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(54) **LUBRICATING OIL COMPOSITION CONTAINING AN ANTIFOAMING AGENT**

(57) Provided is a lubricating oil composition containing an antifoaming agent having high antifoaming performance even when the lubricant base oil has low viscosity. The lubricating oil composition comprises a lubricant base oil and drops of an antifoaming agent dispersion system dispersed in the lubricant base oil, wherein the antifoaming agent dispersion system comprises a dispersion medium mixture and an antifoaming agent dispersed in the dispersion medium mixture, and the dispersion medium mixture comprises a dispersion medium and an additive for dispersion.

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Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a lubricating oil composition and a method for manufacturing a lubricating oil composition; more specifically, it relates to a lubricating oil composition having excellent initial antifoaming performance, capable of maintaining its antifoaming performance in storage, due to the use of a specific antifoaming agent dispersion system, and a method for manufacturing the lubricating oil composition.

10 BACKGROUND ART

[0002] In order to inhibit foaming during usage and maintain the various characteristics of lubricating oil, antifoaming agent has always been added to the lubricant base oil.

15 **[0003]** A method for diluting and dispersing polydimethylsiloxane having a specific molecular weight, used as an antifoaming agent, in kerosene or gas oil, and mixing it into the lubricating oil, is known, and polydimethylsiloxane is considered to be finely dispersed in lubrication oil (JP 2008-120889 A). A method of dissolving and dispersing perfluoroalkyl-modified organopolysiloxane, as an antifoaming agent, in kerosene, and mixing it into the lubricating oil, is known (JP 2010-116493 A). A lubricating oil composition, comprising a base oil having high solubility for additives and polyfluoroalkyl-modified organopolysiloxane as an antifoaming agent, is known, and a mode whereby polyfluoroalkylsiloxane is mixed beforehand into a base oil at approximately 1% by weight, finely dispersed to $\leq 10 \mu\text{m}$, using a homomixer or a homogenizer, to yield a concentrate, and then mixed, at a specific quantity, into the base oil, was disclosed (JP 2000-087069 A). The addition of an antifoaming agent solution, consisting of a combination of fluorinated silicone, a specific fluorine-containing organic compound and a hydrocarbon-based or alcohol-based organic solvent, to the lubricant base oil, is known (JP 2010-132792 A). A method for diluting and dispersing perfluoropolyether polysiloxane block copolymer as an antifoaming agent in kerosene, gas oil or another organic solvent, adjusting the mean particle size of the block copolymer to $\leq 0.1 \mu\text{m}$ and adding it to a base oil is disclosed (JP 2012-062350 A).

Prior Art Documents

30 Patent Documents

[0004]

35 Patent Document 1: JP 2008-120889 A
 Patent Document 2: JP 2010-116493 A
 Patent Document 3: JP 2000-087069 A
 Patent Document 4: JP 2010-132792 A
 Patent Document 5: JP 2012-062350 A

40 SUMMARY OF THE INVENTION

Problem(s) To Be Solved By the Invention

45 **[0005]** In recent years there has been progress in lowering the viscosity of lubricating oil compositions, especially of lubricating oil compositions for automobiles, such as lubricating oil compositions for internal combustion engines, lubricating oil compositions for transmissions and lubricating oil composition for gears. The problem was, however, that the antifoaming performance could not be maintained by using existing antifoaming agents. This is because antifoaming agents are not moderately dispersed in the lubricant base oil. In order to improve their dispersion, techniques of dispersing the antifoaming agent in a solvent and then adding and dispersing it in the lubricant base oil have been disclosed.

50 **[0006]** While dispersion is improved by conventional techniques in the case of lubricant base oils having somewhat low viscosity, when the viscosity is decreased in order to further improve the fuel efficiency, the dispersibility in the lubricant base oil deteriorates. A new technique of further decreasing viscosity was therefore sought after.

Means For Solving the Problem(s)

55 **[0007]** In light of this problem, the inventors discovered that antifoaming agents can be well dispersed in lubricating oil compositions and their antifoaming performance can be improved by using a specific dispersion medium mixture and mixing it with an antifoaming agent to obtain an antifoaming agent dispersion system, which is then mixed with the

lubricating oil composition.

[0008] The first invention of the present invention is a lubricating oil composition comprising a lubricant base oil and an antifoaming agent contained in the lubricant base oil, wherein the lubricating oil composition comprises a lubricant base oil and drops of an antifoaming agent dispersion system dispersed in the lubricant base oil; the antifoaming agent dispersion system comprises a dispersion medium mixture and an antifoaming agent dispersed in the dispersion medium mixture; and the dispersion medium mixture comprises a dispersion medium and an additive for dispersion.

[0009] The second invention of the present invention is a method for manufacturing a lubricating oil composition comprising a lubricant base oil and an antifoaming agent contained in the lubricant base oil, comprising the steps of mixing a dispersion medium and an additive for dispersion to prepare a dispersion medium mixture; mixing an antifoaming agent with the dispersion medium mixture and dispersing the antifoaming agent in the dispersion medium mixture to prepare an antifoaming agent dispersion system; and then dispersing the antifoaming agent dispersion system in a lubricant base oil.

[0010] The third invention of the present invention is a method for preparing an antifoaming agent dispersion system, comprising the steps of mixing a dispersion medium and an additive for dispersion to prepare a dispersion medium mixture; and mixing an antifoaming agent with the dispersion medium mixture to disperse the antifoaming agent in the dispersion medium mixture.

Effect of the Invention

[0011] The lubricating oil composition containing an antifoaming agent has a high antifoaming performance even when the lubricant base oil has low viscosity.

MODE FOR CARRYING OUT THE INVENTION

[0012] The present invention will now be described in detail.

[0013] The first invention of the present invention is a lubricating oil composition comprising a lubricant base oil and an antifoaming agent contained in the lubricant base oil, wherein the lubricating oil composition comprises a lubricant base oil and drops of an antifoaming agent dispersion system dispersed in the lubricant base oil; the antifoaming agent dispersion system comprises a dispersion medium mixture and an antifoaming agent dispersed in the dispersion medium mixture; and the dispersion medium mixture comprises a dispersion medium and an additive for dispersion.

[0014] Preferable embodiments of the first invention are as follows:

(1) The above-mentioned antifoaming agent is fluoroalkylpolysiloxane.

(2) The above-mentioned additive for dispersion is at least one selected from the group consisting of an ashless dispersant, a metallic detergent, an antiwear agent, a friction conditioner and an extreme pressure agent.

(3) The ashless dispersant, mentioned in (2), is selected from a succinimide compound, a succinamide compound and combinations thereof.

(4) The above-mentioned dispersion medium mixture has a kinematic viscosity of 5-50,000 mm²/s at 40°C.

(5) The above-mentioned dispersion medium is selected from a mineral oil, a synthetic oil and combinations thereof.

(6) The antifoaming agent content in the above-mentioned lubricating oil composition is 0.01-500 ppm in terms of elemental fluorine (F) and 0.05-400 ppm in terms of elemental silicon (Si).

(7) The above-mentioned lubricating oil composition is for a transmission, for a gear, for gear oil, for a gear box, for an automotive gear box, for an industrial gear box, or for a transmission fluid.

[0015] The second invention of the present invention is a method for manufacturing a lubricating oil composition comprising a lubricant base oil and an antifoaming agent contained in the lubricant base oil, comprising the steps of mixing a dispersion medium and an additive for dispersion to prepare a dispersion medium mixture; mixing an antifoaming agent with the dispersion medium mixture and dispersing the antifoaming agent in the dispersion medium mixture to prepare an antifoaming agent dispersion system; and then dispersing the antifoaming agent dispersion system in a lubricant base oil.

