

[54] **ALKALI METAL SUCCINAMATE
COMPOSITIONS FOR LUBRICATING
OILS**

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[51] **Int. Cl.**.....C10m 1/54

[58] **Field of Search**.....252/49.6, 33.6, 51.5 A

3,245,908 4/1966 Lowe.....252/51.5 A

3,313,727 4/1967 Peeler.....252/33.4

3,344,069 9/1967 Stuebe.....252/49.6

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[57] **ABSTRACT**

Compositions are provided useful in lubricating oil for detergency, dispersancy, antiwear and acid neutralization, which are the reaction product of an alkali metal metaborate and a succinimide in the presence of water, the presence of excess alkali metal metaborate being contemplated.

[56] **References Cited**

UNITED STATES PATENTS

3,163,603 12/1964 Le Suer252/33.6

11 Claims, No Drawings

ALKALI METAL SUCCINAMATE COMPOSITIONS FOR LUBRICATING OILS

BACKGROUND OF THE INVENTION

1. Field of the Invention

In the area of lubrication, there has been a continuous effort to provide protection from wear and to reduce deposits that form on moving or stationary parts in internal combustion engines. Among additives which have found wide use as detergents in lubricating oils under a wide variety of conditions, e.g., automobile gasoline engines and diesel engines, are succinimides of alkylene polyamines. These succinimides have been reported in numerous patents and have proven to be extremely efficient in maintaining deposits dispersed in oil.

The succinimides, however, provide little if any wear protection. Wear can occur in a variety of areas, by a variety of mechanisms, e.g., corrosion, adhesion, and abrasion. There are numerous chemicals which operate in a variety of ways to reduce wear. Compounds containing halogen, phosphorus, or sulfur are believed to react with the surface to provide a surface which wears more slowly than would occur in the absence of these compounds. Carboxylic acids have been employed which may be adsorbed onto the surface to provide a protective layer. Zinc compounds are also used, which under certain conditions form a non-sacrificial layer to protect the original surface.

Also, since acids are frequently formed in internal combustion engines: hydrohalide acids in automobile engines and sulfuric acids in diesel engines, sources of base are added to neutralize such acids and prevent them from corroding the metal. Various sources include overbased sulfonates, phenates, and phosphonates.

2. Description of the Prior Art

U.S. Pat. Nos. 3,087,936, 3,344,069, and 3,449,362 teach succinimides of alkylene polyamines or polyureas in combination with boric acid, boric acid esters and borohalide complexes. The combinations of the succinimides and boric acid derivatives are taught as having detergency, rust inhibition, corrosion inhibition, extreme pressure activity, antiwear activity, as well as useful for pesticides and plasticizers. U.S. Pat. No. 3,087,936 (column 21, lines 26-30). See also U.S. Pat. No. 3,322,670.

U.S. Pat. No. 3,281,428 teaches the use of succinimides of amines other than alkylene polyamines in combination with a variety of boric acid derivatives, including in addition to those mentioned above, the ammonium salts of such boron acids. See also U.S. Pat. No. 3,282,955.

In U.S. Pat. No. 3,306,908, succinimides are combined with complex forming metal compounds. Illustrative metals include cobalt, chromium, manganese, nickel, zinc, and cadmium. In U.S. Pat. No. 3,313,727, alkali metal borates are prepared by dehydration in the presence of a small amount of a dispersant such as a succinimide or sulfonate. These borates are prepared in amorphous form in an oil medium and provide extreme pressure activity.

SUMMARY OF THE INVENTION

Novel compositions are prepared by reacting at elevated temperatures at least 0.8 mols of an alkali metal metaborate per mol of a succinimide of an alkylene polyamine to form an alkali metal succinamate composition which forms a stable dispersion in a hydrocarbon oil medium. The reaction is carried out in the presence of a hydroxylic compound, e.g., water, usually at least about 4 mols, of the hydroxylic compound per mol of the alkali metal metaborate being present. The compositions find use in lubricating oils for internal combustion engines, providing detergency and dispersancy as well as protection from wear, not only by acid neutralization, but also by protecting from corrosion, abrasive and adhesive wear.

