

[54] LUBRICATING OIL ADDITIVES
[75] Inventor: **Stuart H. Brown**, San Rafael, Calif.
[73] Assignee: **Chevron Research Company**, San Francisco, Calif.
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3,509,052 4/1970 Murphy 252/51.5 A X
3,525,693 8/1970 Lyle et al. 252/51.5 A X
3,573,205 3/1971 Lowe et al. 252/51.5 A

Primary Examiner—Patrick P. Garvin
Assistant Examiner—Andrew H. Metz
Attorney, Agent, or Firm—G. F. Magdeburger; C. J. Tonkin; S. R. La Paglia

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[51] Int. Cl. C10m 1/32
[58] Field of Search 252/51.5 A, 390

[56] **References Cited**
UNITED STATES PATENTS
3,045,042 7/1962 Staker 252/390 X
3,367,943 2/1968 Miller et al. 252/51.5 A X
3,496,249 2/1970 Hitzler et al. 252/51.5 A X

[57] **ABSTRACT**
The reaction product of a C₃₀–C₂₀₀ hydrocarbylsubstituted amine, amide or cyclic imide lubricating oil ashless dispersant, with an organic polyisocyanate and a polyoxyalkylene polyol preferably in excess of 1,000 molecular weight, functions as a superior lubricating oil additive in the inhibition of engine rust.

12 Claims, No Drawings

LUBRICATING OIL ADDITIVES

BACKGROUND OF THE INVENTION

1. Field of the Invention

Lubricating oils are employed for the lubrication of moving engine parts and as a vehicle for additives which promote the protection of the metallic surfaces being lubricated. The surfaces must be protected by the lubricating composition from rust and corrosion. The oil composition must not be prone to haze or sludge formation, or oxidative breakdown and accumulation of corrosive oxidation products.

It has been found that conventional ashless dispersants, even in over based compositions, are unable to meet the high anti-rust and anti-corrosion standards of modern internal combustion engine manufacturers. However, these requirements are met by lubricating oil compositions containing in addition to the usual additives a small percentage of the reaction product of certain ashless dispersants with a polyisocyanate and a polyoxyalkylene polyol.

2. Description of the Prior Art

Certain hydrocarbyl-substituted succinimides, e.g. Stuart et al. U.S. Pat. No. 3,361,673, and hydrocarbyl-substituted amines, e.g. Honnen and Anderson U.S. Pat. No. 3,565,804, are known ashless dispersant additives for internal combustion engine lubricating oils. Lowe, U.S. Pat. No. 3,573,205 suggested the reaction product of alkenyl succinimide and diisocyanate as a lubricating additive. The polyoxyalkylene glycols have been suggested as lubricating oil additives, i.e., demulsifiers to reduce sludge formation in lubricating oil compositions containing dispersants derived from substituted succinic acid, Murphy U.S. Pat. No. 3,509,052, and polypropylene glycol has been taught to be a rust inhibiting additive, U.S. Pat. No. 2,739,126.

SUMMARY OF THE INVENTION

Lubricating oil additives and compositions of superior rust and corrosion inhibition are provided which are the reaction product of certain ashless dispersants consisting of a C_{30} - C_{200} hydrocarbyl-substituted amine, amide or cyclic imide with an organic polyisocyanate and a polyoxyalkylene polyol preferably in excess of about 1,000 molecular weight. Specifically, the ashless dispersants which find use as components of the reaction mixture leading to products of the present invention contain at least one primary or secondary amino nitrogen atom, and for brevity, will be termed "nitrogenous dispersants."

The hydrocarbyl-substituted amines, amides and imides include polyolefin-substituted succinimides of diamines, polyamines and polyalkylene polyamines; polyolefin-substituted amines, polyamines and polyalkylene polyamines; including in each case alkylated, hydroxyalkylated and other substituted amines, polyamines and polyalkylene polyamines.

The polyisocyanates are organic isocyanates of at least three carbon atoms, but preferably of eight or more carbons and preferably are diisocyanates.

The polyoxyalkylene polyols are polyoxyalkylenated diols, triols, etc. where, for example, the polyoxyalkylenation is carried out by base catalyzed condensation of ethylene oxide, or propylene oxide or both, with a polyol. Such polyols include ethylene glycol, propylene glycol, pentaerythritol, dipentaerythritol, sorbitol, etc. The resulting polyoxyalkylene polyol is a polymeric

substance which is preferably of at least about 1000 molecular weight for the purposes of the present invention. A preferred polyoxyalkylene glycol is a block copolymer of propylene oxide units and ethylene oxide units.