[0016] Preferable embodiments of the second invention are as follows:

(1) The above-mentioned antifoaming agent is fluoroalkylpolysiloxane.

(2) The above-mentioned additive for dispersion is at least one selected from the group consisting of an ashless dispersant, a metallic detergent, an antiwear agent, a friction conditioner and an extreme pressure agent.

(3) The ashless dispersant, mentioned in (2), is selected from a succinimide compound, a succinamide compound and combinations thereof.

(4) The above-mentioned dispersion medium mixture has a kinematic viscosity of 5-50,000 mm²/s at 40°C.

- (5) The above-mentioned dispersion medium is selected from a mineral oil, a synthetic oil and combinations thereof.
 (6) The antifoaming agent content in the above-mentioned lubricating oil composition is 0.01-500 ppm in terms of elemental fluorine (F) and 0.05-400 ppm in terms of elemental silicon (Si).
 (7) The above-mentioned lubricating oil composition is for a transmission, for a gear, for gear oil, for a gear box, for an automotive gear box, for an industrial gear box, or for a transmission fluid.

[0017] The third invention of the present invention is a method for preparing an antifoaming agent dispersion system, comprising the steps of mixing a dispersion medium and an additive for dispersion to prepare a dispersion medium mixture; and mixing an antifoaming agent with the dispersion medium mixture to disperse the antifoaming agent in the dispersion medium mixture.

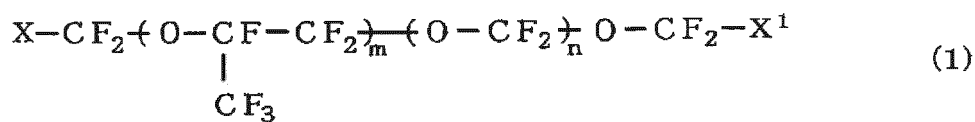
[0018] Preferable embodiments of the third invention are as follows:

- (1) The above-mentioned antifoaming agent is fluoroalkylpolysiloxane.
 (2) The above-mentioned additive for dispersion is at least one selected from the group consisting of an ashless dispersant, a metallic detergent, an antiwear agent, a friction conditioner and an extreme pressure agent.
 (3) The ashless dispersant, mentioned in (2), is selected from a succinimide compound, a succinamide compound and combinations thereof.
 (4) The above-mentioned dispersion medium mixture has a kinematic viscosity of 5-50,000 mm²/s at 40°C.
 (5) The above-mentioned dispersion medium is selected from a mineral oil, a synthetic oil and combinations thereof.

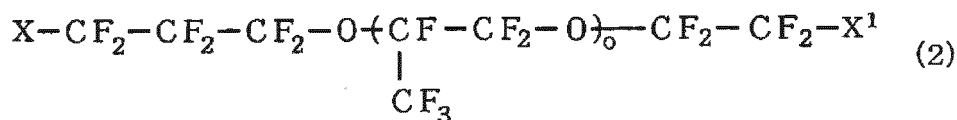
(A) Antifoaming agent

[0019] An antifoaming agent used in the present invention is preferably, but not limited to, fluoroalkylpolysiloxane.

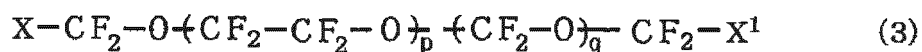
[0020] Examples of an antifoaming agent include compounds having any one of the structures of formulas (1) to (5), and especially a compound having the structure of formula (5) is preferable.



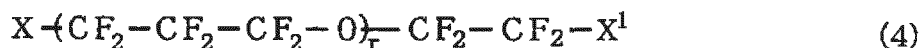
where $m+n = 8$ to 45 and $m/n = 20$ to 100 .



where $o = 7$ to 60 .



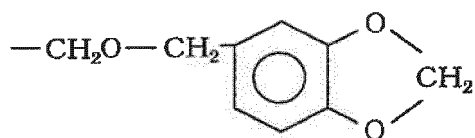
where $p+q = 40$ to 180 and $p/q = 0.5$ to 2 .



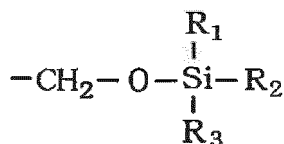
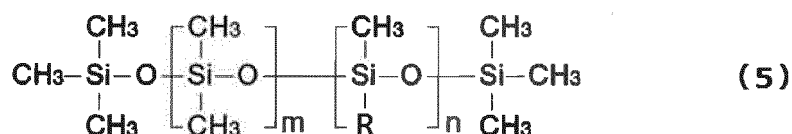
where $r = 10$ to 50 . In the above formulas (1) to (4), X and X¹ are each independently selected from

- (i) a fluorine atom, and
 (ii) the group consisting of following (a) to (g):

- (a) -CH₂OH
 (b) -CH₂(OC₂H₄)_tOH
 (c)



(d)

(e) $\text{---CH}_2\text{COOH}$ (f) $\text{---CF}_2\text{COOH}$ (g) $\text{---CF}_2\text{COONH}_3\text{---(CH}_2\text{)}_5\text{---CH}_3$ 

where R is an organic group. An example of the organic group R in formula (5) is $\text{C}_x\text{H}_{2x}\text{C}_y\text{F}_{2y+1}$, where x is an integer of 1 to 6 and y is an integer of 1 to 14. For m and n, m:n = 95:5 to 0:100. The organic group R may be linear or branched, but linear is preferable. y is preferably an integer of 1 to 8, more preferably an integer of 1 to 6.

(B) Dispersion medium mixture

[0021] The dispersion medium mixture comprises an additive for dispersion and a dispersion medium.

(B1) Dispersion medium

[0022] The dispersion medium in the dispersion medium mixture is preferably, but not limited to, a dispersion medium usually used as a lubricant base oil, and is preferably selected from a mineral oil, a synthetic oil and combinations thereof.

[0023] The mineral oil used as a dispersion medium includes, but is not limited to, paraffinic mineral oils, naphthenic mineral oils, normal paraffins, isoparaffins, etc., obtained by distilling a crude oil at a normal atmospheric pressure or under vacuum to prepare a lubricating oil fraction and subjecting the lubricating oil fraction to one or more of purification treatments such as solvent deasphalting, solvent extraction, hydrogenolysis, solvent dewaxing, catalytic dewaxing, hydrorefining, sulfuric acid treatment and clay treatment.

[0024] A method for manufacturing the mineral oil includes, but is not limited to, a method comprising the steps of distilling a crude oil at a normal atmospheric pressure or under vacuum to obtain a lubricating oil fraction and subjecting the lubricating oil fraction to one or more of purification treatments such as solvent deasphalting, solvent extraction, hydrogenolysis, solvent dewaxing, catalytic dewaxing, hydrorefining, sulfuric acid treatment and clay treatment.

[0025] Moreover, a single mineral oil may be used alone, or two or more mineral oils may be used in combination at any ratio.

[0026] The synthetic oil used as a dispersion medium includes, but is not limited to, poly- α -olefins or hydrogenated products thereof, isobutene oligomers or hydrogenated products thereof, isoparaffin, alkylbenzene, alkylnaphthalene, diesters (such as dodecyl glutarate, di-2-ethylhexyl adipate, diisodecyl adipate, dodecyl adipate and di-2-ethylhexyl sebacate), polyol esters (such as trimethylolpropane caprylate, trimethylolpropane pelargonate, pentaerythritol 2-ethylhexanoate and pentaerythritol pelargonate), polyoxyalkylene glycol, dialkyl diphenyl ether and polyphenyl ether.