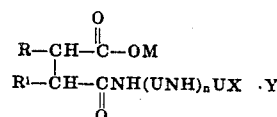
DETAILED DESCRIPTION OF THE INVENTION

The novel compositions of this invention are alkali metal succinamates prepared by the reaction of an alkali metal

metaborate and a succinimide of an alkylene polyamine in the presence of a hydroxylic solvent. Preferred in combination with this composition is an excess of alkali metal metaborate of from about 1 to 20 mols, more usually from about 2 to 12 mols.

In the reaction to form the succinamate salt, the fate of the metaborate residue is not certain. It may become chemically combined with the succinamate salt or become a boron oxide derivative which remains dispersed in the medium.

The compositions of this invention may, therefore, be considered to have the following formula:



wherein

M is an alkali metal of atomic number 11 to 19 (sodium or potassium), preferably sodium;

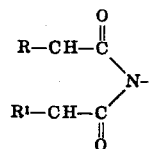
one of R and R¹ is hydrogen and the other is a hydrocarbon group of at least about 50 carbon atoms and usually not more than about 300 carbon atoms, more usually from about 60 to 200 carbon atoms;

U is alkylene of from two to six carbon atoms, more usually of from two to three carbon atoms, the nitrogen atoms being separated by at least two carbon atoms;

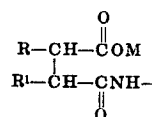
n is an integer of from 0 to 6, more usually of from 1 to 5;

Y is the boron oxide residue from the reaction of the metal metaborate with the succinimide; and

X is amino; succinimide of the formula:

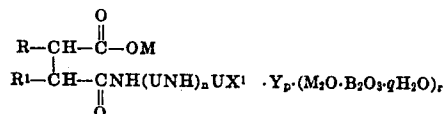


wherein R and R¹ have been previously defined; or succinamate of the formula:

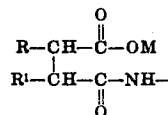


wherein R, R¹ and M have been defined previously.

When greater than 1 mol of the alkali metal metaborate is employed per mol of a monosuccinimide or greater than two mols of an alkali metal metaborate is employed per mol of a bis-succinimide, the resulting composition will have the following formula:



wherein R, R¹, M, U, n, and Y are as defined previously; and X¹ is amino, or succinamate of the formula:



wherein R, R¹ and M are as defined previously;
p is 1 when X¹ is amino and 2 when X¹ is succinamate;
q is an integer or fractional number averaging over the entire compositions in the range of from 0 to 4, usually 1 to 3; and

r is in the range of from 1 to 20, preferably 2 to 12.

The group designated as Y, from the nature and stoichiometry of the reaction, is most likely a borate, the boron oxide residue forming boric acid which forms an ammonium salt with the succinamate. In the presence of excess alkali metal metaborate, the boron oxide residue will probably be involved in a complex manner, with the excess alkali metal metaborate dispersed in the oil.

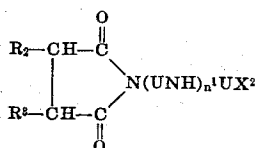
The hydrocarbon group—R or R¹—will be an oil solubilizing group usually aliphatic, having one branch for six carbon atoms along the chain, and more usually about one branch for from one to four carbon atoms along the chain. The branches will normally be of from one to two carbon atoms, more usually of one carbon atom, i.e., methyl. There may be from zero to two sites of olefinic unsaturation as the only unsaturation.

Illustrative hydrocarbon groups are polypropenyl, polyisobutenyl, poly-1-butene, poly-4-methylpentene-1, copolymer of ethylene and isobutylene, etc. These compositions are normally prepared by polymerizing or copolymerizing olefins of from two to six carbon atoms, ethylene being copolymerized with an olefin of from three to six carbon atoms. The copolymers are normally random. The preferred polymers are polypropylene and polyisobutylene.

The alkali metal metaborates which are present in conjunction with the succinamates will generally be either sodium or potassium metaborate, normally having from zero to four waters of hydration, more usually of from one to three water of hydration.