DETAILED DESCRIPTION OF THE INVENTION

The reaction product of certain ashless dispersants consisting of hydrocarbyl-substituted amines, amides and cyclic imides, wherein the hydrocarbyl group contains at least 30 carbon atoms and preferably less than 200 carbon atoms, with an organic polyisocyanate, preferably C_3 - C_{20} , and a polyoxyalkylene polyol, is a superior lubricating oil additive in the inhibition of rust and corrosion of the metallic surfaces of internal combustion engines when used in concentrations of 0.03-3 weight percent of a lubricating oil composition.

The polyisocyanates function as coupling agents to bond the polyol to primary or secondary nitrogen atoms of the amine, amide or cyclic imide. The resulting product is a complex polymeric substance of total molecular weight in the range of about 3,000 to about 20,000, including the weight of hydrocarbyl substituents, depending on the mol ratio of the components in the reaction mixture.

The complexity of the product mitigates against its expression in a chemical structural formula, but is defined by the nature and mol ratio of the reactants which form the reaction product.

COMPONENTS

The ashless dispersants which find use within the scope of this invention are nitrogenous dispersants which when coupled with the defined polyoxyalkylene polyols by means of reaction with polyisocyanates function in lubricating oil compositions to give good rust and corrosion inhibition. These nitrogenous dispersants are certain hydrocarbyl-substituted amines, amides and cyclic imides. Specifically, those having at least one primary or secondary amino nitrogen which, for brevity, we have termed "nitrogenous dispersants."

Hydrocarbyl, as used herein, denotes an organic radical composed of carbon and hydrogen except for minor, sometimes adventitious, amounts of other elements, such as oxygen. Hydrocarbyl as used herein denotes an aliphatic, or aromatic radical, or a radical which is a combination thereof, e.g., aralkyl. Preferably, the hydrocarbyl group will be relatively free of aliphatic unsaturation, i.e., ethylenic and acetylenic, particularly acetylenic. The hydrocarbyl substituents will contain at least 30 carbon atoms and preferably less than 200 carbon atoms. When the hydrocarbyl groups are of lower molecular weight, the average number of hydrocarbyl substituents in a given dispersant may be greater than one. The hydrocarbyl groups are preferably aliphatic, having preferably from zero to two sites of ethylenic unsaturation and most preferably from zero to one such site. Hydrocarbyl groups derived from a polyolefin, itself derived from olefins (normally 1-olefins), from two to six carbon atoms (ethylene being co-polymerized with an olefin of at least three carbon atoms), or from a high molecular weight petroleum-derived hydrocarbon, are preferred.

Illustrative sources for the high molecular weight hydrocarbyl substituents are petroleum mineral oils such as naphthenic bright stocks, polypropylene, polyisobutylene, poly-1-butene, copolymers of ethylene and iso-

butylene, polypropylene and isobutylene, poly-1-pentene, poly-4-methyl-1-pentene, poly-1-hexene, poly-3-methylbutene-1, etc.

The nitrogenous dispersants which are hydrocarbyl-substituted amines are derived from monoamines and polyamines. These monoamines and polyamines are such that after hydrocarbyl substitution the dispersant contains at least one primary or secondary amino nitrogen atom. This requirement is believed to be generally necessary in order that the dispersant be capable of being coupled via the polyisocyanate. Examples of such amines are ethyl amine, butyl amine, piperazine, and alkylene polyamines and preferably polyalkylene polyamines such as ethylene diamine, 2-aminoethyl piperazine, diethylene triamine, trimethylene diamine, di(trimethylene) triamine, dipropylene triamine, triethylene tetramine, tripropylene tetramine, tetraethylene pentamine, pentaethylene hexamine, etc. These primary and secondary amines encompass alkyl-substituted amines, e.g., N-methylethylene diamine, N,N'-dimethylethylene diamine, N,N-dimethylpropylene diamine, N-hydroxyethylethylene diamine, etc. Amines having up to about 12 amino nitrogens are especially preferred. The hydrocarbyl-substituted amines are prepared, in general, by reaction of a halogen-substituted hydrocarbon with the amine. Details of such preparations and further descriptions of some of these hydrocarbyl-substituted amines can be found in Honnen and Anderson U.S. Pat. No. 3,565,804.

