This invention pertains to high temperature greases and in particular to greases for lubricating roller and ball bearings operating at high temperatures.

High temperatures such as above 200°F are frequently encountered in roller and ball bearings. When conventional greases are used to lubricate such bearings, the grease may melt and run out of the bearing in which case effective lubrication takes place only for a relatively short period of time. Conventional greases melting at high temperature will remain in such bearings but because of the high temperature will ordinarily oxidize or polymerize forming hard gummy deposits which increase torque and finally result in breakdown of the bearing. This problem is especially acute in connection with pre-packed, sealed bearings which require effective lubrication over prolonged periods of time, much of which is at elevated temperature.

This invention has for its object to provide an improved high temperature grease. Another object is to provide a grease which will effectively lubricate roller and ball bearings operating at temperatures above 200°F over prolonged periods of time. Another object is to improve the state of the art. Other objects will appear hereinafter.

These and other objects are accomplished by our invention which includes a grease comprising a lubricating oil, a sodium, lithium, barium or strontium soap thickening agent and between about 5 and 30 percent of Agents A, B, C or D described below.

**AGENT A**

A mixture of (1) a member of the group consisting of calcium and barium neutral and basic salts of a compound having the formula:

![Chemical Structure](image)

(wherein R represents any alkyl group containing between about 4 and 20 carbon atoms and n is an integer of 1 to 4) and (2) a salt selected from the group consisting of calcium and barium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms.

Specific examples of component (1) of Agent A are the following:

(i) The barium salt of tertiary octyl phenol sulfide having the formula:

![Chemical Structure](image)

(ii) The barium salt of tertiary amyl phenol sulfide having the formula:

![Chemical Structure](image)

(iii) The barium salt of stearylphenol sulfide having the formula:

![Chemical Structure](image)

(iv) The barium salt of ditertiary butylphenol sulfide having the formula:

![Chemical Structure](image)

The barium salt of di-tert-octylphenol sulfide was prepared by the following reaction and procedure.

![Chemical Reaction](image)

To prepare this compound, 442 grams (1 mol) of tert-octyl sulfide were dissolved in 865 grams of SAE 20 lubricating oil and heated with stirring to about 220°-225°F. Stirring was continued while 325 grams of barium hydroxide, Ba(OH)2.8H2O (slight excess over 1 mol), was added gradually over a period of about two hours. The temperature was raised during the last hour to about 275°-280°F to avoid foaming as the water of reaction was being removed. The temperature was raised to about 300°F for about one-half hour or until all water was removed. A small amount of filter aid was added with stirring to the hot oil solution and the solid impurities removed by filtration. The oil solution consists of approximately 40 percent solution of the neutral barium salt of the tert-octylphenol sulfide.

Examples of component (2) of Agent A are the following:

- Calcium petroleum sulfonate
- Barium petroleum sulfonate
- Sodium petroleum sulfonate
- Calcium octyl benzene sulfonate
- Barium nonyl benzene sulfonate
- Calcium hexadecyl benzene sulfonate
- Calcium octadecyl benzene sulfonate
- Calcium wax-alkylated benzene sulfonate

The two components of Agent A may vary in amount between about 50 and 90 percent of component (1) and 10 to 50 percent of component (2). A satisfactory mixture is obtained by adding 63 parts of the barium di-tert-
octylphenol sulfide prepared as described above to 37 parts of calcium petroleum sulfonate prepared as follows:

One thousand four hundred fifty grams of an oil solution of the sodium salt of oil soluble petroleum sulfonic acids are agitated in 4000 ml. of water during the addition of a solution of 220 grams of Ca(OH)₂ to insure complete neutralization. The oil solution contains 62 percent by weight of the sulfonates. This reaction represents about 2 mols of sodium petroleum sulfonate with a very slight excess of calcium chloride. After the reaction is completed, the excess water is separated by decantation and the oil-solids mass washed with cold water. The calcium salt-oil mass is added to 2400 grams of an SAE 20 viscosity mineral oil together with about 23 grams of Ca(OH)₂ to insure complete neutralization. The oil solution is dehydrated at about 300° F. and filtered. The resulting oil solution contains 1.35 percent calcium and the calcium content of the oil-free active ingredient is 4.5 percent, i.e., the oil solution contains 30 percent of the calcium petroleum sulfonate.