[0027] A preferable synthetic oil includes poly- α -olefin. Typical examples of poly- α -olefin include oligomers or co-oligomers of α -olefin having 2 to 32 carbon atoms, preferably 2 to 16 carbon atoms (such as 1-octene oligomer, 1-decene oligomer and ethylene-propylene oligomer) and hydrogenated products thereof.

[0028] The method for manufacturing poly- α -olefin includes, but is not limited to, α -olefin polymerization in the presence of a polymerization catalyst such as a Friedel-Crafts catalyst including aluminum trichloride, boron trifluoride or a complex of boron trifluoride with water, an alcohol (such as ethanol, propanol or butanol), a carboxylic acid or an ester (such as

ethyl or ethyl acetate propionate).

[0029] The kinematic viscosity of the dispersion medium at 100°C is preferably, but not limited to, 2 to 1,000 mm²/s, more preferably 5 to 500 mm²/s, still more preferably 10 to 500 mm²/s and most preferably 20 to 300 mm²/s.

5 (B2) Additive for dispersion

[0030] The additive for dispersion is an agent having a function of raising the viscosity of a mixture of the dispersion medium and the agent above the viscosity of the dispersion medium alone when it is mixed with the dispersion medium. The additive for dispersion is preferably at least one selected from the group consisting of an ashless dispersant, metallic detergent, friction conditioner, antiwear agent and extreme pressure agent among additives usually added to lubricating oil, but is not limited to these.

[0031] Of the above-mentioned additives for dispersion, an ashless dispersant is preferable. A conventional publicly-known ashless dispersant may be used. The ashless dispersant includes, but are not limited to, products obtained by modifying a nitrogen-containing compound having at least one linear or branched C₄₀₋₄₀₀ alkyl or alkenyl group in one molecule or derivatives thereof or alkenylsuccinimide with boron, etc. The ashless dispersant also includes products modified with carboxylic acid, alcohol, aldehyde, ketone or alkylphenol, but a boron-modified product (hereinafter referred to as a "boronated ashless dispersant") is preferable. One ashless dispersant may be used alone, or two or more ashless dispersants may be used in combination. The boronated ashless dispersant is a product obtained by boronating any ashless dispersant used in lubricating oil. Boronation is generally conducted by reacting a nitrogen-containing compound with boric acid to neutralize some or all of the remaining amino groups and/or imino groups.

[0032] The carbon number of the above alkyl group or alkenyl group is preferably from 40 to 400, more preferably from 60 to 350. If the carbon number of the alkyl group or alkenyl group is below the above lower limit, the solubility of the compound in the lubricant base oil tends to decrease. If, on the other hand, the carbon number of the alkyl group or alkenyl group exceeds the above upper limits, the low-temperature fluidity of the lubricating oil composition tends to deteriorate. The above alkyl group and alkenyl group may have a straight chain structure or a branched chain structure. Preferable examples thereof include branched alkyl groups or branched alkenyl groups, derived from oligomers of olefin, such as propylene, 1-butene and isobutylene, and co-oligomers of ethylene and propylene.

[0033] Examples of succinimide include a so-called monotype succinimide, which is a reaction product of one end of a polyamine and succinic anhydride, and a so-called bis-type succinimide, which is a reaction product of both ends of polyamine and succinic anhydride. The lubricating oil composition of the present invention may contain either the monotype or the bis-type, or it may contain both.

[0034] The above modified alkenylsuccinimide may be, for example, a product obtained by modifying a succinimide compound containing an alkenyl group with a boron compound (hereinafter referred to as "boronated succinimide"). One boronated succinimide may be used alone, or two or more boronated succinimides may be used in combination. A boronated succinimide and an unboronated succinimide may be used in combination, and a combination of two or more types of boronated succinimide may be used. Furthermore, combined use of a monotype and a bis-type, combined use of two monotypes or combined use of two bis-types is possible.

[0035] Examples of a method for manufacturing a boronated succinimide include methods disclosed in Japanese Examined Patent Publication Nos. S42-8013 and S42-8014, Japanese Unexamined Patent Publication Nos. S51-52381 and S51-130408, etc. Specifically, it can be obtained, for example, by mixing polyamine, polyalkenylsuccinic acid or anhydride, and a boron compound such as boric acid, borate ester or borate salt with an organic solvent such as alcohols, hexane or xylene, a light lubricant base oil, etc., and heat-treating them. The boron content of the boronated succinimide, obtained in this way, can usually be from 0.1 to 4% by weight. A boron-modified alkenylsuccinimide compound, i.e., boronated succinimide, is especially preferable, since the heat resistance, oxidation resistance and wear prevention thereof are superior.

[0036] The boron content of the boronated ashless dispersant is usually, but not limited to, 0.1 to 3% by weight based on the weight of the ashless dispersant. The boron content of the ashless dispersant is preferably not less than 0.2% by weight, more preferably not less than 0.4% by weight, and is preferably not more than 2.5% by weight, more preferably not more than 2.0% by weight and still more preferably not more than 1.5% by weight. The boronated ashless dispersant is preferably boronated succinimide, and especially preferably boronated bis-succinimide.

[0037] The boronated ashless dispersant has a boron/nitrogen weight ratio (B/N ratio) of preferably not less than 0.1, more preferably not less than 0.2, and preferably less than 1.0, more preferably not more than 0.8.

[0038] A metallic detergent may also be used as the additive for dispersion in the dispersion medium mixture. An example of a metallic detergent is a detergent containing an alkali metal or an alkaline earth metal.

[0039] Examples of alkali metals and alkaline earth metals include, but are not limited to, magnesium, barium, sodium and calcium.

[0040] Examples of the metallic detergent include, but are not limited to, sulfonates containing an alkali metal or an alkaline earth metal, salicylates containing an alkali metal or an alkaline earth metal, and phenates containing an alkali

metal or an alkaline earth metal.

[0041] Preferable examples of a sulfonate containing an alkali metal or an alkaline earth metal include, but are not limited to, calcium sulfonate and magnesium sulfonate.

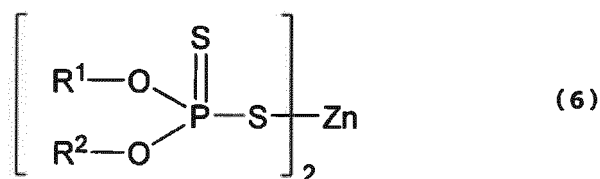
[0042] Preferable examples of a salicylate containing an alkali metal or an alkaline earth metal include, but are not limited to, calcium salicylate and magnesium salicylate.

[0043] Preferable examples of a phenate containing an alkali metal or an alkaline earth metal include, but are not limited to, calcium phenate and magnesium phenate.

[0044] The content of the alkali metal or an alkaline earth metal in the metallic detergent is preferably, but is not limited to, from 0.1 to 20% by weight, more preferably from 0.5 to 15% by weight and still more preferably from 1.0 to 15% by weight. The metallic detergent has a total base number of preferably, but not limited to, from 10 to 500 mgKOH/g, more preferably from 50 to 400 mgKOH/g and still more preferably from 150 to 400 mgKOH/g.

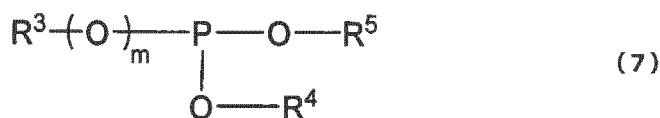
[0045] An antiwear agent may also be used as the additive for dispersion in the dispersion medium mixture. A conventional publicly-known antiwear agent may be used.