Nitrogenous dispersants which are hydrocarbyl-substituted amides and cyclic imides are derived from the reaction of hydrocarbyl-substituted carboxylic acids, anhydrides, acid chlorides, etc., with certain of the amines described above. Again, the requirement being that the nitrogenous dispersant contain at least one primary or secondary amino nitrogen atom. Consequently, a preferred dispersant is the reaction product of hydrocarbyl-substituted succinic acid or anhydride with amines containing at least one primary amino nitrogen, and at least one additional primary or secondary amino nitrogen, e.g., the polyalkylene polyamines fulfill this requirement as do the substituted polyalkylene polyamines, and for that matter, ammonia.

The bis-succinimides are useful nitrogenous dispersants for this invention. The bis-succinimides are prepared by the reaction of hydrocarbyl-substituted succinic acid or anhydride with an amine containing at least two primary amino nitrogens. Of course, as in all the nitrogenous dispersants which find use within the scope of this invention, it is required that the imide have at least one remaining primary or secondary nitrogen available for the coupling reaction with isocyanate. Such bis-succinimides are, for example, polyisobutenyl bis-succinimide of diethylene triamine, or triethylene tetramine, or tetraethylene pentamine, or N-methyldipropylene triamine, etc. (e.g., Benoit, U.S. Pat. No. 3,438,899).

Organic polyisocyanates which find use as coupling agents within the scope of this invention react with primary or secondary amino nitrogen to yield hydrocarbyl-ureas or polyureas. They also react with hydroxyl groups to form urethane-like bonds. To function as coupling agents the isocyanates must be polyfunctional (i.e., diisocyanates, triisocyanates, etc.) and preferably telechelic (terminally reactive) molecules of at least three carbon atoms and preferably of from 8 to about 20 carbon atoms. Examples of such organic polyisocya-

nates include phenylene diisocyanate, toluene diisocyanate, methylenediphenyl diisocyanate, polymethylene polyphenyl isocyanate, alkylated methylene diphenyl diisocyanate, hexamethylene diisocyanate and polymeric isocyanates.

The polyols which find use in the present invention have molecular weights preferably in excess of about 1000 and preferably consist of one or more polyoxyalkylene chains capped by alkylhydroxy groups, e.g., polyoxyethylene, polyoxypropylene, polyoxybutylene, polyoxypentylene, etc. Monohydroxy compounds such as ether-capped polyoxyalkylene glycols, find use within the present invention as "chain stoppers," i.e., terminating groups. In general, polyols are preferred, and the most preferred polyols have from 2 to about 10 OH groups. Polyhydric alcohols, such as the 1,2-glycols, 1,3-glycols, α , ω -glycols, pentaerythritol, sorbitol, mannitol, dipentaerythritol, etc., are converted to the preferred polyoxyalkylene polyol form by the addition of propylene oxide or ethylene oxide to their hydroxy groups. Especially preferred are the polyoxyalkylene glycols and block-copolymer glycols. These are prepared by adding propylene oxide to the two hydroxy groups of a propylene glycol or ethylene glycol nucleus. The resulting hydrophobic base can be made to any controlled length varying from about 500 to thousands in molecular weight. By then adding ethylene oxide to both ends of this hydrophobic base it is possible to put polyoxyethylene hydrophilic groups on both ends of the molecule. The hydrophilic group may be added to constitute anywhere from a few per cent to 80 per cent of the final molecule (U.S. Pat. No. 2,674,619). In general, the polyoxyalkylene glycols are mixtures of compounds that differ in polymer chain lengths. However, their properties approximate those of the molecule represented by the average composition. Solubility in lubricating oils indicates that the most effective compounds of this form in the acid neutralization test contain less than 20 percent polyoxyethylene units by weight, the remainder being substantially made up of polyoxypropylene.

Reaction Conditions

In general, when carrying out the reaction which yields the products of the present invention, the reactants may be mixed and reacted in any of several orders. That is, the nitrogenous dispersant may be first reacted with the desired amount of polyisocyanate to form a first product, followed by reaction of said first product with polyol. Alternatively, the polyol could be reacted with the polyisocyanate to form a first product, followed by reaction of said product with the nitrogenous dispersant. Alternatively, all three reactants which form the desired product can be mixed and reacted simultaneously. Alternatively, the polyol and nitrogenous dispersant can be mixed together and then polyisocyanate added to give the desired product.