AGENT B

A mixture of (1) the product obtained by reacting P₃S₈ with a member of the group consisting of the calcium and barium neutral and basic salts of a compound having the formula:

\[
\text{(wherein } R \text{ is an alkyl group containing between about 4 and 20 carbon atoms and } n \text{ is an integer of 1 to 4)}
\]

and (2) a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms.

Specific examples of component (1) of Agent B are the products obtained by reacting one of the following materials with P₃S₈:

(i) The barium salt of tertiary octyl phenol sulfide having the formula:

\[
\text{O} \quad \text{Ba} \quad \text{O}
\]

(ii) The barium salt of tertiary amyl phenol sulfide having the formula:

\[
\text{O} \quad \text{Ba} \quad \text{O}
\]

(iii) The barium salt of stearylphenol sulfide having the formula:

\[
\text{O} \quad \text{Ba} \quad \text{O}
\]

(iv) The barium salt of ditertiary butylphenol sulfide having the formula:

\[
\text{O} \quad \text{Ba} \quad \text{O}
\]

Calcium or mixed barium-calcium salts may be employed instead of the barium salt in each of the above compounds. The reaction with P₃S₈ may be accomplished by dissolving the metal salt of the phenol sulfide in a solvent such as a lubricating oil and adding the P₃S₈ with heating and stirring. Proportions of between about 3 and 5 parts of the metal salt of the phenol sulfide to one part of P₃S₈ are employed. The reaction mixture is heated and stirred at about 175° and 300° F. for a time period between about 2 and 3 hours. The reaction may be carried out in the presence of solvents such as lubricating oils, heavy naphthas, etc. The reaction product may be treated by blowing with a gas such as nitrogen in order to remove hydrogen sulfide, filtered and air blown to remove any remaining volatile sulfides.

Examples of component (2) of Agent B are the same substances mentioned in connection with component (2) of Agent A.

The two components of Agent B may vary in amount between about 50 and 90 percent of component (1) and 10 to 50 percent of component (2). A satisfactory mixture constituting Agent B is obtained by reacting 40 parts of the barium salt of ditertiary butyl phenol sulfide containing the formula given in subparagraph (iv) above with 4 parts of P₃S₈ in presence of 60 parts of a solvent comprising SAE 20 grade lubricating oil at a temperature of 212° F. for a time of one-half hour and at 300° F. for an additional 2 hours to obtain a product which consists essentially of a lubricating oil solution containing about 40 percent by weight of the phosphorized barium tert-octylphenol sulfide as the active ingredient. This sulfide contains 23.8 percent barium and 5.5 percent sulfur. Sixty-three grams of the lubricating oil solution containing this phosphorusulfurized barium tert-octylphenol sulfide was blended with 37 grams of a lubricating oil (SAE 20) solution containing as the active ingredient (component 2) about 35 percent by weight of the calcium petroleum sulfonate prepared as described above in connection with Agent A.

AGENT C

The product obtained by reacting P₃S₈ with a terpene hydrocarbon. Examples of terpene hydrocarbons are pinene, dipinene and terpinolene. The reaction between the terpene and P₃S₈ is carried out by reacting between about 3.5 and 4.5 parts of the terpene hydrocarbon with one part of P₃S₈. The temperature during the reaction may be about 205° and 320° F. and preferably between 210° and 255° F. The reactants are heated at this temperature for a period of time between about two hours and five hours. It is desirable that the reaction be carried out in the presence of a non-reactive solvent such as a hydrocarbon in the lubricating oil range. The reaction products may be employed as formed in the reaction mixture or the reaction mixture may be purified by any desired method such as by filtering the warm oil solution in which case the filtrate contains the desired agent. A composition representing Agent C was produced by reacting 4 parts of alpha pinene with 1 part of P₃S₈ at a temperature of 210°-255° F. for 2 hours in the presence of a lubricating oil solvent having an SAE viscosity of 20. The reaction product was then filtered to obtain the lubricating oil solution of the desired agent in an amount of 57 percent. The product contained 4.45 percent phosphorus and 12.61 percent sulfur.

AGENT D

A mixture of (1) the product obtained by reacting P₃S₈ with a terpene hydrocarbon and (2) a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms. Component (1) of Agent D is the same as the above described Agent C. Component (2) of Agent D is the same as component (2) of Agents A and B. Fifty to 80 percent of component (1) to 50 to
20 percent of component (2) is preferably employed in the mixture. A preferred specific mixture is 4 parts of the reaction product of PhS with a pine Kerr prepared as described in connection with Agent C and one part of barium paraffin wax alkylated benzene sulfonate solution prepared as follows:

A paraffin wax having an average of about 24 carbon atoms to the molecule and a melting point of 124°-127° F. was chlorinated at about 195° F. with chlorine gas until the weight of the wax had increased about 10 percent. The chlorowax (10 percent Cl) thus obtained was then blown with nitrogen to remove any oiledud chlorine and hydrogen chloride.

One thousand and twenty (1020) parts of the above chlorowax was then reacted with 460 parts by weight of benzene in the presence of 65 parts of AICl3 at about 140° F. for about two hours. The excess benzene was then distilled off by warming to 240° F. with a stream of N2 gas bubbling through the mixture. The wax benzene thus formed as treated with an additional 1020 parts of chlorowax and the mixture heated to 185° F. until the reaction stopped. It was allowed to stand over night at 140° F. and then decanted from the settled AICl3 sludge and filtered. The product consisted essentially of di wax benzene.

Five thousand two hundred (5200) parts of the di wax benzene, prepared as described above, were treated with successive 250 parts of oleum containing 15 percent SO3 while maintaining the temperature at 95°-130° F. After 2600 parts of oleum had been added and the reaction had ceased, 3000 parts of water were added while the mixture was thoroughly stirred. An AAE 30 grade motor oil (3000 parts) was then added and the mixture was allowed to settle over night at about 165° F. The lower layer, consisting mostly of dilute sulfuric acid, was withdrawn leaving di wax benzene sulfonic acid in the upper layer. This upper layer was treated with 3170 parts by weight of barium hydroxide octahydrate.

\[ \text{(Ba(OH)}_2 \cdot \text{SH}_2\text{O)} \]

which represents an excess of barium hydroxide over that required to neutralize the di wax benzene sulfonic acid and any free sulfuric acid occluded therein. The reaction was then thus formed at about 285° F. for about six hours with nitrogen gas bubbling through it to remove water, and it was then filtered through a layer of clay. The product consisted of approximately 50 percent oil blend of essentially neutral barium di wax benzene sulfonate.

The grease constituting our invention is prepared in known manner from a lubricating oil and a sodium, lithium, barium or strotium soap thickening agent. The lubricating oil may be a hydrocarbon lubricating oil or a synthetic lubricating oil. For instance di-2-ethylhexyl sebacate or azelate or glycol derivatives of the "Ucon" type are suitable synthetic lubricating oils. In the event a hydrocarbon oil is used, it may be derived from any mineral oil base such as Pennsylvania, Mid Continent, etc. deoxygenated, etc. It may be refined by distillation, solvent extraction, etc. The hydrocarbon oil should have a viscosity of between 100 SUS at 100° F. and 2000 SUS at 100° F. at 100° F. The viscosity is preferably between about 300 and 700 SUS at 100° F. The sodium, lithium, barium or strotium soap employed to thicken the lubricating oil may be prepared from an organic acid having between about 12 and 32 carbon atoms. The acid may be unsaturated and may contain substituents such as hydroxyl groups. Aliphatic acids are preferred. Examples of satisfactory acids are lauric, myristic, palmitic, stearic and arachidic. Mixtures of these acids or mixtures obtained by saponification of naturally occurring fats such as beef fat, tallow, etc. may be used.

The soaps are formed by saponifying the acid or the fat with a sodium, lithium, barium or strotium base, preferably sodium, lithium, strotium or barium hydroxide. The soaps are incorporated in the lubricating oil in amounts up to about 50 percent by weight. Amounts of between about 5 to 25 percent are preferred.

The grease may be prepared using any of the well known grease manufacturing procedures. A batch or continuous method of manufacture may be used. One satisfactory method is the following:

1. Saponify the fatty acids in a pressure vessel at 100-300 p.s.i. in the presence of part (approximately 30 percent) of the lubricating oil at a temperature of about 320° F.

2. Transfer the reaction product to an open kettle, dehydrate the resulting soap stock by heating in the open kettle and add the remainder of oil at a temperature between 300° and 420° F.

3. Cool the mixture to a temperature of about 200° F.

4. Add agent A, B, C or D. Stir the mixture to incorporate the additive.

5. Either (a) pour the grease into containers at about 200° F., or (b) stir the grease in the kettle while cooling it to a lower temperature and then pour into containers, or (c) cool still further, mill as by pumping through a colloid mill followed by packaging.

Alternatively the detergent and/or antioxidant (i.e. Agent A, B, C or D) may be added to the contents of the grease kettle at any stage of the described grease making operation. The detergent and/or antioxidant is added in amounts between 5 and 30 percent and preferably in amounts between 7.5 and 20 percent (based on weight of oil plus soap, not on total weight of finished grease).

Secondary additives may also be incorporated in the grease in order to improve its properties. Thus rust preventives, extreme pressure agents, etc., may be added to obtain the required properties.

From the foregoing it will be apparent that the grease constituting our invention should contain between about 1 and 50 percent and preferably between about 5 and 25 percent of the saponified soap thickening agent, between about 5 and 30 percent and preferably between about 7.5 and 20 percent of the detergent and/or antioxidant listed above, the balance being lubricating oil and minor amounts of other additives in case such other additives are desired.

Table I presents data comparing the greases constituting the present invention in a conventional or base grease containing no additive. Table II presents performance data on the base grease, the greases of the present invention and the base grease plus well known commercial detergent additives. For these tests the base grease was prepared in a conventional manner by saponifying a commercial stearic acid (90 percent stearic and 10 percent palmitic) with sodium hydroxide. A hydrocarbon lubricating oil and a small amount of diphenylamine was incorporated in the soap. The composition of this base grease was 68.65 percent lubricating oil, 24.67 percent fatty acids, 3.92 percent sodium hydroxide, 1.74 percent glycerin and 1.02 percent diphenylamine. The lubricating oil was a petroleum distillate having the following properties:

Gravity *API ----------------------------------- 29.8
Vis. SUS sec.:
100° F. ---------------------------------------- 305
210° F. ---------------------------------------- 54.5
Flash O.C., ° F. --------------------------------- 455

Into samples of this base grease was incorporated about 7.5 percent of the additive to be tested. The additives employed were the specific additives A, B, C or D described above and the commercial additives listed in Table II. Incorporation was accomplished by working the sample and additive in a grease worker.

The machine used for the performance tests in Table II consists essentially of two flat-rimmed steel wheels,
each containing two No. 6210 ball bearings, mounted on two parallel spindles, one above the other, and loaded through a system of levers and fulcrum plates by tangential contact of the wheels. The lower spindle with its wheel is connected to the loading system, and the upper assembly is brought to bear upon the lower by turning down two large screws until it counterbalances the chosen loading weight, which in these tests was 1000 pounds. To insure a fixed temperature of 250° F., the wheels are enclosed in an insulated box and heated by thermostatically controlled ring heaters surrounding the hubs. A cartridge heater in the rear of each spindle compensates for the heat loss through the heavy steel structure. Thermocouples are situated in grooves in the spindles and contact each bearing. A pulley on the upper wheel and two appropriate holes in the side of the insulated box provide for a belt driven by means of a motor mounted on the outside. A single charge of grease (10 grams) is packed into each ball bearing. The test runs continue as long as the bearings remain lubricated by the original charge, but with several interruptions for inspections, to observe developments and changing conditions. Finally, the runs were terminated and grease failure declared when the race paths are found to be dry, a condition sometimes signaled by a sudden temperature rise in the bearing.