[0046] Among them, a phosphorus-containing antiwear agent is preferable. For example, zinc dithiophosphate (ZnDTP, also referred to as "ZDDP"), represented by following formula (6), may be used.

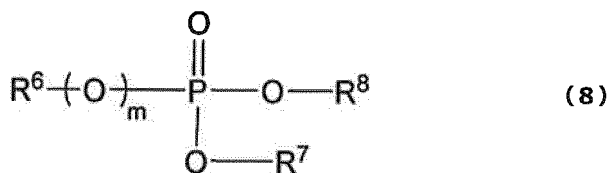


In formula (6), R¹ and R² may be different or the same, and are a hydrogen atom or a C₁₋₂₆ monovalent hydrocarbon group. Examples of a monovalent hydrocarbon group include a C₁₋₂₆ primary or secondary alkyl group; a C₂₋₂₆ alkenyl group; a C₆₋₂₆ cycloalkyl group; a C₆₋₂₆ aryl group, alkylaryl group or arylalkyl group; or a hydrocarbon group containing an ester bond, ether bond, alcohol group or a carboxyl group. R¹ and R² are preferably a C₂₋₁₂ primary or secondary alkyl group, C₈₋₁₈ cycloalkyl group or C₈₋₁₈ alkylaryl group, and they may be different or the same. Zinc dialkyldithiophosphate is especially preferable, and the primary alkyl group has preferably 3 to 12 carbon atoms, more preferably 4 to 10 carbon atoms. The secondary alkyl group has preferably 3 to 12 carbon atoms, more preferably 3 to 10 carbon atoms. In order to increase the torque reduction rate, zinc dialkyldithiophosphate having a secondary alkyl group is preferable. One of the above-mentioned zinc thiophosphates may be used alone or two or more thereof may be used in mixture. Moreover, zinc dithiocarbamate (ZnDTC) may be used in combination therewith.

[0047] Moreover, at least one compound selected from phosphate- and phosphite-based phosphorus compounds represented by formulas (7) and (8) below and metal salts and amine salts thereof may be used.



In formula (7), R³ is a C₁₋₃₀ monovalent hydrocarbon group, R⁴ and R⁵ are each independently a hydrogen atom or a C₁₋₃₀ monovalent hydrocarbon group, and m is 0 or 1.



In formula (8), R⁶ is a C₁₋₃₀ monovalent hydrocarbon group, R⁷ and R⁸ are each independently a hydrogen atom or a C₁₋₃₀ monovalent hydrocarbon group, and n is 0 or 1.

[0048] Examples of the C₁₋₃₀ monovalent hydrocarbon group represented by R³ to R⁸ in formulas (7) and (8) include an alkyl group, cycloalkyl group, alkenyl group, alkylsubstituted cycloalkyl group, aryl group, alkylsubstituted aryl group and arylalkyl group. In particular, it is preferably a C₁₋₃₀ alkyl group or a C₆₋₂₄ aryl group, more preferably a C₃₋₁₈ alkyl group, and most preferably a C₄₋₁₅ alkyl group.

[0049] Examples of the phosphorus compound represented by formula (7) include monoesters of phosphorous acid

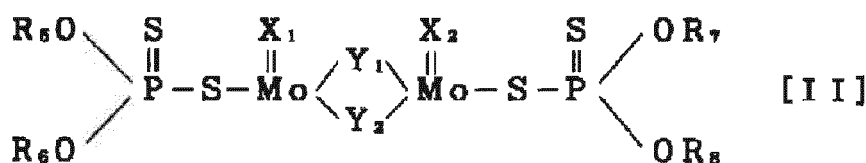
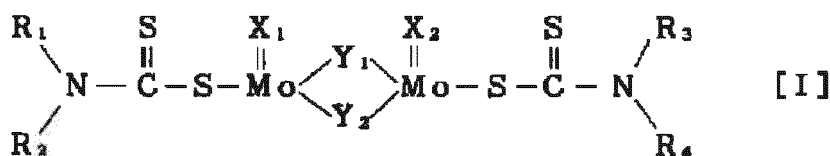
and hydrocarbylphosphonous acids having one of the above C₁₋₃₀ hydrocarbon groups; diesters of phosphorous acid, diesters of monothiophosphorous acid and monoesters of hydrocarbylphosphonous acid having two of the above C₁₋₃₀ hydrocarbon groups; triesters of phosphorous acid and diesters of hydrocarbylphosphonous acid having three of the above C₁₋₃₀ hydrocarbon groups; and mixtures thereof.

[0050] Metal salts or amine salts of the phosphorus compounds represented by formulas (7) or (8) can be obtained by reacting the phosphorus compounds represented by formulas (7) and (8) with a metallic base, such as a metal oxide, metal hydroxide, metal carbonate, and metal chloride, a nitrogen compound, such as ammonia, and an amine compound having, in its molecule, only a C₁₋₃₀ hydrocarbon group or a hydroxyl group-containing hydrocarbon group, or the like, and neutralizing part or all of the remaining acidic hydrogen. Examples of a metal in the above-mentioned metallic base include an alkali metal such as lithium, sodium, potassium, and cesium; an alkaline earth metal such as calcium, magnesium, and barium; a heavy metal such as zinc, copper, iron, lead, nickel, silver, and manganese (except for molybdenum). Of these, an alkaline earth metal, such as calcium and magnesium, and zinc are preferable, and zinc is especially preferable.

[0051] A friction conditioner may also be used as the additive for dispersion in the dispersion medium mixture. Examples of the friction conditioner include, but are not limited to, a molybdenum-based friction conditioner. Moreover, friction conditioners other than a molybdenum-based friction conditioner may also be used, and examples thereof include ester-based friction conditioners, amine-based friction conditioners and ether-based friction conditioners.

[0052] Conventional publicly-known molybdenum-based friction conditioners can be used. Examples of a molybdenum-based friction conditioner include, but are not limited to, sulfur-containing organomolybdenum compounds such as molybdenum dithiophosphate (MoDTP) and molybdenum dithiocarbamate (MoDTC); complexes of a molybdenum compound with a sulfur-containing organic compound or another organic compound; complexes of sulfur-containing molybdenum compounds, such as molybdenum sulfide and sulfurized molybdenum acid, with alkenylsuccinimide; etc. Examples of the above molybdenum compounds include molybdenum oxides such as molybdenum dioxide and molybdenum trioxide; molybdic acids such as orthomolybdic acid, paramolybdic acid, and molybdic acid (poly)sulfide; salts of molybdic acid such as metal salts and ammonium salts of the above molybdic acids; molybdenum sulfides such as molybdenum disulfide, molybdenum trisulfide, molybdenum pentasulfide, and molybdenum polysulfide; molybdic sulfide acid; metal salts or amine salts of sulfurized molybdic acid; molybdenum halides such as molybdenum chloride; etc. Examples of the above sulfur-containing organic compounds include alkyl(thio)xanthate, thiadiazole, mercaptothiadiazole, thiocarbonate, tetrahydrocarbylthiuram disulfide, bis(di(thio)hydrocarbyl dithiophosphonate) disulfide, organo(poly)sulfide, sulfurized esters, etc. Organomolybdenum compounds such as molybdenum dithiophosphate (MoDTP) and molybdenum dithiocarbamate (MoDTC) are especially preferable.