The alkylene group designated by U, which is of from two to six carbon atoms, may be straight chain or branched, but will usually be straight chain. Illustrative alkylene groups are ethylene, propylene, 1,2-propylene, tetramethylene, hexamethylene, etc. The preferred alkylene groups are of from two to three carbon atoms, there being two carbon atoms between the nitrogen atoms.

The succinimides which are used in the preparation of the compositions of this invention have the following formula:



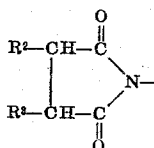
wherein

one of R² and R³ is hydrogen and the other is a hydrocarbon group of from 50 to 300 carbon atoms, more usually of from 60 to 200 carbon atoms;

U is alkylene of from two to six carbon atoms, more usually of from two to three carbon atoms, there being at least two carbon atoms between the nitrogen atoms;

n¹ is an integer of from 0 to 6, more usually an integer of from 1 to 5; and

X² is amino or of the formula:



wherein R² and R³ are as defined previously. The illustrative descriptions of R and R¹ will also suffice for R² and R³.

The alkali metal metaborates which are employed in this invention will have the following formula:



wherein

M is sodium or potassium; and

q¹ is a number of from 0 to 8, more usually of from 4 to 8.

In preparing the compositions of this invention, the succinimide will conventionally be used in a suitable medium, e.g., a hydrocarbon medium. Suitable hydrocarbon media, in view of the use intended for these compositions, will normally be an oil of lubricating viscosity. These oils may be paraffinic, naphthenic or aromatic, or combinations thereof, but are preferably predominantly paraffinic.

The succinimide will generally be employed in solution in from about 10 to 60 weight percent, more usually in from about 15 to 50 weight percent. Conveniently, the solution is heated to a temperature of at least 150° F., preferably to a temperature of from about 175° F. to about 300° F., more usually to a temperature of from about 175° F. to 250° F. before the introduction of the alkali metal metaborate.

To the succinimide solution is then added the alkali metal metaborate, normally dissolved in a hydroxylic solvent. The preferred hydroxylic solvent is water, although an alcohol of from one to three carbon atoms may be employed, normally as mixtures with water. Usually, the alkali metal metaborate solution will be heated to the highest temperature permissible, depending on the solvent. Temperatures will, therefore, vary from a low of about 100° F. to a high of about 200° F. The concentration of the alkali metal metaborate in the hydroxylic solvent will normally be from about 15 to 80 weight percent, more usually from about 25 to 75 weight percent. There will be at least 4 mols of water per ml of metaborate. While the maximum amount of water or alcohol is one of convenience, usually there will not be more than about 20 mols, more usually not more than about 10 mols of water and/or alcohol per mol of metaborate.

While at least about 0.8 mols of alkali metal metaborate will be used per mol of succinimide, the total number of mols of metaborate will not exceed 22 mols per mol of succinimide. Alkali metal metaborate may be added after the completion of the reaction to further augment the metaborate initially added. Therefore, during the reaction the amount of metaborate added will usually not exceed about 15 mols per mol of succinimide.

Vigorous agitation should be employed during the addition and subsequent to the addition of the alkali metal metaborate. Any high speed and, preferably, high shearing device may be used to provide the necessary agitation. After adding the alkali metal metaborate, the temperature is normally raised, usually not to exceed 400° F., more usually not to exceed 300° F., and preferably in the range of 250° to 300° F. The reaction is carried out for a time sufficient to drive off a substantial amount of the water. Normally, from about 20 to 100 percent, usually not more than 90 percent of the water initially introduced (both as solvent and water of hydration) will be driven off. The amount of water remaining will be sufficient to provide the zero to four waters of hydration for the inorganic boron present in the solution.

When the desired amount of water has distilled over, the heating is stopped and the reaction mixture is allowed to cool. Since the reaction mixture is normally formed as a concentrate, it can then be suitably diluted to be used in lubricating oil compositions.

With excess alkali metal metaborate, high alkalinity values can be achieved. The preferred compositions of this invention will normally have alkalinity values of from about at least 50 to 300 mg. KOH/gram, more usually alkalinity values of from about 100 to 250, and preferably 150 to 250.

The following examples are offered by way of illustration and not by way of limitation.