The reactants may be reacted neat, or preferably in an inert solvent such as benzene or xylene. The reactions are carried out by stirring at room temperature, or at an elevated temperature such as in refluxing solvent. The mol ratio of nitrogenous dispersant to polyol to polyisocyanate is variable. The mol ratio of nitrogenous dispersant to polyol is preferably in the range of about 0.5-5:1. If too much polyisocyanate is charged, the final product is rubber-like. Consequently it is preferred, but not essential, that the number of equivalents of polyisocyanate (based on isocyanate) is equal to

from about one to one half the number of equivalents of active nitrogen in the nitrogenous dispersant, plus from about one to about one half the number of equivalents of hydroxyl in the polyol. By "active nitrogen" is meant primary and secondary amino nitrogen atoms. The preferred mol ratio of polyisocyanate to polyol is in the range 0.75-6:1.

EXAMPLE 1.

The reaction product of a hydrocarbyl-substituted bis-succinimide with a polyoxyalkylene glycol is carried out by charging 111 g. of the polyol (0.045 equivalents of OH) and 240 g. of the bis-succinimide into a flask with 400 ml. of xylene. The hydrocarbyl succinimide is a succinimide of triethylene tetramine wherein the hydrocarbyl substituent is a polyisobutylene of 950 number average molecular weight. The polyoxyalkylene glycol is a block-copolymer of propylene oxide and polypropylene oxide of about 12 mol percent ethylene oxide and of total molecular weight of about 4,500. The mixture is azeotroped for three hours. 7.14 ml. of toluene diisocyanate (about 0.10 equivalents of NCO) are added to the stirred solution at 145°C. The mixture is stirred and refluxed for about 9 hours. The mixture is then stripped to 150°C under vacuum. Infrared analysis shows no free isocyanate in the product.

EXAMPLE 2.

A polyisobutylene polyamine can be reacted with polypropylene glycol of about 2,000 molecular weight by charging 2,000 g. of polyol (about 2 equivalents of OH) and 1,400 g. of polyisobutenyl polyamine into a flask with 4,000 ml. of xylene. The polyisobutylene polyamine is derived from the reaction product of chlorinated polyisobutylene of number average molecular weight about 1,400 and ethylene diamine. The reaction mixture is azeotroped for 3 hours and 230 ml. of toluene diisocyanate (about 3.2 equivalents NCO) is added with stirring. The mixture is refluxed at 145°C for about 16 hours, cooled to room temperature and stripped to 150°C under vacuum.

EXAMPLE 3.

The polyol of Example 1 (111 g., 0.045 equivalents of OH) is charged with 240 g. of bis-succinimide of Example 1 in 400 ml of xylene. The mixture is azeotroped for 3 hours and 9 ml of toluene diisocyanate (about 0.126 equivalents of NCO) are added to the stirred solution at 145°C. The mixture is stirred and refluxed for about 9 hours. The product is stripped to 150°C at 150 mm. Infrared analysis of the product shows a trace of -CO.

Lubricating Oils

The oils which find use in this invention as base oils of the lubricating composition are oils of lubricating viscosity derived from petroleum or synthetic sources. Oils of lubricating viscosity normally have viscosities in the range of 35 to 50,000 Saybolt Universal Second (SUS) at 100° F, and more usually from about 50 to 10,000 SUS at 100° F. Examples of such base oils are naphthenic base, paraffin base, and mixed base mineral oils; synthetic oils, for example, alkylene polymers, such as polymers of propylene, butylene, etc. and mixtures thereof; alkylene oxide type polymers; dicarboxylic acid esters; phosphorus esters; silicone esters such as silicates and polysiloxanes; and alkyl aromatic hydrocarbons.

Usually included in the oils besides the subject additives are such additives as dispersant/detergents, rust inhibitors, anti-oxidants, oiliness agents, foam inhibitors, viscosity index improvers, pour point depressants, etc. Usually these other additives will be present in the range of from about 0.1 to 20 weight percent, more usually of from about 0.5 to 15 weight percent of the total composition. Generally, each of the additives will be present in the range from about 0.01 to 5 weight percent of the total composition. In concentrates, the weight percent of these additives will usually range from about 0.3 to 30 weight percent. A preferred aspect of the use of the compositions of this invention is to include in the oil from about 1 to about 50 mM/kg of a dihydrocarbyl phosphorodithioate, wherein the hydrocarbyl groups are from about 4 to 36 carbon atoms. Usually the hydrocarbyl groups will be alkyl or alkaryl groups. The remaining valence of the phosphorodithioate will usually be satisfied by zinc but polyoxyalkylene or a third hydrocarbyl group may also be used.