[0053] Molybdenum dithiocarbamate (MoDTC) is a compound represented by following formula [I] and molybdenum dithiophosphate (MoDTP) is a compound represented by following formula [II].



[0054] In formulas [I] and [II], R₁ to R₈ may be different or the same, and are a C₁₋₃₀ monovalent hydrocarbon group. The hydrocarbon group may be linear or branched. Examples of the monovalent hydrocarbon group include a C₁₋₃₀ linear or branched alkyl group; a C₂₋₃₀ alkenyl group; a C₄₋₃₀ cycloalkyl group; a C₆₋₃₀ aryl group, alkylaryl group or arylalkyl group; etc. In the arylalkyl group, the aryl may bond to any position of the alkyl group. In the alkylaryl group, the alkyl may bond to any position of the aryl group. More specifically, examples of the alkyl group include a methyl group, ethyl group, propyl group, butyl group, pentyl group, hexyl group, heptyl group, octyl group, nonyl group, decyl group, undecyl group, dodecyl group, tridecyl group, tetradecyl group, pentadecyl group, hexadecyl group, heptadecyl group, octadecyl group, etc., and branched alkyl groups thereof, and a C₃₋₈ alkyl group is especially preferable. Moreover, X₁ and X₂ are oxygen atoms or sulfur atoms, and Y₁ and Y₂ are oxygen atoms or sulfur atoms.

[0055] In addition, organomolybdenum compounds not containing sulfur may also be used. Examples of such compounds include molybdenum-amine complexes, molybdenum-succinimide complexes, molybdenum salts of organic

acids, molybdenum salts of alcohols, etc.

[0056] An extreme pressure agent may also be used as the additive for dispersion in the dispersion medium mixture. An extreme pressure agent is preferably, but not limited to, at least one extreme pressure agent selected from the group consisting of phosphorus-based extreme pressure agent, sulfur-based extreme pressure agent and phosphorus-sulfur-based extreme pressure agent.

[0057] Examples of phosphorus-based extreme pressure agents include phosphoric acid, phosphorous acid, and phosphates and phosphites having a C_{2-30} , preferably C_{3-20} hydrocarbon group, and salts thereof.

[0058] Examples of sulfur-based extreme pressure agents include sulfurized oils and fats, sulfurized olefins, dihydrocarbyl polysulfides, dithiocarbamates, thiadiazoles and benzothiazoles.

[0059] Moreover, examples of phosphorus-sulfur-based extreme pressure agents include thiophosphoric acid, thiophosphorous acid, thiophosphates and thiophosphites having a C_{2-30} , preferably C_{3-20} hydrocarbon group, and salts thereof, and zinc dithiophosphate.

[0060] Examples of suitably used extreme pressure agents include at least one phosphorus-based extreme pressure agent selected from phosphorous acid, monoesters of phosphorous acid, diesters of phosphorous acid, triesters of phosphorous acid and salts thereof; at least one sulfur-based extreme pressure agent selected from sulfurized fats and oils, olefin sulfides, dihydrocarbyl polysulfides, dithiocarbamates, thiadiazoles and benzothiazoles; and/or at least one phosphorus-sulfur-based extreme pressure agent selected from thiophosphorous acid, monoesters of thiophosphorous acid, diesters of thiophosphorous acid, triesters of thiophosphorous acid, dithiophosphorous acid, monoesters of dithiophosphorous acid, diesters of dithiophosphorous acid, triesters of dithiophosphorous acid, trithiophosphorous acid, monoesters of trithiophosphorous acid, diesters of trithiophosphorous acid, triesters of trithiophosphorous acid, and salts thereof.

[0061] Examples of the above-mentioned C_{2-30} hydrocarbon group include an alkyl group, cycloalkyl group, alkylcycloalkyl group, alkenyl group, aryl group, alkylaryl group and arylalkyl group.

[0062] Examples of the alkyl group include ethyl group, propyl group, butyl group, pentyl group, hexyl group, heptyl group, octyl group, nonyl group, decyl group, undecyl group, dodecyl group, tridecyl group, tetradecyl group, pentadecyl group, hexadecyl group, heptadecyl group, octadecyl group, etc. These alkyl groups may be linear or branched.

[0063] Examples of the cycloalkyl group include a C_{5-7} cycloalkyl group such as a cyclopentyl group, cyclohexyl group, and cycloheptyl group.

[0064] Examples of the alkylcycloalkyl group include a C_{6-11} alkylcycloalkyl group such as methylcyclopentyl group, dimethylcyclopentyl group, methylethylcyclopentyl group, diethylcyclopentyl group, methylcyclohexyl group, dimethylcyclohexyl group, methylethylcyclohexyl group, diethylcyclohexyl group, methylcycloheptyl group, dimethylcycloheptyl group, methylethylcycloheptyl group and diethylcycloheptyl group. The alkyl group(s) may bond to any position on the cycloalkyl group.

[0065] Examples of the alkenyl group include a butenyl group, pentenyl group, hexenyl group, heptenyl group, octenyl group, nonenyl group, decenyl group, undecenyl group, dodecenyl group, tridecenyl group, tetradecenyl group, pentadecenyl group, hexadecenyl group, heptadecenyl group and octadecenyl group. These alkenyl groups may be linear or branched, and the double bond may exist at any position of the group.

[0066] Examples of the aryl group include a phenyl group, naphthyl group, etc.

[0067] Examples of the alkylaryl group include a C_{7-18} alkylaryl group such as a tolyl group, xylyl group, ethylphenyl group, propylphenyl group, butylphenyl group, pentylphenyl group, hexylphenyl group, heptylphenyl group, octylphenyl group, nonylphenyl group, decylphenyl group, undecylphenyl group and dodecylphenyl group. The alkyl group may be linear or branched, and may bond to any position of the aryl group.

[0068] Examples of the arylalkyl group include a C_{7-12} arylalkyl group such as a benzyl group, phenylethyl group, phenylpropyl group, phenylbutyl group, phenylpentyl group, and phenylhexyl group. The alkyl group may be linear or branched.

[0069] Concrete preferable examples of the phosphorus-based extreme pressure agent include monobutyl phosphate, monoethyl phosphate, monolauryl phosphate, dibutyl phosphate, dioctyl phosphate, dilauryl phosphate, tributyl phosphate, trioctyl phosphate, trilauryl phosphate, triphenyl phosphate; monobutyl phosphite, monoethyl phosphite, monolauryl phosphite, dibutyl phosphite, dioctyl phosphite, dilauryl phosphite, tributyl phosphite, trioctyl phosphite, trilauryl phosphite, triphenyl phosphite; and salts thereof. Of these, phosphite-based extreme pressure agents are preferable, and extreme pressure agents based on diester of phosphorous acid are especially preferable.

[0070] Concrete preferable examples of the phosphorus-sulfur-based extreme pressure agent include monobutyl thiophosphate, monoethyl thiophosphate, monolauryl thiophosphate, dibutyl thiophosphate, dioctyl thiophosphate, dilauryl thiophosphate, tributyl thiophosphate, trioctyl thiophosphate, triphenyl thiophosphate, trilauryl thiophosphate; monobutyl thiophosphite, monoethyl thiophosphite, monolauryl thiophosphite, dibutyl thiophosphite, dioctyl thiophosphite, dilauryl thiophosphite, tributyl thiophosphite, trioctyl thiophosphite, triphenyl thiophosphite, trilauryl thiophosphite having one to three, preferably two or three, more preferably three sulfur atoms per molecule; and salts thereof. Of these, thiophosphite-based extreme pressure agents are preferable, and trithiophosphite-based extreme pressure agents are

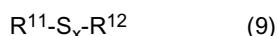
especially preferable.