Example I

Into a Waring blender equipped with a heating jacket, a thermometer and stirring motor was charged 400 grams of a 40 weight percent solution in neutral oil of a polyisobutenyl succinimide of tetraethylene pentamine (polyisobutenyl group of about 1,000 viscosity average molecular weight) (percent N, 2.1, alkalinity value, 22 mg. KOH/gram) and 3 drops of a foam inhibitor (DC-200 supplied by Dow Corning Company). The oil solution was heated to about 200° F. with stirring. To the solution was then added 213 grams of sodium metaborate tetrahydrate in 107 ml. of distilled water. With continual stirring, the temperature was raised from 210° F. to about 300° F. over a period of 2 hours and then maintained at that temperature for an additional half hour.

At the end of this time, the product was isolated and analyzed. Percent N, 1.54, 1.51; alkalinity value, 201, 204 mg. KOH/gram.

Example II

Into a Waring blender was charged 400 grams of bis-polyisobutenyl succinimide of triethylene tetramine (polyisobutenyl of about 1,000 viscosity average molecular weight) as a 40 weight percent solution in a neutral oil (percent N, 1.12) and 4 drops of DC-200. The mixture was stirred and heated to 200° F. and a solution of 113.5 grams of sodium metaborate tetrahydrate in 55 ml. of distilled water at 200° F. quickly added. The temperature of the solution was slowly raised to 300° F. over a period of about 1 hour and 7 minutes and maintained at that temperature for an additional 18 minutes. The reaction mixture was then allowed to cool. Analysis: percent N, 0.95.

Example III

Following the procedure of Example II, to 400 grams of a 40 weight percent solution of bis-polyisobutenyl succinimide of tetraethylene pentamine in a neutral oil (one polyisobutenyl group is of about 1,000 viscosity average molecular weight and the other polyisobutenyl group is about 650 viscosity average molecular weight) (percent N, 1.27; alkalinity value, 22 mg. KOH/gram) was added 113.5 grams of sodium metaborate tetrahydrate in 57 ml. of distilled water. At the end of the reaction, after cooling, the product was analyzed. Percent N, 1.09; alkalinity value, 120 mg KOH/gram.

Succinamate salts may be used with a wide variety of hydrocarbon lubricating oils, usually derived from petroleum or prepared synthetically. The mineral lubricating oils may be paraffinic, naphthenic, asphaltic, or compositions thereof, while the synthetic oils will normally be polymers of low molecular weight olefins. Lubricating oils generally have viscosities of from about 35 to 50,000 Saybolt Universal Seconds (SUS) at 100° F.

The above oils may be used individually or together, whenever miscible or made so by the use of mutual solvents.

The compositions of this invention will be employed in lubricating oils in from 0.5 to 60 weight percent. When in use in an internal combustion engine, the concentration will vary from 0.5 to 20 weight percent. Concentrates will vary from 10 to 60 weight percent, more usually 20 to 50 weight percent.

Other additives are normally included in the oil along with the detergent antiwear additive of this invention. These additives include pour point depressants, oiliness agents, antioxidants, rust inhibitors, additional antiwear additives, such as bearing corrosion inhibitors, extreme pressure agents, as well as detergents and additional sources of alkalinity value. The individual additives will normally vary in amount from about 0.01 to 5 weight percent of the total composition used in the engine. In concentrates, the weight percent of these additives will usually range individually from about 0.3 to 10 weight percent.

Two additives of particular value are dithiophosphate and terephthalic acid. Included in the lubricating oils are from about 1 to 50 mM/kg, preferably 5 to 30 mM/kg, of an O,O-dihydrocarbyl phosphorodithioate, particularly the zinc salt, wherein the hydrocarbyl groups are of from about four to 36 carbon atoms. Usually, the hydrocarbyl groups will be alkyl or alkaryl. Other phosphorodithioates, such as trialkyl or polyethyleneoxy dihydrocarbyl phosphorodithioate may also be used with advantage.

Terephthalic acid, which may be used, gives greatly enhanced antiwear protection, and will normally be present in from 0.01 to 0.5, more usually from about 0.05 to 0.2 weight percent of the total composition.