In the preferred embodiments of the present invention lubricating oil composition will contain sufficient alkaline earth metal carbonate dispersed in the composition to provide an alkalinity value of from 0.5 to 100 mg KOH/g.

The alkaline earth metal carbonates are magnesium, calcium and barium carbonates, preferably calcium and barium carbonates. Small amounts of the hydroxide of the metals may also be present, usually not contributing more than about 20 percent of the alkalinity value from the alkaline earth metal carbonate composition. The alkaline earth metal carbonates are not soluble in hydrocarbon media, therefore, they are invariably dispersed with some type of metal salt dispersant. These dispersants are well known in the art and will be discussed only summarily.

The preferred alkaline earth metal carbonate dispersants are the sulfonates and phenates. These sulfonates are extensively discussed in U.S. Pat. No. 3,488,284. The organic sulfonates are prepared from either natural or synthetic sources. The natural sulfonates are referred to as mahogany sulfonates and are derived from petroleum mineral fractions and normally have from about 25 to 50 carbon atoms per sulfonic acid. Synthetic sources are also employed which are usually alkylated benzene having from about 25 to 50 carbon atoms. The use of the sulfonates and the method of preparing over based sulfonates is well known as indicated in the above patent.

Another class of dispersant for the alkaline earth metal carbonates are the phenates. The phenates are alkylated phenols either individually or polymerized to a low order of from two to five alkyl phenols, normally bridged with sulfur, alkylene groups or dialkylene amino groups (Mannich bases). The alkyl group on the phenol is normally of at least eight carbon atoms and usually does not exceed 36 carbon atoms, more usually being in the range of about 12 to 30 carbon atoms. The phenoxide in the phenate also contributes to the alkalinity value. The over based phenates are described in numerous patents such as U.S. Pat. Nos. 3,474,033; 3,429,812; 3,388,063; and 3,336,224.

The alkalinity value of the over based dispersant will usually be at least 150 and not exceed 500, more usually being in the range of about 200 to about 450 mg KOH/g. The equivalent ratio of base to dispersant will

be at 1:1 and more usually 1.5:1, normally not exceeding about 20:1.

These compositions may be used in a sufficient amount to provide the desired alkalinity value in the final composition. Therefore, the alkaline earth metal carbonates are prepared as concentrates and then diluted into a lubricating oil medium to provide the desired end composition.

Evaluation and Performance

Table I presents an evaluation of the anti-rust performance of 3 compositions containing additives of the present invention.

TABLE I.

MOL RATIO ¹	Example 1 0.5:1	Example 3 2:1	Example 3 2:1
weight % polyol in additive concentration ² of additive	63	31	31
II-C, AER ³	0.1 9.0	0.2 8.1, 8.0	0.4 8.9

¹Mol ratio of hydrocarbyl substituted bis-succinimide to polyoxyalkylene glycol in reaction with toluene diisocyanate

²Weight percent of the products of the present invention in the final oil composition

³Average Engine Rust in MS Sequence II-C Engine Test

Engine Test is a test of the rust inhibitory of an engine oil lubricating composition and it requires a 8.4 AER (Average Engine Rust) to pass. AER 8.0 is good and AER 9.0 is excellent rust inhibitory action in this test. The reference oil composition used in Table I, without the additives of the present invention, gives an AER 7.4 in the II-C Engine Test.

The first composition of Table I (Example 1) has also been tested for varnish formation in gasoline engines and in 120 hours of use in a diesel engine (180 BMEP test). In the 180 BMEP diesel engine test order out temperature 190°F, air in temperature 255°F, air pressure in inches Hg Abs. 70, the sulfur content of the fuel is 0.4 percent and is input at a rate which provides 7,460 BTU/minute. The engine is then disassembled and the grooves and lands of the piston as well as the underhead region are examined for deposits. The rating for groove deposits is based on a range of 0 to 100, 100 being completely filled grooves. The rating for land deposits is based on a range of 0-800, 800 being completely black. The rating for underhead deposits is based on a range of 0-10, 10 being completely clean. The results for the reference oil composition and the reference oil composition containing the additive of the present invention, are given in Table II.

TABLE II.

	Grooves	Lands	Underhead
Reference Oil	79.3, 4.2, 0.5, 0.6	8, 18, 13	3.6
Additive, Ex. 1 at 0.1 wt. %	76.2, 4.3, 0.7, 0.5	228, 12, 15	5.6

The mol ratio in Table I is that of a hydrocarbylsubstituted bis-succinimide of triethylene tetramine to a polyoxyalkylene glycol in a reaction according to Examples 1 and 3.