[0071] Moreover, examples of salts of (thio)phosphates and (thio)phosphites include salts obtained by reacting a (thio)phosphate monoester, (thio)phosphate diester, (thio)phosphite monoester, (thio)phosphite diester, etc., with a nitrogen compound such as ammonia and an amine compound containing only a C₁₋₈ hydrocarbon group or hydroxyl-containing hydrocarbon group in its molecule, or a metallic base such as zinc oxide and zinc chloride to neutralize part or all of the remaining acidic hydrogen.

[0072] Specific examples of the above nitrogen compound include ammonia; alkylamines, in which the alkyl group may be linear or branched, such as monomethylamine, monoethylamine, monopropylamine, monobutylamine, monopentylamine, monohexylamine, monoheptylamine, monooctylamine, dimethylamine, methylethylamine, diethylamine, methylpropylamine, ethylpropylamine, dipropylamine, methylbutylamine, ethylbutylamine, propylbutylamine, dibutylamine, dipentylamine, dihexylamine, diheptylamine, and dioctylamine; alkanolamines, in which the alkanol group may be linear or branched, such as monomethanolamine, monoethanolamine, monopropanolamine, monobutanolamine, monopentanolamine, monohexanolamine, monoheptanolamine, monooctanolamine, monononanolamine, dimethanolamine, methanolethanolamine, diethanolamine, methanolpropanolamine, ethanolpropanolamine, dipropanolamine, methanolbutanolamine, ethanolbutanolamine, propanolbutanolamine, dibutanolamine, dipentanolamine, dihexanolamine, diheptanolamine, and dioctanolamine; and mixtures thereof.

[0073] Examples of sulfurized fats and oils include oils such as sulfurized lard, sulfurized rapeseed oil, sulfurized castor oil, sulfurized soybean oil, and sulfurized rice bran oil; fatty acid disulfide such as oleic acid sulfide; and sulfurized esters such as sulfurized methyl oleate.

[0074] Examples of olefin sulfides include compounds represented by following formula (9).



In formula (9), R¹¹ is a C₂₋₁₅ alkenyl group, R¹² is a C₂₋₁₅ alkyl group or alkenyl group, and x is an integer of 1 to 8.

[0075] This compound can be obtained by reacting a C₂₋₁₅ olefin or a dimer, trimer or tetramer thereof with a sulfurizing agent such as sulfur and sulfur chloride. Preferable examples of the olefin include propylene, isobutene and diisobutene.

[0076] Dihydrocarbyl polysulfide is a compound represented by following formula (10).



In formula (10), R¹³ and R¹⁴ represent each independently a C₁₋₂₀ alkyl group (including cycloalkyl group), a C₆₋₂₀ aryl group and a C₇₋₂₀ arylalkyl group, and they may be different or the same, and y is an integer of 2 to 8.

[0077] Specific examples of R¹³ and R¹⁴ include a methyl group, ethyl group, n-propyl group, isopropyl group, n-butyl group, isobutyl group, sec-butyl group, tert-butyl group, various pentyl groups, various hexyl groups, various heptyl groups, various octyl groups, various nonyl groups, various decyl groups, various dodecyl groups, cyclohexyl group, phenyl group, naphthyl group, tolyl group, xylyl group, benzyl group, phenethyl group, etc.

[0078] Specific preferable examples of dihydrocarbyl polysulfide include dibenzyl polysulfide, di-tert-nonyl polysulfide, didodecyl polysulfide, di-tert-butyl polysulfide, dioctyl polysulfide, diphenyl polysulfide, dicyclohexyl polysulfide, etc.

[0079] Regarding the weight ratio of the additive for dispersion to the dispersion medium in the dispersion medium mixture, the dispersion medium mixture comprises preferably, but not limited to, 5 to 95% by weight of the additive for dispersion and 95 to 5% by weight of the dispersion medium, more preferably 10 to 90% by weight of the additive for dispersion and 90 to 10% by weight of the dispersion medium, and most preferably 20 to 80% by weight of the additive for dispersion and 80 to 20% by weight of the dispersion medium.

[0080] The dispersion medium mixture can be obtained by mixing and stirring the dispersion medium with the additive for dispersion at a temperature within the range of 30 to 80°C. Into the dispersion medium mixture obtained in this way, an antifoaming agent is added at a quantity of 0.1 to 10% by weight, preferably 0.3 to 2% by weight, and dispersed using a homogenizer or a nozzle injector. Since the kinematic viscosity of the dispersion medium mixture has increased, the antifoaming agent disperses better than when an antifoaming agent is dispersed in a solvent such as kerosene.

[0081] When a homogenizer is used, they are stirred preferably at a high-speed rotation of 8,000 to 24,000 rpm for 1 to 15 minutes, and more preferably at 15,000 to 20,000 rpm for 5 to 10 minutes, but the rotating speed and stirring duration are not limited to these.

[0082] When a nozzle injector is used, the liquid pressure and the liquid flow rate are not limited. The liquid pressure is preferably from 30 MPa to 200 MPa, more preferably from 100 MPa to 200 MPa.

[0083] In other words, provided is a method for producing an antifoaming agent dispersion system, comprising the steps of mixing an antifoaming agent with a dispersion medium mixture comprising an additive for dispersion and a dispersion medium, and dispersing the antifoaming agent in the dispersion medium mixture using a homogenizer or a nozzle injector.

[0084] Thus, the initial dispersion performance and the dispersion performance after storage of the antifoaming agent

in the dispersion medium mixture are increased.

[0085] Moreover, when a lubricating oil composition is made using the antifoaming agent dispersion system, the dispersion performance of the antifoaming agent in the lubricating oil composition is good not only initially but also after long-term storage.

[0086] The lubricating oil composition of the present invention can be suitably used as lubricating oil compositions for an automobile, such as lubricating oil compositions for internal combustion engines, lubricating oil compositions for transmissions and lubricating oil composition for gears. The lubricating oil composition for transmissions can be used for any of non-stage transmission oil, stage transmission oil and motor speed changer oil.

(C) Lubricant base oil

[0087] The lubricant base oil used in a lubricating oil composition is preferably selected from, but not limited to, mineral oils, synthetic oils and combinations thereof.

[0088] The mineral oil used as a lubricant base oil include, but not limited to, paraffinic, naphthenic and other mineral oils and normal paraffin, isoparaffin, etc., obtained by distilling crude oil at a normal atmospheric pressure or under vacuum to obtain a lubricating oil distillate fraction and purifying the lubricating oil distillate fraction by use of one or a combination of two or more of purification treatments such as solvent deasphalting, solvent extraction, hydrogenolysis, solvent dewaxing, catalytic dewaxing, hydrotreating, sulfuric acid treatment and clay treatment.

[0089] An example of a method for manufacturing the mineral oil includes, but is not limited to, a method comprising the steps of distilling crude oil at a normal atmospheric pressure or under vacuum to obtain a lubricating oil fraction; and purifying the lubricating oil fraction by use of one or a combination of two or more of purification treatments such as solvent deasphalting, solvent extraction, hydrogenolysis, solvent dewaxing, catalytic dewaxing, hydrotreating, sulfuric acid treatment and clay treatment.

[0090] Moreover, one of these mineral oils may be used alone, or two or more thereof may be used in combination at any ratio.