In order to demonstrate the effectiveness of the subject compositions, a number of tests were carried out. The tests employ oil formulations which simulate or are substantially the same as those used commercially except for the presence of the exemplary additives and such changes necessitated by its presence.

Two tests were carried out to demonstrate the detergency of the subject compositions, one in an automobile internal combustion engine and the other in a diesel engine.

The first test was a Sequence VB engine test which is described in Schilling, *Motor Oils and Engine Lubrication*, Scientific Publications (GB) (1968), 3.35. In this formulation, a 100 neutral oil was compounded with 12 mM/kg of zinc dialkyl dithiophosphate (alkyl of from four to five carbon atoms), 16 mM/kg based on calcium of an overbased calcium sulfonate, 1.6 weight percent of sodium polyisobutenyl succinate of tetraethylene pentamine (polyisobutenyl of about 1,000 viscosity average molecular weight), and 0.25 weight percent of sodium metaborate (approximately a 4:1 mol ratio of metaborate to succinamate).

The results are reported for piston varnish 0 to 10, 10 being clean. For total varnish and sludge, 0 to 50, 50 being clean. The above indicated oil had the following ratings: Piston varnish — 8.9; total varnish — 41.9; sludge — 44.1. These results demonstrate that the succinamate is an effective detergent in an automobile internal combustion engine.

In the Caterpillar 1-H test, the test was carried out for 120 hours. In a mid-continent 200 neutral oil was formulated 1.8 weight percent of an ethylene/propylene copolymer viscosity index improver (V₂₁₀92 SUS), 6.67 mM/kg of a neutral calcium sulfonate, 16.7 mM/kg of a sulfurized calcium polypropylene phenate having about a 1.1:1 calcium ratio to stoichiometric, 4.7 mM/kg of zinc O,O-dialkylphenyl dithiophosphate (alkyl of from 12 to 15 carbon atoms), 7.3 mM/kg of zinc O,O-dialkyl dithiophosphate (alkyl of from four to five carbon atoms), 2 weight percent of the sodium succinamate described in Example I with 0.5 weight percent of sodium metaborate, a mol ratio of about 8.1. The engine test was carried out for 120 hours and the results are reported as follows: Grooves, 0 to 100, 100 indicating no filling of the grooves; lands, 0 to 800, 0 being clean; and underhead 0 to 10, 10 being clean. For the above formulation, the results were as follows: Grooves, 16, 2.2, 0.7, 0.7; lands, 185, 35, 30; underhead, 9.1.

For comparison purposes, a like formulation which did not employ the succinamate, but rather the same amount of succinimide used to form the succinamate and had no sodium metaborate present, the results were as follows: Grooves, 64, 0.8, 0.6, 0.6; lands, 155, 30, 35; underhead, 7.1. The results clearly show that the succinamate in combination with sodium metaborate is an effective detergent under the extremely hot conditions of the diesel engine.

To demonstrate the effect on wear, a number of tests were also carried out. The first test was the L-38 Engine Test, which is described in Schilling, *supra*, 4.31. The oil employed as a base oil was a 480 neutral oil. It was formulated with 9 mM/kg of zinc O,O-dialkyl dithiophosphate (alkyl of from four to five carbon atoms), 2.2 weight percent of sodium succinamate described in Example I, and 0.25 weight percent of sodium metaborate. The test duration is 40 hours, and the bearing weight loss at the end of this time was 82.3 mg. By comparison, using the succinimide in the same amount as the succinamate and in the absence of any sodium metaborate, the bearing weight loss was 148.8 mg. When 0.1 weight percent of terephthalic acid was added to the sodium metaborate containing oil, the result was 22.5 mg. weight loss.

A further test, which is extremely severe as an antiwear test, is the Ford Valve Train Wear Test. The engine employed is a 1967-1968 Ford, 240 CID six-cylinder engine equipped with a single barrel carburetor with a blocked throttle to prevent en-

gine speed from exceeding 1,050 RPM, a closed crankcase filtration system and an oil filter. Additionally, a heating system is employed in the oil pan to provide a temperature of the heating element of approximately 267° F. To provide enhanced severity in the valve train the valve springs are over-loaded 21 percent. A normal leaded fuel is employed.