Preferably, the weight percent of the reaction products added to the oil composition varies with mol ratio in order to provide an approximately constant 0.06 weight percent of bound polyol in the final blends. The base oil stock consists of a neutral petroleum oil having a paraffinic base and viscosity of about 30 SUS at 100°F, to which is added 8 percent by weight of a dispersant which is a hydrocarbylsubstituted bis-succinimide of triethylene tetramine wherein the hydrocarbon is polyisobutenyl of 950 number average molecular weight, 20-25 mM/kg of calcium sulfonates (2.35 weight percent calcium), 40-45 mM/kg carbonated and sulfurized calcium polypropylene phenate (9.25 percent calcium) and 15 mM/kg of zinc bis(polypropylenophenyl) dithiophosphate to make the reference oil composition to which the products of Example 1 and 3 are added.

The test results show the effectiveness of the additives of the present invention as rust inhibitors even at extremely low concentrations. The MS sequence II-C

Although the primary purpose of the additive of the present invention is to inhibit the formation of rust and corrosion in lubricating oil compositions containing nitrogenous dispersants, the results of Table II show that these additives do not degrade the antivarnish performance of the composition, on the contrary, varnish performance can be improved.

While the character of this invention has been described in detail with several examples, this has been done by way of illustration, and without limitation of the invention. It will be apparent to those skilled in the art that numerous modifications and variations of the illustrative examples can be made in the practice of the invention within the scope of the following claims.

I claim:

1. A lubricating composition comprising a major amount of an oil of lubricating viscosity and from 0.01 to 5 percent by weight of the oil-soluble reaction product produced by contacting a nitrogenous dispersant containing at least one primary or secondary amino nitrogen atom, which is a hydrocarbyl-substituted hydrocarbyl monoamine, polyamine or succinimide wherein said hydrocarbyl substituent is from about C₃₀ to about

C₂₀₀, a C₃-C₂₀ hydrocarbyl polyisocyanate, and a polyoxyalkylene polyol of at least about 1,000 molecular weight in the range of mol ratios of nitrogenous dispersant to polyisocyanate to polyol of about 0.5-5:0.75-6:1, neat or in an inert solvent, at a temperature from room temperature to the temperature of solvent reflux.

2. A lubricating oil composition according to claim 1 wherein the hydrocarbyl substituent is a polyolefin derived from C₂-C₆ monoolefins, with the proviso that ethylene is copolymerized with a higher olefin.

3. A lubricating oil composition according to claim 1 wherein the hydrocarbyl-substituted hydrocarbyl polyamine is an alkylene polyamine of from 2-10 amino nitrogen atoms.

4. A lubricating oil composition according to claim 1 wherein the hydrocarbyl-substituted succinimide is an imide of an alkylene polyamine of from 2 to 10 amino nitrogen atoms.

5. A lubricating oil composition according to claim 2 wherein the hydrocarbyl substituent is polyisobutenyl or polyisopropenyl.

6. A lubricating oil composition according to claim 3 wherein the alkylene polyamine is an ethylene polyamine or a propylene polyamine.

7. A lubricating oil composition according to claim 6 wherein the ethylene polyamine is selected from the

group consisting of ethylene diamine, diethylene triamine, triethylene tetramine and tetraethylene pentamine, and the propylene polyamine is selected from the group consisting of propylene diamine, dipropylene triamine, tripropylene tetramine and tetrapropylene pentamine.

8. A lubricating oil composition according to claim 1 wherein the said polyisocyanate is selected from the group consisting of toluene diisocyanate, phenylene diisocyanate and methylene diisocyanate.

9. A lubricating oil composition according to claim 1 wherein the polyoxyalkylene polyol is a block copolymer of ethylene oxide and propylene oxide units having a total molecular weight of at least about 4,500, and having a mol percent of ethylene oxide in the range 5-15 percent.

10. A lubricating oil composition according to claim 1 wherein the polyoxyalkylene polyol is a polyoxyalkylenated polyhydric alcohol wherein the polyhydric alcohol is of from 1 to 10 carbon atoms.

11. A lubricating oil composition according to claim 10 wherein the polyhydric alcohol is selected from the group consisting of pentaerythritol, sorbitol, and glycerol.

12. A lubricating oil composition according to claim 1 wherein said hydrocarbyl-substituted succinimide is a polyisobutenyl bis-succinimide of triethylene tetramine.

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