[0091] The synthetic oil used as a lubricant base oil includes, but not limited to, poly- α -olefins or hydrogenated products thereof, isobutene oligomers or hydrogenated products thereof, isoparaffin, alkylbenzene, alkylnaphthalene, diesters (such as dodecyl glutarate, di-2-ethylhexyl adipate, diisodecyl adipate, dodecyl adipate and di-2-ethylhexyl sebacate), polyol esters (such as trimethylolpropane caprylate, trimethylolpropane pelargonate, pentaerythritol 2-ethylhexanoate and pentaerythritol pelargonate), polyoxyalkylene glycol, dialkyl diphenyl ether, polyphenyl ether, etc.

[0092] A preferable synthetic oil includes poly- α -olefin. Typical examples of poly- α -olefin include oligomers or co-oligomers of α -olefins having 2 to 32 carbon atoms, preferably 2 to 16 carbon atoms (such as 1-octene oligomer, 1-decene oligomer and ethylene-propylene oligomer) and hydrogenated products thereof.

[0093] An example of a method of manufacturing poly- α -olefin include, but are not limited to, a method comprising the step of polymerizing α -olefin in the presence of a polymerization catalyst such as a Friedel-Crafts catalyst including aluminum trichloride, boron trifluoride or a complex of boron trifluoride with water, an alcohol (such as ethanol, propanol or butanol), a carboxylic acid or an ester (such as ethyl acetate or ethyl propionate).

[0094] One of these synthetic oils may be used alone, or two or more synthetic oils may be used in combination at any ratio.

[0095] Moreover, the above mineral oil(s) and synthetic oil(s) may be used in combination at any ratio, wherein one mineral or synthetic oil may be used, or two or more mineral or synthetic oils may be used.

[0096] The kinematic viscosity of the lubricant base oil at 100°C is, but not limited to, preferably 1 to 300 mm²/s, more preferably 1 to 100 mm²/s, still more preferably 1 to 50 mm²/s and most preferably 1 to 30 mm²/s.

(D) Additives to the lubricant base oil

[0097] In addition to the antifoaming agent, any publicly-known additives may be added to the lubricant base oil.

[0098] Examples of the additive include, but are not limited to, an ashless dispersant, metallic detergent, antiwear agent, friction conditioner, extreme pressure agent, viscosity index improver, metal deactivator, pour point depressant, antioxidant, etc.

[0099] Conventional publicly-known ashless dispersants, metallic detergents, antiwear agents, friction conditioners and extreme pressure agents may be used, and no particular restrictions are placed on it. Specifically, the additives for dispersion described above may be suitably used.

[0100] Examples of a viscosity index improver include polymethacrylate, dispersed polymethacrylate, olefin copolymer (polyisobutylene, ethylene-propylene copolymer), dispersed olefin copolymer, polyalkylstyrene, hydrogenated styrene-butadiene copolymer, styrene-maleic anhydride ester copolymer, star isoprene, etc. In addition, a comb polymer, whose backbone comprises at least a repeating unit based on polyolefin macromer and a repeating unit based on alkyl (meth)acrylate having a C₁₋₃₀ alkyl group, can be also used.

[0101] Examples of the metal deactivator include imidazoline, pyrimidine derivatives, alkylthiadiazole, mercaptobenzothiazole, benzotriazole or derivatives thereof, 1,3,4-thiadiazole polysulfide, 1,3,4-thiadiazolyl-2,5-bis-dialkyl dithiocarbamate, 2-(alkyldithio)benzimidazole, β -(*o*-carboxybenzylthio)propionitrile, etc.

[0102] As a pour point depressant, for example, a polymethacrylate-based polymer that suits a used lubricant base oil, etc. can be used.

[0103] Examples of an antioxidant include phenol-based or amine-based ashless antioxidants, and metal-based antioxidants such as copper-based and molybdenum-based antioxidants. Examples of phenol-based ashless antioxidants include 4,4'-methylene-bis(2,6-di-*tert*-butylphenol), 4,4'-bis(2,6-di-*tert*-butylphenol), isooctyl 3-(3,5-di-*t*-butyl-4-hydroxyphenyl)propionate, and the like. Examples of amine-based ashless antioxidants include phenyl- α -naphthylamine, alkyl-phenyl- α -naphthylamine, dialkyldiphenylamine, etc.

[0104] These additives may be suitably added according to the intended usage. The quantity added depends on the usage, but is from 0 to 20% by weight of the lubricating oil composition.

[0105] A lubricating oil composition is provided by mixing an antifoaming agent with a dispersion medium mixture consisting of an additive for dispersion and a dispersion medium, and dispersing the antifoaming agent in the dispersion medium mixture using a homogenizer or a nozzle injector to form an antifoaming agent dispersion system, and mixing the antifoaming agent dispersion system with a lubricant base oil.

[0106] Moreover, a method of manufacturing a lubricating oil composition, comprising mixing an antifoaming agent with a dispersion medium mixture consisting of an additive for dispersion and a dispersion medium, and dispersing the antifoaming agent in the dispersion medium mixture using a homogenizer or a nozzle injector to form an antifoaming agent dispersion system, and mixing the antifoaming agent dispersion system with a lubricant base oil, is provided.

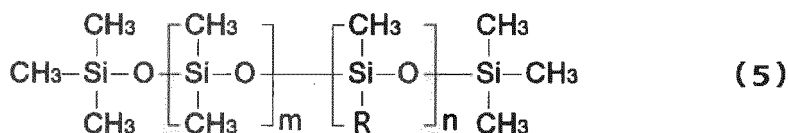
EXAMPLES

[0107] The present invention will now be explained by means of examples and comparative examples.

[0108] Lubricating oil compositions for transmissions are illustrated in the following examples, but the present invention is not limited to or by these examples.

(Example 1)

[0109] FA-630® (Shin-Etsu Chemical Co., Ltd.), which is one of fluoroalkylpolysiloxanes, was used as an antifoaming agent. Its structure is as follows:



where R is $\text{C}_x\text{H}_{2x}\text{C}_y\text{F}_{2y+1}$.

[0110] 49.5 parts by weight of poly- α -olefin oil having a kinematic viscosity at 100°C of 100 mm²/s used as a dispersion medium, and 49.5 parts by weight of polybutenylsuccinimide having a molecular weight of the polybutenyl group of 3000, a nitrogen content of 2.0% by weight, and a boron content of 1.0% by weight, which is an ashless dispersant used as an additive for dispersion, were mixed to prepare a dispersion medium mixture. One part by weight of the above-mentioned fluoroalkylpolysiloxane was added to the dispersion medium mixture, and the mixture was jetted at a liquid pressure of 100 MPa, using a nozzle injector (Nanomizer, Nanofuel Co., Ltd.), to obtain an antifoaming agent dispersion system, in which the antifoaming agent was dispersed in the dispersion medium mixture.

[0111] When the antifoaming agent dispersion system was put into a beaker and left to stand for one week, no precipitation of the antifoaming agent was observed.

[0112] To a mineral oil having a kinematic viscosity of 15 mm²/s at 40°C used as a lubricant base oil, an additive package for ATF (T4278 of Infineum Co.) was added at a quantity of 10% by weight based on the total weight of the lubricating oil composition, and the above-mentioned antifoaming agent dispersion system was added at a quantity of 0.4% by weight, and the mixture was heated to 60°C and mixed by stirring, using a propeller, to prepare a lubricating oil composition.

[0113] 3.3 kg thereof were moved to a 4L can and the static stability was evaluated; in the early phase, the whippability was 10 mm, and after 84 days (12 weeks) the whippability remained at 13 mm. In other words, the antifoaming performance was maintained.

[0114] The whippability after 84 days was measured by putting 200 cm³ of sample into a 500 cm³ tall beaker, raising the temperature to 140°C on a hot plate, stirring it for 5 minutes at 11,600 rpm by use of a homogenizer (manufactured

by IKA) while blowing air at 200 mL/min, and measuring the increase in the height of the liquid level.

[0115] The lubricating oil composition thus obtained is useful as a lubricating oil composition for transmissions.

(Example 2)

[0116] An antifoaming agent dispersion system was obtained using the same method as in Example 1, except that a homogenizer was used for dispersion instead of the nozzle injector.

[0117] When the antifoaming agent dispersion system was put into a beaker and left to stand for one week, no precipitation of the antifoaming agent was observed. Using the obtained antifoaming agent dispersion system with the same lubricant base oil and additive as used in Example 1, a lubricating oil composition was obtained in the same way as in Example 1. 3.3 kg thereof were moved to a 4L can and the static stability was evaluated; in the early phase, the whippability was 13 mm, and after 84 days (12 weeks) it remained at 15 mm. In other words, the antifoaming performance was maintained. The lubricating oil composition thus obtained is useful as a lubricating oil composition for transmissions.

(Comparative Example 1)

[0118] Forty (40) parts by weight of fluoroalkylpolysiloxane used in the above Example 1 was added to 60 parts by weight of kerosene, and an antifoaming agent dispersion system was obtained in the same way as in Example 1.

[0119] When put into a beaker and left to stand, precipitation of the antifoaming agent was observed after 30 minutes, and after one hour all the antifoaming agent precipitated. For this reason, it was unsuitable for use as a lubricating oil composition.

[0120] The above results showed that the antifoaming agent dispersion system used in the present invention enables dispersion of an antifoaming agent without precipitation over a long time. As the result, it is not necessary to produce a lubricating oil composition immediately after the production of an antifoaming agent dispersion system, thus improving the production efficiency of an lubricating oil composition.

[0121] Moreover, it was found that in the lubricating oil composition of the present invention, the antifoaming performance of the antifoaming agent is maintained over a long time.

INDUSTRIAL APPLICABILITY

[0122] The lubricating oil composition of the present invention can be used in a wide variety of fields, in which a lubricating oil is needed. While the above examples relate to lubricating oil compositions for transmissions, the invention is not limited to or by them; it is applicable to all lubricating oil compositions, and can be suitably used especially to lubricating oil compositions for automobiles, more especially to lubricating oil compositions for internal combustion engines, lubricating oil compositions for transmissions, and lubricating oil composition for gears. The lubricating oil composition for transmissions includes non-stage transmission oil, stage transmission oil and motor speed changer oil.

Claims

1. A lubricating oil composition comprising a lubricant base oil and an antifoaming agent contained in the lubricant base oil, wherein the lubricating oil composition comprises a lubricant base oil and drops of an antifoaming agent dispersion system dispersed in the lubricant base oil; the antifoaming agent dispersion system comprises a dispersion medium mixture and an antifoaming agent dispersed in the dispersion medium mixture; and the dispersion medium mixture comprises a dispersion medium and an additive for dispersion.
2. The lubricating oil composition according to Claim 1, wherein the antifoaming agent is fluoroalkylpolysiloxane.
3. The lubricating oil composition according to Claim 1 or 2, wherein the additive for dispersion is at least one selected from the group consisting of an ashless dispersant, a metallic detergent, an antiwear agent, a friction conditioner and an extreme pressure agent.
4. The lubricating oil composition according to Claim 3, wherein the ashless dispersant is selected from a succinimide compound, a succinamide compound and combinations thereof.
5. The lubricating oil composition according to any one of Claims 1-4, wherein the dispersion medium mixture has a kinematic viscosity of 5-50,000 mm²/s at 40°C.

6. The lubricating oil composition according to any one of Claims 1-5, wherein the dispersion medium is selected from a mineral oil, a synthetic oil and combinations thereof.
7. The lubricating oil composition according to any one of Claims 1-6, wherein an antifoaming agent content in the lubricating oil composition is 0.01-500 ppm in terms of elemental fluorine (F) and 0.05-400 ppm in terms of elemental silicon (Si).
8. The lubricating oil composition according to any one of Claims 1-7, which is for a transmission, for a gear, for gear oil, for a gear box, for an automotive gear box, for an industrial gear box, or for a transmission fluid.
9. A method for manufacturing a lubricating oil composition comprising a lubricant base oil and an antifoaming agent contained in the lubricant base oil, comprising the steps of mixing a dispersion medium and an additive for dispersion to prepare a dispersion medium mixture; mixing an antifoaming agent with the dispersion medium mixture and dispersing the antifoaming agent in the dispersion medium mixture to prepare an antifoaming agent dispersion system; and then dispersing the antifoaming agent dispersion system in a lubricant base oil.
10. The method for manufacturing a lubricating oil composition according to Claim 9, wherein the antifoaming agent is fluoroalkylpolysiloxane.
11. The method for manufacturing a lubricating oil composition according to Claim 9 or 10, wherein the additive for dispersion is at least one selected from the group consisting of an ashless dispersant, a metallic detergent, an antiwear agent, a friction conditioner and an extreme pressure agent.
12. The method for manufacturing a lubricating oil composition according to Claim 11, wherein the ashless dispersant is selected from a succinimide compound, a succinamide compound and combinations thereof.
13. The method for manufacturing a lubricating oil composition according to any one of Claims 9-12, wherein the dispersion medium mixture has a kinematic viscosity of 5-50, 000 mm²/s at 40°C.
14. The method for manufacturing a lubricating oil composition according to any one of Claims 9-13, wherein the dispersion medium is selected from a mineral oil, a synthetic oil and combinations thereof.
15. The method for manufacturing a lubricating oil composition according to any one of Claims 9-14, wherein an anti-foaming agent content in the lubricating oil composition is 0.01-500 ppm in terms of elemental fluorine (F) and 0.05-400 ppm in terms of elemental silicon (Si).
16. The method for manufacturing a lubricating oil composition according to any one of Claims 9-15, wherein the lubricating oil composition is for a transmission, for a gear, for gear oil, for a gear box, for an automotive gear box, for an industrial gear box, or for a transmission fluid.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/000600

A. CLASSIFICATION OF SUBJECT MATTER
INV. C10M169/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C10M C10N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, COMPENDEX, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2010 132792 A (TONENGENERAL SEKIYU KK) 17 June 2010 (2010-06-17) paragraph [0001] paragraph [0013] - paragraph [0014] paragraph [0018] - paragraph [0041] paragraph [0052] - paragraph [0085] paragraph [0096] - paragraph [0118] claims; examples -----	1-16
X	CN 105 385 484 A (CHINA PETROLEUM & CHEM CORP) 9 March 2016 (2016-03-09)	1-4, 6-12, 14-16
A	paragraph [0007] - paragraph [0021] claims; examples ----- -/-	5,13

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

11 October 2017

Date of mailing of the international search report

09/11/2017

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/000600

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/054542 A1 (MUCHMORE ROBERT A [US] ET AL) 10 March 2005 (2005-03-10)	1-6, 8-14, 16
A	paragraph [0030] - paragraph [0037] paragraph [0046] - paragraph [0054] paragraph [0073] - paragraph [0079] claims; examples -----	7, 15
X	JP 2000 087065 A (IDEMITSU KOSAN CO) 28 March 2000 (2000-03-28)	1-8
A	paragraph [0004] - paragraph [0019] claims; examples -----	9-16

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2017/000600

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Form PCT/ISA/210 (patent family annex) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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