The engine is thoroughly flushed to remove any traces of prior additives and then filled with 5 quarts of test oil. The spark advance is set at 6° BTDC at 1,000 RPM and the engine is run with no load for a total running time of 60 hours. Speed is maintained at 1,000 RPM, oil temperature at 220° F. and exit water temperature at 200° F. Two 4 oz. samples are taken during the test, one at 30 hours and one at 60 hours. At the end of the run, the valve tips are examined by profilometer and the profilometer traces are measured by planimeter to determine the cross sectional area.

In this test, the base oil was a 100/200 mid-continent base stock, containing 7.4 weight percent of an acrylate detergent viscosity improver, 40 mM/kg of an overbased calcium sulfonate (9.9:1 calcium ratio), 9 mM/kg of zinc O,O-dialkyl dithiophosphate (alkyl of from four to five carbon atoms) and 1.3 weight percent of the sodium succinamate described in Example I. Varying amounts of sodium succinamate were employed. The results are reported in percent reduction in tip wear relative to the reference oil which uses the succinimide in place of the succinamate and sodium metaborate. At 0.25 weight percent of sodium metaborate, there was a 58 weight percent reduction in tip wear, while at 0.50 weight percent sodium metaborate, there was a 51 weight percent reduction.

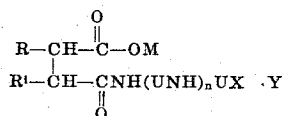
When the zinc dithiophosphate was replaced with a different zinc dialkyl dithiophosphate, differing only in the structure of the alkyl groups, and at the same concentration, with 0.50 weight percent of sodium metaborate, 71 percent reduction in tip wear was achieved.

In addition, the compositions of this invention are found to be effective additives against rust and other types of wear.

It is evident from the above results that the succinamates of this invention, particularly in combinations with excess alkali metal metaborates, are extremely effective additives in not only providing detergency which has been previously known for succinimides, but providing antiwear and an alkalinity source. The additives are compatible with a wide variety of other additives normally included in lubricating oils and provide bright, compounded oil compositions. The presence of the succinamate as a detergent, provides desirable relatively low ash formulated compositions.

I claim:

1. A lubricating oil composition comprising lubricating amounts of an oil of lubricating viscosity and from 0.5 to 60 weight percent of a succinamate composition of the formula:



wherein

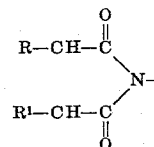
M is an alkali metal of atomic number 11 to 19, one of R and R¹ are hydrogen and the other is an oil solubilizing hydrocarbon group of from about 50 to 300 carbon atoms;

U is alkylene of from two to six carbon atoms;

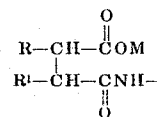
n is an integer of from 0 to 6;

Y is the boron oxide residue from the reaction at elevated temperatures of an alkali metal metaborate in the presence of at least about 4 moles of water per mole of metaborate with the succinimide from which the succinamate composition of said formula is derived;

X is amino, succinimide of the formula



wherein R and R¹ are as have been defined above; or are succinamate of the formula:



wherein R, R¹ and M have been defined above.

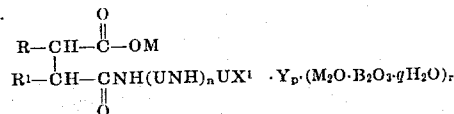
2. A lubricating oil composition comprising lubricating amounts of an oil of lubricating viscosity and from 0.5 to 60 weight percent of a succinamate composition according to claim 1, wherein

one of R and R¹ is of 60 to 200 carbon atoms;

3. A lubricating oil composition having from 0.5 to 20 weight percent of a composition according to claim 1 and from 0.01 to 0.5 weight percent of terephthalic acid.