### Table I

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Base Grease Containing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Additive A</td>
</tr>
<tr>
<td>Dropping Point, ° F., ASTM D 07-61-62</td>
<td>430</td>
</tr>
<tr>
<td>Penetration, ASTM D 217-52T</td>
<td>212</td>
</tr>
<tr>
<td>Unworked</td>
<td>222</td>
</tr>
<tr>
<td>Worked 50 strokes, 370°F, 72°F</td>
<td>226</td>
</tr>
<tr>
<td>Worked 10,000 strokes, 370°F, 72°F</td>
<td>302</td>
</tr>
<tr>
<td>Evaporation percent, ASTM D 922-52T</td>
<td>208</td>
</tr>
<tr>
<td>Oil Separation, percent, NI filter cone, 221°F, 50 hr</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>0.46</td>
</tr>
</tbody>
</table>

### Table II

<table>
<thead>
<tr>
<th>Composition Tested</th>
<th>Hours to Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base grease</td>
<td>2,909</td>
</tr>
<tr>
<td>Base grease plus Additive A</td>
<td>3,009</td>
</tr>
<tr>
<td>Base grease plus Additive B</td>
<td>6,782</td>
</tr>
<tr>
<td>Base grease plus Additive C</td>
<td>4,194</td>
</tr>
<tr>
<td>Base grease plus Additive D</td>
<td>5,289</td>
</tr>
<tr>
<td>Base grease plus Lubriox 355</td>
<td>7,737</td>
</tr>
<tr>
<td>Base grease plus Lubriox 899</td>
<td>7,079</td>
</tr>
<tr>
<td>Base grease plus Lubriox 729</td>
<td>2,049</td>
</tr>
<tr>
<td>Base grease plus Parano 64</td>
<td>2,027</td>
</tr>
<tr>
<td>Base grease plus Parano 64</td>
<td>2,009</td>
</tr>
</tbody>
</table>

It will be noted from the data in Tables I and II that the greases constituting the present invention had excellent characteristics including exceptional ability to lubricate at high temperatures over prolonged periods of time. The invention is applicable only to greases in which sodium, lithium, barium or strontium soaps are employed as thickening agents. We have added 7.5 percent of the same detergents tested in Table I to silica, Bentone, aluminum, and calcium greases having otherwise the same composition as the control greases mentioned in connection with Table I, and found that the resulting products were entirely unsatisfactory for high temperature use. The present invention is not to be considered as limited by any of the examples described herein which are given by way of illustration only, but it is to be limited solely by the terms of the appended claims.

This application is a continuation-in-part of our application Serial No. 536,293, filed September 23, 1955, now abandoned.

We claim:

1. A grease composition adapted to lubricate at temperatures above about 200° F., comprising a lubricating oil, an amount sufficient to form a grease of a member of the group consisting of sodium, lithium, barium and strontium soaps and between about 5 and 30 percent of an additive selected from the group consisting of:

(A) a mixture of (1) between about 50 and 90 percent of a member of the group consisting of calcium and barium neutral and basic salts of a compound having the formula:

```
R₂S₂O₇
```

(wherin R represents any alkyl group containing between about 4 and 20 carbon atoms and n is an integer of 1 to 4) and (2) between about 10 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms;

(B) a mixture of (1) between about 50 and 90 percent of the product obtained by reacting P₂S₅ with a member of the group consisting of the calcium and barium neutral and basic salts of a compound having the formula:

```
R₂S₂O₇
```

(wherin R is any alkyl group containing between about 4 and 20 carbon atoms and n is an integer of 1 to 4) and (2) between about 10 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms;

(C) the product obtained by reacting P₂S₅ with a terpene hydrocarbon; and

(D) a mixture of (1) between about 50 and 80 percent of the product obtained by reacting P₂S₅ with a terpene hydrocarbon; and (2) between about 20 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms.

2. A grease composition adapted to lubricate at temperatures above about 200° F., comprising a mineral lubricating oil, an amount sufficient to form a grease of a member of the group consisting of sodium, lithium, barium and strontium soaps and between about 5 and 30 percent of an additive selected from the group consisting of:

(A) a mixture of (1) between about 50 and 90 per-
9

cent of a member of the group consisting of calcium and barium neutral and basic salts of a compound having the formula:

\[
\begin{align*}
\text{OH} & \quad \text{O} \\
\text{R}_1 & \quad \text{S} \quad \text{R}_2 \\
\end{align*}
\]

(wherein \( R \) represents any alkyl group containing between about 4 and 20 carbon atoms and \( n \) is an integer of 1 to 4) and (2) between about 10 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms;

(B) a mixture of (1) between about 50 and 90 percent of the product obtained by reacting \( \text{PS}_n \) with a member of the group consisting of the calcium and barium neutral and basic salts of a compound having the formula:

\[
\begin{align*}
\text{OH} & \quad \text{OH} \\
\text{R}_1 & \quad \text{S} \quad \text{R}_2 \\
\end{align*}
\]

(wherein \( R \) is any alkyl group containing between about 4 and 20 carbon atoms and \( n \) is an integer of 1 to 4) and (2) between about 10 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms;

(C) the product obtained by reacting \( \text{PS}_n \) with a terpene hydrocarbon; and

(D) a mixture of (1) between about 50 and 80 percent of the product obtained by reacting \( \text{PS}_n \) with a terpene hydrocarbon and (2) between about 20 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms.

3. A grease composition adapted to lubricate at temperatures above about 200°F, comprising a mineral lubricating oil, an amount sufficient to form a grease of a member of the group consisting of calcium and barium neutral and basic salts of a compound containing the formula:

\[
\begin{align*}
\text{OH} & \quad \text{OH} \\
\text{R}_1 & \quad \text{S} \quad \text{R}_2 \\
\end{align*}
\]

(wherein \( R \) represents any alkyl group containing between about 4 and 20 carbon atoms and \( n \) is an integer of 1 to 4) and (2) between about 10 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of about 8 and 100 carbon atoms.

4. A grease composition adapted to lubricate at temperatures above about 200°F, comprising a mineral lubricating oil, an amount sufficient to form a grease of a member of the group consisting of sodium, lithium, barium and strontium soaps and between about 5 and 30 percent of a mixture of (1) between about 50 and 90 percent of the product obtained by reacting \( \text{PS}_n \) with a member of the group consisting of calcium and barium neutral and basic salts of a compound having the formula:

\[
\begin{align*}
\text{OH} & \quad \text{OH} \\
\text{R}_1 & \quad \text{S} \quad \text{R}_2 \\
\end{align*}
\]

(wherein \( R \) is any alkyl group containing between about 4 and 20 carbon atoms and \( n \) is an integer of 1 to 4)
and (2) between about 10 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms.

9. A grease composition adapted to lubricate at temperatures above about 200° F. comprising a mineral lubricating oil, an amount sufficient to form a grease of a member of the group consisting of sodium, lithium, barium and strontium soaps and between about 7.5 and 20 percent of the product obtained by reacting P₂S₅ with a terpene hydrocarbon.

10. A grease composition adapted to lubricate at temperatures above about 200° F. comprising a mineral lubricating oil, an amount sufficient to form a grease of a member of the group consisting of the lithium, barium and strontium soaps and between about 7.5 and 20 percent of a mixture of (1) between about 50 and 80 percent of a product obtained by reacting P₂S₅ with a terpene hydrocarbon and (2) between about 20 and 50 percent of a salt selected from the group consisting of barium and calcium sulfonates of an alkylated aromatic hydrocarbon in which the alkyl groups contain a total of between about 8 and 100 carbon atoms.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor(s)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,394,790</td>
<td>Lief</td>
<td>Feb. 12, 1946</td>
</tr>
<tr>
<td>2,416,281</td>
<td>Berger et al.</td>
<td>Feb. 25, 1947</td>
</tr>
<tr>
<td>2,451,345</td>
<td>McNab et al.</td>
<td>Oct. 12, 1948</td>
</tr>
<tr>
<td>2,813,077</td>
<td>Rogers et al.</td>
<td>Nov. 12, 1957</td>
</tr>
</tbody>
</table>