. A grease having high dropping point and water-proof characteristics.
2. A grease having alcohol-proof characteristics.
3. A grease having concentrated nitric acid proof characteristics.

Up to the time of this report, conclusive results were not obtained. However, the summary of the experimental data as a progress report is given as follows:

1. A grease having high dropping point and water-proof characteristics.

This grease was prepared by several methods, but results were all negative in regard to objectives sought.

According to the literature,* barium soap base grease made from petroleum acids obtained by oxidation of paraffin wax, but this was not tried.

2. A grease having an alcohol proof nature.

A grease consisting of aluminium stearate and mineral oil, refined by alcohol extraction, may be suitable.

3. A grease having an acid-proof nature.

A mixture of petrolatum and paraffin wax may be suitable.

I. INTRODUCTION

Ordinary cup greases have water-proof characteristics, but their dropping points are generally below 100°C.

Magneto grease is of high dropping point nature, but this grease is water soluble. Therefore, a grease which satisfies both conditions was needed for lubri-

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cating conditions of very high temperature and for contact with cooling water. Moreover, special greases for lubricating conditions involving contact with alcohol or concentrated nitric acid, were required. Therefore, the researches on these special lubricating greases were carried on during 1945.

II. DETAILED DESCRIPTIONA. Research for Manufacturing Water-Proof Grease having High Dropping Point

1. Since calcium soap base grease is water-proof, the question of what kind of fatty acids in combination with calcium soap influenced the dropping point was studied.

The prepared greases had the properties shown in Table XXVII(B)36.

From these results, calcium soap greases prepared with calcium stearate had the highest dropping point, but these dropping points were too low.

2. Calcium and Other Mixed Base Greases. Calcium and sodium soap greases were prepared in order to add the high dropping point nature of sodium soap base grease to the water-proof nature of calcium base grease. Their properties were as shown in Table XIX(B)36.

From these results, it is evident that generally the dropping point of mixed base grease is lower than that of mono-base grease, and the water-proof characteristic becomes poorer by adding sodium soap, so that this method is also unsatisfactory.

3. Several Metallic Soap Base Greases. Since the stearates of aluminum, cobalt, barium, and nickel are insoluble in water, we prepared greases, by mixing a constant amount of mineral turbine oil and 20% of these soaps.

From the results, it can be seen that aluminum, cobalt, nickel, and magnesium soap greases are very water-proof but that their dropping points vary from 60° to 120°C and, do not reach the desired 150°C.

4. Resin Acid-Calcium Soap Base Grease. Calcium resinate, which was prepared by double decomposition of calcium chloride and potassium resinate, has a higher melting point than the other calcium fatty acid soaps.

<u>Calcium Soaps</u>	<u>Melting Point (°C)</u>
Calcium Stearate	113
Calcium Oleate	93
Calcium Resinate	212-241

So, when this calcium resinate (20%) was mixed with mineral oil (80%), a grease was obtained whose dropping point was 98°C and its general characteristics were as follows:

Consistency at 25°C	170
Dropping Point (°C)	98
Water-proof Characteristics	Good

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5. Conclusions. Greases were prepared by several methods, but a grease of the desired characteristics was not successfully made.

According to the literature, 0.1% of potassium permanganate and 1% of stearic acid, as the catalyst were added to paraffin wax. This was heated to about 130°C passing air into it, and oxidized petroleum acid was prepared.

The preparation of a grease composed of the barium soap of petroleum acid and mineral oil was not tried.

B. Alcohol-Proof Grease

As the preliminary test, several greases were extracted by alcohol in a Soxlet's apparatus. The results were as follows:

<u>Samples of Greases</u>	<u>Amount of Extracted (%)</u>
Experimental grease for magneto	26.7
Ordinary cup grease	17.7
Mixture of petrolatum and 10% of aluminum stearate	3.0

These results showed that the grease mixture of petrolatum and aluminum stearate is best for alcohol proof grease.

The example of composition and general characteristics were as follows:

<u>Composition (%)</u> :	
Petrolatum	54.5%
Mineral oil (residue extracted from alcohol)	36.4%
Aluminum Stearate	9.1%
<u>General Characteristics</u> :	
Consistency at 25°C (Worked Penetration)	216
Extracted amount by alcohol (%)	3.0

C. Concentrated Nitric Acid-Proof Grease

According to the investigations in the laboratory, among the calcium, sodium and aluminum soap base greases and petrolatum, petrolatum was most inactive for concentrated nitric acid at the ordinary temperature.

And then to make petrolatum possible to use at higher temperatures than 50°C; powdered graphite or talc was added as an inorganic solid lubricant. However, the results were unsatisfactory as shown in Tables XXXI(B)36 and XXXII(B)36.

III. CONCLUSIONSA. Water-Proof Grease Having High Dropping Point

This grease was prepared by several methods using calcium soap base, calcium and sodium mixed soap base, several metallic soaps as a base, and calcium resinate base, but none had the desired dropping point of 150°C or above.

According to the literature, barium soap base grease of petroleum acid is preferable and its trial is intended.

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B. Alcohol-Proof Grease

The following grease which consisted of aluminum stearate and refined mineral oil may be suitable.

Composition (%):
 Petrolatum 54.5%
 Refined mineral oil (by alcohol) 36.4%
 Aluminum Stearate 9.1%

General Properties:
 Consistency at 25°C 216
 Amount extracted by alcohol (%) 3.0

C. Concentrated Nitric Acid Proof Grease

The following two examples were prepared but were not subjected to practical tests.

Example Grease No. 1

Petrolatum 80%
 Paraffin wax 20%
 Fine powdered graphite 1%

Example Grease No. 2

Petrolatum 48%
 Paraffin wax 12%
 Talc 40%

Table XXVII(B)36
 CALCIUM SOAP GREASE PROPERTIES

Stearic acid(gm)	Oleic acid(gm)	CaO (gm)	Mineral oil(gm)	Consistency (25°C)*	Dropping pt. (°C)	Water-proof characteristics
25	25	6.58	232	250	103	Good
60	—	7.85	232	280	119	Good
—	50	6.58	232	235	82	Good

*Worked Penetration

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Table XXIX(B)36
CALCIUM AND SODIUM MIXED-BASE GREASES

Sample No.	Mixing Ratio		Consistency (25°C)*	Dropping pt. (°C)	Water-proof characteristics
	Sodium soap base grease (soap cont. 20%)	Carusume soap base grease (soap cont. 20%)			
1	0	1	263	113	Good
2	1	10	207	103	Good
3	1	5	260	120	Emulsify
4	1	2	-	98	Emulsify
5	1	1	-	96	Emulsify
6	1	0	250	150	Emulsify

*Worked Penetration

Table XXX(B)36
VARIOUS METALLIC-BASE GREASES

Name of soap base	Consistency (25°C)*	Dropping point (°C)	Water-proof characteristics
Calcium stearate	150	100	Good
Cobalt stearate	230	110	Good
Nickel stearate	250	120	Good
Magnesium stearate	180	60	Good
Aluminium stearate	170	90	Good

*Worked Penetration

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Table XXXI(B)36
TEST GREASE NO. 1

	Percent	Consistency (25°C)*	General Properties	
			Dropping pt. (°C)	Ash(%)
Petrolatum	80			
Paraffin wax	20	260	46	0.2
Fine powdered graphite	1.0			

*Worked Penetration

Table XXXII(B)36
TEST GREASE NO. 2

	Percent	Consistency (25°C)*	General Properties	
			Dropping pt. (°C)	Ash(%)
Petrolatum	48			
Paraffin wax	12	185	47.5	37.4
Talc	40			

*Worked Penetration