4. A lubricating oil composition having from 0.5 to 20 weight percent of a composition according to claim 1.

5. A lubricating oil composition comprising lubricating amounts of an oil of lubricating viscosity and from 0.5 to 60 weight percent of a composition of the formula:



wherein

M is an alkali metal of atomic number 11 to 19;

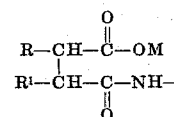
one of R and R¹ is an oil solubilizing hydrocarbon group of from about 50 to 300 carbon atoms;

U is alkylene of from two to six carbon atoms;

n is an integer of from 0 to 6;

Y is the boron oxide residue from the reaction of an alkali metal metaborate at elevated temperatures in the presence of at least 4 moles of water per mole of metaborate with the succinimide from which the succinamate composition of said formula is derived;

X¹ is amino or a succinamate of the formula



wherein R, R¹ and M are as defined above;

p is one when X¹ is amino and 2 when X¹ is succinamate;

q is in the range of 0 to 4; and

r is in the range of 1 to 15.

6. A lubricating oil composition according to claim 5, wherein said oil solubilizing hydrocarbon group is of from 60 to 200 carbon atoms;

U is alkylene of from two to three carbon atoms;

n is an integer of from 1 to 5;

q is in the range of 1 to 3; and

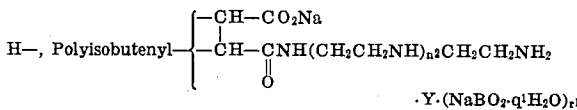
r is in the range of 2 to 12.

7. A lubricating oil composition according to claim 6, wherein M is sodium, and said oil solubilizing hydrocarbon group is polyisobutylene.

8. A lubricating oil composition according to claim 6, wherein X¹ is a succinamate.

9. A lubricating oil composition having from 0.5 to 20 weight percent of a composition according to claim 5.

10. A lubricating oil composition comprising lubricating amounts of an oil of lubricating viscosity and from 0.5 to 60 weight percent of a polyisobutenyl succinamate of the formula:



wherein the polyisobutenyl group is of from about 60 to 200 carbon atoms;

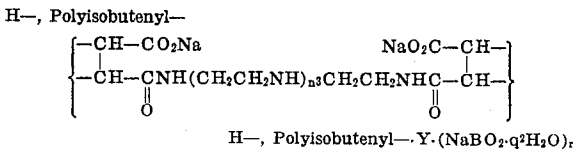
n² is an integer of from 0 to 3;

Y is the boron oxide residue from the reaction of an alkali metal metaborate with a polyisobutenyl succinimide of an ethylene polyamine having from two to five amino groups, wherein the polyisobutenyl group is of from about 60 to 200 carbon atoms, at an elevated temperature in the presence of at least 4 moles of water per mole of metaborate;

q¹ is in the range of 1 to 3; and

r¹ is in the range of 1 to 20.

11. A lubricating oil composition comprising lubricating amounts of an oil of lubricating viscosity and from 0.5 to 60 weight percent of a composition of the formula:



wherein the polyisobutenyl group is of from about 60 to 200 carbon atoms;

n³ is of from 1 to 3

Y is a boron oxide residue from the reaction of an alkali metal metaborate with a bis(polyisobutenyl succinimide), of an ethylene polyamine having from three to five amino groups, wherein the polyisobutenyl group is of from about 60 to 200 carbon atoms, at an elevated temperature in the presence of at least 4 moles of water per mole of metaborate amine;

q² is of from 1 to 3; and

r² is of from 1 to 20.

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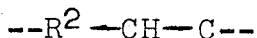
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,666,662 Dated May 30, 1972

Inventor(s) WARREN LOWE

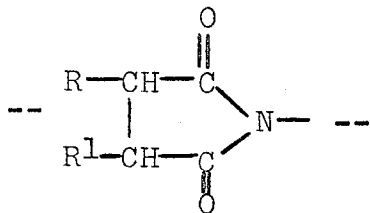
It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 3, line 45, the first line of formula should read



Col. 4, line 33, "per ml" should read --per mol--

Column 8, line 1, the formula should read



Column 8, line 23, after the line "one of R and R¹ is of 60 to 200 carbon atoms;" should be inserted the following three lines

--U is alkylene of from 2 to 3 carbon atoms;
n is an integer of from 1 to 5; and
X is amino.--

Signed and sealed this 26th day of September 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents