(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 050 945 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
03.08.2016 Bulletin 2016/31

(21) Application number: **14848142.7**

(22) Date of filing: **05.09.2014**

(51) Int Cl.:
C10M 133/06 *(2006.01)* ***C10M 101/02*** *(2006.01)*
C10M 129/74 *(2006.01)* ***C10M 137/04*** *(2006.01)*
C10M 141/10 *(2006.01)* ***C10M 169/04*** *(2006.01)*
C10N 20/00 *(2006.01)* ***C10N 30/06*** *(2006.01)*
C10N 40/04 *(2006.01)*

(86) International application number:
PCT/JP2014/073568

(87) International publication number:
WO 2015/045816 (02.04.2015 Gazette 2015/13)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **25.09.2013 JP 2013198825**

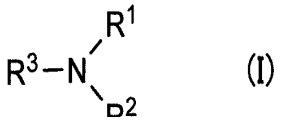
(71) Applicant: **Idemitsu Kosan Co., Ltd**
Tokyo 100-8321 (JP)

(72) Inventor: **KOGA, Hidetoshi**
Ichihara-shi
Chiba 299-0107 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) LUBRICATING OIL COMPOSITION FOR TRACTION DRIVE TRANSMISSION

(57) An object of the present invention is to provide a lubricating oil composition capable of improving oxidation stability by allowing a base number to remain, preserving seizure resistance, preventing generation of precipitation to be caused due to addition of a base, and inhibiting a lowering of traction coefficient. The lubricating oil composition for traction drive transmission includes (A) a base oil, (B) a phosphate ester-based compound, (C) an antioxidant, and (D) an amine represented by the following general formula (I) and/or an amine oxide of the amine.



(I)

In the general formula (I), each of R^1 and R^2 independently represents a linear, branched, or cyclic alkyl group having 1 to 26 carbon atoms, a linear, branched, or cyclic alkenyl group having 1 to 26 carbon atoms, $(R^4\text{-}O)_m\text{-}H$, or $(R^5\text{-}O)_{n1}\text{-}(R^6\text{-}O)_{n2}\text{-}H$, and R^1 and R^2 may be the same as or different from each other; each of R^4 to R^6 independently represents an alkylene group having 2 to 3 carbon atoms; each of m, n1, and n2 independently represents a number of 2 to 25; and R^3 represents a substituted or unsubstituted, linear, branched, or cyclic alkyl group having 1 to 26 carbon atoms, or a substituted or unsubstituted, linear, branched, or cyclic alkenyl group having 1 to 26 carbon atoms.

EP 3 050 945 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a lubricating oil composition for traction drive transmission.

BACKGROUND ART

[0002] In recent years, with respect to transmissions for automobile, such as a traction drive transmission (T-CVT), etc., not only there are trends toward capacity enlargement of transmission power and miniaturization, but also there are tendencies to demand fuel-saving properties and extension of no change interval for fats and oils to be used therefor. In consequence, lubricating oil compositions to be used for transmissions for automobile are required to have oxidation stability or extreme-pressure properties (seizure resistance) at higher levels.

[0003] In relation to the foregoing issues, PTL 1 proposes a lubricating oil composition containing an antioxidant composed of a specified hindered phenol compound. In addition, PTL 2 proposes a lubricating oil composition containing an acidic phosphate ester.

CITATION LIST

PATENT LITERATURE

[0004]

PTL 1: JP 6-293892 A
PTL 2: JP 2010-202680 A

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] The lubricating oil composition of PTL 1 may exhibit a good oxidation stability of the lubricating oil composition by the hindered phenol compound; however, the seizure resistance is not studied.

[0006] The lubricating oil composition of PTL 2 may exhibit a good wear resistance of the lubricating oil composition by the acidic phosphate ester; however, the seizure resistance and the oxidation stability are not studied. In addition, in the case of adding the acidic phosphate ester to the lubricating oil composition, for the purpose of suppressing corrosion to be caused due to an increase of acidity, it is required to take balance by adding a base to the lubricating oil composition. However, in the case of adding a base (monoamine compound) disclosed in PTL 2 to the lubricating oil composition, there was a concern that the acidic phosphate ester reacts with the instant amine to generate precipitation. In addition, the lubricating oil composition of PTL 2 is used for machine tools, but any lubricating oil composition for automobile transmission is not described at all.

[0007] Furthermore, in order to appropriately transmit a power, the lubricating oil compositions for traction drive transmission are demanded to have a high traction coefficient. However, with respect to the lubricating oil compositions of PTLs 1 and 2, a balance between the traction coefficient and other performances is not studied at all.

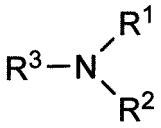
[0008] In the light of the above, any lubricating oil composition for traction drive transmission capable of satisfying improvement of oxidation stability, preservation of seizure resistance, prevention of generation of precipitation to be caused due to addition of a base, and inhibition of a lowering of traction coefficient has not been proposed yet.

[0009] In view of the foregoing circumstances, the present invention has been made, and an object thereof is to provide a lubricating oil composition for traction drive transmission capable of improving oxidation stability by allowing a base number to remain, preserving seizure resistance, preventing generation of precipitation to be caused due to addition of a base, and inhibiting a lowering of traction coefficient.

SOLUTION TO PROBLEM

[0010] In order to solve the aforementioned problem, the present invention is to provide the following lubricating oil composition for traction drive transmission.

[0011] 1. A lubricating oil composition for traction drive transmission preparing by blending (A) a base oil, (B) a phosphate ester-based compound, (C) an antioxidant, and (D) an amine represented by the following general formula (I) and/or an amine oxide of the amine:



(I)

wherein each of R^1 and R^2 independently represents a linear, branched, or cyclic alkyl group having 1 to 26 carbon atoms, a linear, branched, or cyclic alkenyl group having 1 to 26 carbon atoms, $(R^4\text{-}O)_m\text{-}H$, or $(R^5\text{-}O)_{n1}\text{-}(R^6\text{-}O)_{n2}\text{-}H$, and R^1 and R^2 may be the same as or different from each other; each of R^4 to R^6 independently represents an alkylene group having 2 to 3 carbon atoms; each of m, n1, and n2 independently represents a number of 2 to 25; and R^3 represents a substituted or unsubstituted, linear, branched, or cyclic alkyl group having 1 to 26 carbon atoms, or a substituted or unsubstituted, linear, branched, or cyclic alkenyl group having 1 to 26 carbon atoms.

ADVANTAGEOUS EFFECTS OF INVENTION

[0012] The lubricating oil composition for traction drive transmission of the present invention is capable of preserving seizure resistance while improving oxidation stability by allowing a base number to remain, preventing generation of precipitation to be caused due to addition of a base, and inhibiting a lowering of traction coefficient.

DESCRIPTION OF EMBODIMENTS

[0013] The lubricating oil composition for traction drive transmission of the present invention preparing by blending (A) a base oil, (B) a phosphate ester-based compound, (C) an antioxidant, and (D) an amine represented by the general formula (I) and/or an amine oxide of the amine.

[0014] In the present invention, for example, the composition prescribed as "the lubricating oil composition preparing by blending (A) a base oil, (B) a phosphate ester-based compound, (C) an antioxidant, and (D) an amine represented by the general formula (I) and/or an amine oxide of the amine" includes not only a "composition comprising the (A) to (D) components" but also a "composition comprising, in place of at least one of the (A) to (D) components, a modified material resulting from modification of the at least one of the (A) to (D) components" and a "composition comprising a reaction product resulting from reaction of at least a part of the (A) to (D) components with each other".

[0015] It is to be noted that the "lubricating oil composition for traction drive transmission of the present invention" will be sometimes referred to as "lubricating oil composition".

[A Component: Base Oil]

[0016] As the base oil in the lubricating oil composition, a mineral oil and/or a synthetic oil is used.

[0017] Examples of the mineral oil include paraffin-based mineral oils, intermediate-based mineral oils, and naphthene-based mineral oils, all of which are obtained by usual purification methods, such as solvent purification, hydrogenation purification, etc., and the like; and those prepared by isomerizing wax produced through Fischer-Tropsch process (gas-to-liquid waxes) or mineral oil-based wax; and the like.

[0018] Examples of the synthetic oil include hydrocarbon-based synthetic oils, ether-based synthetic oils, and the like.

[0019] Examples of the hydrocarbon-based synthetic oil include α-olefin oligomers or hydrides thereof, such as polybutene, polyisobutylene, a 1-octene oligomer, a 1-decene oligomer, an ethylene-propylene copolymer, etc.; aromatic compounds, such as an alkylbenzene, an alkylnaphthalene, etc.; naphthene ring-containing compounds, such as compounds having one naphthene ring, e.g., cyclopentane, cyclohexane, etc., compounds having two or more naphthene rings, e.g., phychtelite, oleanane, 2,4-dicyclohexyl-2-methylpentane, bicyclo[2.2.1]heptane, a hydride of a dimer of bicyclo[2.2.1]heptane ring compound, octahydrometanonaphthalene, octahydrometanoindane, decahydrometanoazulene, etc., etc.; and compounds resulting from substitution of the aforementioned compounds having one naphthene ring or compounds having two or more naphthene rings with one or more alkyl groups or alkylene groups having 1 to 3 carbon atoms. It is to be noted that with respect to crosslinked cyclic hydrocarbons, in the case of bicyclic hydrocarbons, the number of naphthene rings is defined as 2, and in the case of tricyclic hydrocarbons, the number of naphthene rings is defined as 3.

[0020] Examples of the ether-based synthetic oil include polyoxyalkylene glycols, polyphenyl ethers, and the like.

[0021] As for the base oil, only one of the aforementioned mineral oils and/or the aforementioned synthetic oils may be used, or two or more thereof may also be used. Furthermore, at least one mineral oil and at least one synthetic oil may be used in combination.

[0022] Among the aforementioned base oils, naphthene-based mineral oils or naphthene ring-containing compounds (naphthene-based synthetic oils) are preferred from the viewpoint of increasing the traction coefficient. Above all, naph-

thene-based synthetic oils are more preferred, and especially, naphthene-based synthetic oils having two or more naphthene rings are still more preferred.

[0023] Among the naphthene-based synthetic oils having two or more naphthene rings, bicyclo[2.2.1]heptane and a hydride of a dimer or trimer of bicyclo[2.2.1]heptane ring compound are suitable, with a dimer being especially preferred.

[0024] Examples of the bicyclo[2.2.1]heptane ring compound include compounds having a bicyclo[2.2.1]heptane ring, on which at least one alkyl group having 1 to 3 carbon atoms may be substituted, and having a molecular weight of 200 to 500. Examples of the dimer of the instant compound include endo-2-methyl-exo-3-methyl-exo-2-[(exo-3-methylbicyclo[2.2.1]hept-exo-2-yl)methyl]bicyclo[2.2.1]heptane, endo-2-methyl-exo-3-methyl-exo-2-[(exo-2-methylbicyclo[2.2.1]hept-exo-3-yl)methyl]bicyclo[2.2.1]heptane, endo-2-methyl-exo-3-methyl-exo-2-[(endo-3-methylbicyclo[2.2.1]hept-endo-2-yl)methyl]bicyclo[2.2.1]heptane, endo-2-methyl-exo-3-methyl-exo-2-[(endo-2-methylbicyclo[2.2.1]hept-endo-3-yl)methyl]bicyclo[2.2.1]heptane, and the like. Examples of the trimer of the instant compound include 3-methyl-2-[(3-methylbicyclo[2.2.1]hept-2-yl)methyl]-2-[(2,3-dimethylbicyclo[2.2.1]hept-2-yl)methyl]bicyclo[2.2.1]heptane, 2-[(bicyclo[2.2.1]hept-2-yl)methyl]-2-[(2-methylbicyclo[2.2.1]hept-2-yl)methyl]bicyclo[2.2.1]heptane, 2-[(bicyclo[2.2.1]hept-2-yl)ethyl]-2-[(2-ethylbicyclo[2.2.1]hept-2-yl)ethyl]bicyclo[2.2.1]heptane, and the like.

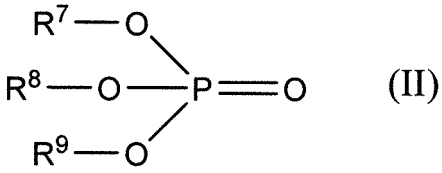
[0025] A blending amount of the base oil that is the (A) component is preferably 80 to 99% by mass, and more preferably 90 to 95% by mass relative to the total amount of the lubricating oil composition from the viewpoint of keeping a high traction coefficient while ensuring the blending proportions of other components.

[B Component: Phosphate Ester-Based Compound]

[0026] In the present invention, a phosphate ester-based compound is used as the B component. The phosphate ester-based compound has a role of preserving the seizure resistance.

[0027] Examples of the phosphate ester-based compound include phosphate esters, such as orthophosphate esters, acidic phosphate esters, phosphite esters, etc. At least one of these phosphate esters may be used. Among these phosphate esters, phosphite esters are suitable, but they may be properly selected according to the purpose.

[0028] As the orthophosphate ester, for example, those represented by the following general formula (II) are useful.



(II)

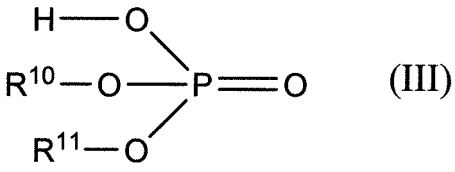
[0029] In the general formula (II), each of R^7 to R^9 represents an alkyl group having 4 to 24 carbon atoms, an alkenyl group having 4 to 24 carbon atoms, or a hetero atom-containing group having 4 to 24 carbon atoms which contains an atom selected from an oxygen atom, a nitrogen atom, and a sulfur atom in the aforementioned alkyl group or alkenyl group.

[0030] Though the alkyl group and the alkenyl group represented by R^7 to R^9 may be linear, branched, or cyclic, they are preferably linear. Furthermore, the alkyl group and the alkenyl group represented by R^7 to R^9 have preferably 6 to 20 carbon atoms, and more preferably 7 carbon atoms.

[0031] In the case where R^7 to R^9 are each a hetero atom-containing group, the number of hetero atoms is preferably 1 to 4, and the hetero atom is preferably a sulfur atom.

[0032] Examples of the alkyl group represented by R^7 to R^9 include an octyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group, a tridecyl group, a tetradecyl group, a pentadecyl group, a hexadecyl group, a heptadecyl group, an octadecyl group, a nonadecyl group, an eicosyl group, a heneicosyl group, a docosyl group, a tricosyl group, and a tetracosyl group. These may be linear, branched, or cyclic. Examples of the alkenyl group include an octenyl group, a nonenyl group, a decenyl group, an undecenyl group, a dodecenyl group, a tridecenyl group, a tetradecenyl group, a pentadecenyl group, a hexadecenyl group, a heptadecenyl group, an octadecenyl group, a nonadecenyl group, an eicosenyl group, a heneicosenyl group, a docosenyl group, a tricosenyl group, and a tetracosenyl group. These may be linear, branched, or cyclic, and a position of the double bond is arbitrary.

[0033] As the acidic phosphate ester, for example, those represented by the following general formula (III) are useful.



(III)

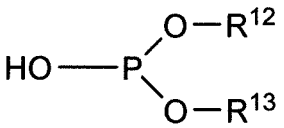
[0034] In the general formula (III), R^{10} represents a hydrogen atom, an alkyl group having 4 to 24 carbon atoms, an alkenyl group having 4 to 24 carbon atoms, or a hetero atom-containing group having 4 to 24 carbon atoms which contains an atom selected from an oxygen atom, a nitrogen atom, and a sulfur atom in the aforementioned alkyl group or alkenyl group. Among those, an alkyl group, an alkenyl group, or a hetero atom-containing group is preferable. R^{11} represents an alkyl group having 4 to 24 carbon atoms, an alkenyl group having 4 to 24 carbon atoms, or a hetero atom-containing group having 4 to 24 carbon atoms and containing an atom selected from an oxygen atom, a nitrogen atom, and a sulfur atom in the aforementioned alkyl group or alkenyl group.

[0035] Though the alkyl group and the alkenyl group represented by R^{10} and R^{11} may be linear, branched, or cyclic, they are preferably linear. Furthermore, the alkyl group and the alkenyl group represented by R^{10} and R^{11} have preferably 6 to 20 carbon atoms.

[0036] Specific examples of the alkyl group and the alkenyl group represented by R^{10} and R^{11} are the same as those in R^7 to R^9.

[0037] With respect to the hetero atom-containing group as R^{10} or R^{11}, the number of hetero atoms is preferably 1 to 4, and the hetero atom is preferably a sulfur atom.

[0038] As the phosphite ester, for example, those represented by the following general formula (IV) are useful.



(IV)

[0039] In the general formula (IV), R^{12} represents a hydrogen atom, an alkyl group having 4 to 24 carbon atoms, an alkenyl group having 4 to 24 carbon atoms, or a hetero atom-containing group having 4 to 24 carbon atoms and containing an atom selected from an oxygen atom, a nitrogen atom, and a sulfur atom in the aforementioned alkyl group or alkenyl group. Among those, an alkyl group, an alkenyl group, or a hetero atom-containing group is preferable. R^{13} represents an alkyl group having 4 to 24 carbon atoms, an alkenyl group having 4 to 24 carbon atoms, or a hetero atom-containing group having 4 to 24 carbon atoms and containing an atom selected from an oxygen atom, a nitrogen atom, and a sulfur atom in the aforementioned alkyl group or alkenyl group.

[0040] Though the alkyl group and the alkenyl group represented by R^{12} and R^{13} may be linear, branched, or cyclic, they are preferably linear. Furthermore, the alkyl group and the alkenyl group represented by R^{12} and R^{13} have preferably 6 to 20 carbon atoms, and more preferably 6 to 12 carbon atoms.

[0041] With respect to the hetero atom-containing group as R^{12} or R^{13}, the number of hetero atoms is preferably 1 to 4, and the hetero atom is preferably a sulfur atom.

[0042] Specific examples of the alkyl group and the alkenyl group represented by R^{12} and R^{13} are the same as those in R^7 to R^9.

[0043] A blending amount of the phosphate ester-based compound as the B component is preferably 0.05 to 10% by mass, and more preferably 0.5 to 8% by mass relative to the total amount of the lubricating oil composition from the viewpoints of improving the seizure resistance and inhibiting a lowering of the traction coefficient.

[C Component: Antioxidant]

[0044] In the present invention, an antioxidant is used as the C component. Examples of the antioxidant include amine-based antioxidants, phenol-based antioxidants, and sulfur-based antioxidants.

[0045] Examples of the amine-based antioxidant include dialkyldiphenylamines (the carbon number of the alkyl group is 1 to 20), such as 4,4'-dibutyldiphenylamine, 4,4'-dioctyldiphenylamine, 4,4'-dinonyldiphenylamine, etc and naphthylamines, such as phenyl-α-naphthylamine, octylphenyl-α-naphthylamine, nonylphenyl-α-naphthylamine, etc.

[0046] Examples of the phenol-based antioxidant include monophenol-based antioxidants, such as 2,6-di-tert-butyl-4-methylphenol, 2.6-di-tert-butyl-4-ethylphenol, etc.; and diphenol-based antioxidants, such as 4,4'-methylenebis(2,6-di-tert-butylphenol), 2,2'-methylenebis(4-ethyl-6-tert-butylphenol), etc.

[0047] Examples of the sulfur-based antioxidant include phenothiazine, pentaerythritol-tetrakis-(3-laurylthiopropionate), bis(3,5-tert-butyl-4-hydroxybenzyl)sulfide, thiodiethylenebis(3-(3,5-di-tert-butyl-4-hydroxyphenyl))propionate, 2,6-di-tert-butyl-4-(4,6-bis(octylthio)-1,3,5-triazine-2-methylamino)phenol, and the like.

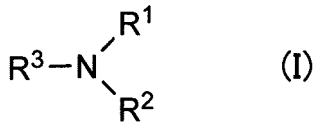
[0048] The aforementioned antioxidants may be used alone, or may be used in combination of two or more thereof. In the present invention, a combination of the phenol-based antioxidant with the amine-based antioxidant or sulfur-based antioxidant is preferably used, and a combination of the phenol-based antioxidant with the amine-based antioxidant is optimum.

[0049] A blending amount of the antioxidant as the C component is preferably 0.1 to 1.6% by mass, and more preferably

0.5 to 1% by mass relative to the total amount of the lubricating oil composition from the viewpoints of improving the oxidation stability and inhibiting a lowering of the traction coefficient.

[D Component: Amine]

[0050] In the present invention, an amine represented by the general formula (I) and/or an amine oxide of the instant amine (hereinafter sometimes referred to as "amine of the D component") is used as the D component. Either of the amine represented by the general formula (I) and the amine oxide of the instant amine may bring the effects of the present invention, but the amine represented by the general formula (I) is preferable from the viewpoints that it is likely to allow the base number to remain and that it is excellent in maintenance of the oxidation stability.



(I)

[0051] In the general formula (I),
each of R^1 and R^2 independently represents a linear, branched, or cyclic alkyl group having 1 to 26 carbon atoms, a linear, branched, or cyclic alkenyl group having 1 to 26 carbon atoms, $(R^4\text{-}O)_m\text{-}H$, or $(R^5\text{-}O)_{n1}\text{-}(R^6\text{-}O)_{n2}\text{-}H$, and R^1 and R^2 may be the same as or different from each other; each of R^4 to R^6 independently represents an alkylene group having 2 to 3 carbon atoms; each of m, n1, and n2 independently represents a number of 2 to 25; and
R^3 represents a substituted or unsubstituted, linear, branched, or cyclic alkyl group having 1 to 26 carbon atoms, or a substituted or unsubstituted, linear, branched, or cyclic alkenyl group having 1 to 26 carbon atoms.

[0052] The amine as the D component plays a role of not only neutralizing the acidity which has been increased by the addition of the phosphate ester-based compound as the B component, to inhibit corrosion of the metal but also inhibiting oxidation of the lubricating oil composition, to improve the oxidation stability. As other basic substances, a metal-based detergent, a primary amine, and a second amine might be thought. However, the metal-based detergent is excessively high in reactivity, so that the effect for preserving the seizure resistance of the phosphate ester-based compound as the B component is impaired. With respect to the primary amine and the secondary amine, there is a concern that such an amine reacts with the phosphate ester-based compound to generate precipitation.

[0053] In the general formula (I), each of R^1 to R^3 is preferably an alkyl group, and more preferably an unsubstituted linear alkyl group from the viewpoint of improving the stability.

[0054] In the general formula (I), the sum total of carbon number of R^1 to R^3 is preferably 10 to 40, more preferably 11 to 23, and still more preferably 12 to 22. When the sum total of carbon number is 10 or more, the amine as the D component may be allowed to remain as an effective component for a long period of time, and when the sum total of carbon number is 40 or less, the addition amount of the amine as the D component may be suppressed while ensuring the basic effective component in a certain proportion.

[0055] In the general formula (I), it is preferred that one or two of R^1 and R^2 are a methyl group, and it is more preferred that both of R^1 and R^2 are a methyl group. From the viewpoint of improving the stability, R^3 is preferably an unsubstituted linear alkyl group having 8 to 22 carbon atoms, and more preferably an unsubstituted linear alkyl group having 10 to 20 carbon atoms.

[0056] The amine as the D component may be used alone, or may be used in admixture of two or more thereof.

[0057] With respect to the amine as the D component, from the viewpoint of inhibiting a lowering of the traction coefficient, its base number is preferably one at which the blending amount of the D component becomes small, and the base number is preferably 50 mgKOH/g or more, and more preferably 100 mgKOH/g or more. It is to be noted that the base number as referred to in the present invention refers to a value measured by the hydrochloric acid method in conformity with JIS K2501.

[0058] A blending amount of the amine as the D component is preferably 0.05 to 4% by mass, more preferably 0.1 to 0.8% by mass, and still more preferably 0.15 to 0.5% by mass relative to the total amount of the lubricating oil composition from the viewpoints of appropriate neutralization and inhibition of a lowering of the traction coefficient.

[0059] In the lubricating oil composition, the phosphate ester-based compound as the B component and the amine as the D component are preferably blended in a mass ratio of 35/1 to 2/1, and more preferably blended in a mass ratio of 20/1 to 3/1. By blending these components in such a mass ratio, it is possible to improve a balance between the seizure resistance and the inhibition of corrosion favorable.

[E Component: Lubricating Oil Additive]

[0060] In the lubricating oil composition of the present invention, a lubricating oil additive may be further blended as an E component in the composition of the A to D components.

[0061] Examples of the lubricating oil additive as the E component include a viscosity index improver, a friction modifier, other lubricating oil additives, and the like. It is preferred to blend one or two or more lubricating oil additives selected from the foregoing additives.

[0062] Examples of the friction modifier include partial ester compounds obtained through reaction between a fatty acid and an aliphatic polyhydric alcohol. In the partial ester compound, the fatty acid is preferably a fatty acid having a linear or branched hydrocarbon group having 6 to 30 carbon atoms, and the carbon number of the hydrocarbon group is more preferably 8 to 24, and especially preferably 10 to 20. Examples of the fatty acid include saturated fatty acids, such as caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, arachidic acid, behenic acid, lignoceric acid, etc.; and unsaturated fatty acids, such as myristoleic acid, palmitoleic acid, oleic acid, linoleic acid, etc., with oleic acid being preferred. The aforementioned aliphatic polyhydric alcohol is an alcohol having a valence of 2 to 6, and examples thereof include ethylene glycol, glycerin, trimethylolpropane, pentaerythritol, sorbitol, sorbitan, and the like, with sorbitan being preferred. These partial ester compounds may be used alone, or may be used in combination of two thereof.

[0063] A fatty acid saturated monoamine and an unsaturated monoamine each having about 10 to 20 carbon atoms, such as stearylamine, oleylamine, etc., may also be suitably used as the friction modifier.

[0064] Examples of other lubricating oil additives include an antifoaming agent, a metal deactivator, an ultraviolet absorber, a rust-preventive agent, a pour-point depressant, and the like. Examples of the antifoaming agent include a silicone oil, a fluorinated silicone oil, and the like, and examples of the metal deactivator include copper deactivators, such as an N-[N,N'-dialkylaminomethyl] triazole (the carbon number of the alkyl group is 3 to 12), etc., and the like.

[0065] A blending amount of the lubricating oil additive varies with a performance to be added, and hence, it may not be unequivocally defined. However, it is preferably 3% by mass or less, and more preferably 0.1 to 1% by mass relative to the total amount of the lubricating oil composition.

[0066] It is preferred that the lubricating oil composition does not substantially contain a primary or secondary aliphatic amine. What the lubricating oil composition does not substantially contain a primary or secondary aliphatic amine means that the amount of the primary or secondary aliphatic amine is 0.1% by mass or less, preferably 0.01% by mass or less, and more preferably 0% by mass on the basis of the total amount of the lubricating oil composition. It is to be noted that even a primary or secondary amine may be added within the range where the effects of the present invention are not impaired. For example, so long as a primary or secondary amine having more than 20 carbon atoms is concerned, it tends to hardly generate a precipitate while it depends on a kind of the base oil.

[Traction Drive Transmission]

[0067] The traction drive transmission of the present invention is one using the aforementioned lubricating oil composition for traction drive transmission of the present invention as a lubricating oil composition contained in a traction drive transmission.

[0068] As a main body of the traction drive transmission, those which are conventionally known may be used. As the lubricating oil composition contained in the traction drive transmission, the aforementioned lubricating oil composition for traction drive transmission of the present invention is used.

[0069] The traction drive transmission of the present invention is excellent in remaining properties of the base number, and hence, it has thorough oxidation stability, preserves seizure resistance, and is free from an obstruction by a precipitate, high in a traction coefficient, and excellent in power transmission.

EXAMPLES

[0070] Next, the present invention is hereunder described in more detail by reference to Examples, but it should be construed that the present invention is in no way limited by these Examples. It is to be noted that in the Examples, the lubricating oil compositions were evaluated and measured in the following manners. The results are shown in Tables 1 and 2.

<Evaluation Method and Measurement Method of Lubricating Oil Composition>

(1) Base Number

[0071] A base number of a lubricating oil composition (new oil) was measured the hydrochloric acid method in conformity

with JIS K2501.

(2) Seizure Resistance

[0072] In the Falex test (rotation rate: 290 rpm, oil temperature: 100°C) in conformity with ASTM D3233 (A method), a load (N) at which a test piece caused seizure was measured. It is meant that the larger the load, the more excellent the seizure resistance performance is. A test piece which did not cause the seizure even at a load of 13,340 N is designated as ">13340".

(3) Remaining Base Number Amount

[0073] A base number of a lubricating oil composition which had been subjected to an oxidation stability test under conditions at 150°C for 240 hours in conformity with CEC L-48-A-00[B] was measured by the hydrochloric acid method in conformity with JIS K2501.

(4) Appearance

[0074] An appearance of a lubricating oil composition (new oil) immediately after blending was observed through visual inspection. The case where any change of the appearance was not observed is designated as "A", the case where the appearance was cloudy is designated as "B", and the case where precipitation was generated is designated as "C".

(5) Traction Coefficient

[0075] The measurement of the traction coefficient at 100°C was performed by using a two-cylinder friction tester. That is, the traction coefficient was determined with two cylinders each having the same size and coming into contact with each other (which had a diameter of 40 mm and a thickness of 20 mm and which were composed of a drum-shaped driven cylinder with a curvature radius of 20 mm and a flat driving cylinder without crowning) by rotating either one of the cylinders at a constant velocity while continuously varying a rotational velocity of the other, applying a load of 147.1 N to the contact portion of the both cylinders by a weight, and measuring a tangent force generating between the both cylinders, that is, the objective traction force. The cylinders were made of chromium molybdenum steel SCM420 and mirror-finished, an average circumferential velocity was 6.8 m/s, and a maximum hertz contact pressure was 1.24 GPa. The traction coefficient was measured under conditions at a slip ratio of 5%.

(6) μ Decrease Rate

[0076] A decrease ratio of the traction coefficient of each of the Examples and Comparative Examples relative to the traction coefficient of Comparative Example 1 was calculated based on the traction coefficients thus obtained above.

[Examples 1 to 18 and Comparative Examples 1 to 15]

[0077] Materials shown in Tables 1 and 2 were blended and stirred at 80°C for 30 minutes to prepare lubricating oil compositions, followed by undergoing the aforementioned evaluations and measurements.

[0078] It is to be noted that the symbols of the raw materials used in Tables 1 and 2 express as follows.

(A Component)

[0079]

A-1: Naphthene-based synthetic oil (hydride of dimer of bicyclo[2.2.1]heptane ring compound) (mixture of endo-2-methyl-exo-3-methyl-exo-2-[(exo-3-methylbicyclo[2.2.1]hept-exo-2-yl)methyl]bicyclo[2.2.1]heptane and endo-2-methyl-exo-3-methyl-exo-2-[(exo-2-methylbicyclo[2.2.1]hept-exo-3-yl)methyl]bicyclo[2.2.1]heptane) (number of naphthene rings: 4)
A-2: Naphthene-based synthetic oil (2,4-dicyclohexyl-2-methylpentane) (number of naphthene rings: 2)
A-3: Naphthene-based synthetic oil ((lS,3aR,4S,8aS)-4,8,8-trimethyl-9-methylene-decahydro-1,4-metanoazulene)
A-4: Ester-based synthetic oil (3,5,5-trimethylhexanoic acid 3,5,5-trimethylhexyl ester)

(B Component)

[0080] Phosphate ester-based compound (phosphorus content: 920 ppm, total acid number: 1.95 mgKOH/g)

(C Component)

[0081]

C-1: Monobutylphenyl monooctylphenylamine
C-2: Pentaerythritol tetrakis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate] C-3: Benzenepropanoic acid, 3,5-bis(1,1-dimethyl-ethyl)-4-hydroxy-C7-C9-alkyl ester (side chain)
C-4: 2,6-Di-tert-butyl-4-methylphenol
C-5: Phenyl-1-naphthylamine
C-6: Bis(tridecyl) thiodipropionate

(D Component)

[0082]

D-1: N-Methyldioleylamine (total carbon number of R^1 to R^3 in the general formula (I): 37, base number: 107 mgKOH/g)
D-2: N-Methyldidecylamine (total carbon number of R^1 to R^3 in the general formula (I): 21, base number: 184 mgKOH/g)
D-3: Dimethyldodecylamine (total carbon number of R^1 to R^3 in the general formula (I): 14, base number: 261 mgKOH/g)
D-4: Trioctylamine (total carbon number of R^1 to R^3 in the general formula (I): 24, base number: 154 mgKOH/g)
D-5: Dicyclohexylmethylamine (total carbon number of R^1 to R^3 in the general formula (I): 13, base number: 297 mgKOH/g)
D-6: N,N-Dimethyloctylamine (total carbon number of R^1 to R^3 in the general formula (I): 10, base number: 327 mgKOH/g)

(E Component)

[0083]

E-1: Detergent dispersant (calcium long chain alkyl sulfonate)
E-2: Detergent dispersant (polyolefin polyamine succinimide·polyol)
E-3: Detergent dispersant (calcium long chain alkyl salicylate)
E-4: Friction modifier (mixture of long chain alkyl polyamide, thio alkyl long chain alkyl ester, and oleic acid monoglyceride (mixture ratio:8/2/1))
E-5: Antifoaming agent (fluorinated silicone)
E-6: Benzotriazole-based ultraviolet absorber (aliphatic primary amine or secondary amine)
F-1: Oleylamine (aliphatic primary amine)
F-2: Di-hardened tallow alkylamine (carbon number of individual alkyl group: 12 to 20, C16: 30%, C18: 64%) (aliphatic secondary amine)

Table 1

Raw material	Example																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A-1	63.00	62.55	62.05	61.56	63.05	62.35	63.23	63.03	62.68	61.95	60.45	62.15	62.78	62.99	91.25	41.25	-	-
A-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	91.25	-
A-3	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	0.50	50.50	0.50	0.50
A-4	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	91.25
8	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65
C-1	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
C-2	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
C-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D-1	0.45	0.90	1.40	1.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D-2	-	-	-	-	0.40	1.10	-	-	-	-	-	-	-	-	-	-		-
D-3	-	-	-	-	-	-	0.20	0.40	0.77	1.50	3.00	-	-	-	0.20	0.20	0.20	0.20
D-4	-	-	-	-	-	-	-	-	-	-	-	1.30	-	-	-	-	-	-
D-5	-	-	-	-	-	-	-	-	-	-	-	-	0.67	-	-	-	-	-
D-6	-	-	-	-	-	-	-	-	-	-	-		-	0.46	-	-	-	-
E-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
E-5	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
E-6	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
F-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Base number (mgKOH/g)	1.73	2.20	2.74	3.22	1.93	3.17	1.63	2.2	3.18	5.76	9.7	3.27	3.13	3.28 1.75		1.75	1.74	1.77

(continued)

Raw material	Example																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Seizure resistance (N)	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340
Remaining base number	0.24	0.39	0.48	0.69	0.47	1.12	0.53	0.52	1.07	1.99	3.75	0.35	0.53	0.07	0.38	0.34	0.41	0.12
Appearance	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A
Traction coefficient	0.0845	0.0844	0.0831	0.0829	0.0842	0.0833	0.0847	0.0845	0.0845	0.0833	0.0813	0.0836	0.0842	0.0844	0.0847	0.0800	0.0847	0.0740
μ Decrease ratio (%)	0.6	0.7	2.2	2.5	0.9	2.0	0.4	0.6	0.6	2.0	4.4	1.6	0.9	0.7	0.4	5.9	0.4	12.9

Table 2

Raw material	Comparative Example														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A-1	63.45	62.65	61.85	62.39	61.46	62.25	62.10	61.74	62.83	62.67	62.56	91.45	41.45	-	-
A-2	-	-	-	-	-	-	-	-	-	-	-	-	-	91.45	-
A-3	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	0.50	50.50	0.50	0.50
A-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	91.45
B	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65
C-1	0.40	0.80	1.20	0.80	1.20	1.00	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
C-2	0.40	0.80	1.20	-	-	-	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
C-3	-	-	-	1.06	1.59	-	-	-	-	-	-	-	-	-	-
C-4	-	-	-	-	-	0.30	-	-	-	-	-	-	-	-	-
C-5	-	-	-	-	-	0.20	-	-	-	-	-	-	-	-	-
C-6	-	-	-	-	-	0.50	-	-	-	-	-	-	-	-	-
D-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-1	-	-	-	-	-	-	-	-	0.62	-	-	-	-	-	-
E-2	-	-	-	-	-	-	-	-	-	0.78	-	-	-	-	-
E-3	-	-	-	-	-	-	-	-	-	-	0.89	-	-	-	-
E-4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
E-5	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
E-6	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
F-1	-	-	-	-	-	-	1.35	-	-	-	-	-	-	-	-
F-2	-	-	-	-	-	-	-	1.71	-	-	-	-	-	-	-
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Base number (mgKOH/q)	1.17	1.29	1.26	1.25	1.26	1.26	4.49	3.13	1.04	1.22	1.31	1.25	1.22	1.22	1.25

(continued)

Raw material	Comparative Example														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Seizure resistance (N)	>13340	>13340	>13340	>13340	>13340	>13340	>13340	>13340	4220	3420	2280	>13340	>13340	>13340	>13340
Remaining base number	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.20	0.03	0.02	0.08	0.02	0.01	0.03	0.00
Appearance	A	A	A	A	A	A	C	C	A	A	A	A	A	A	A
Traction coefficient	0.0850	0.0841	0.0830	0.0838	0.0826	0.0836	0.834	0.0830	0.0843	0.0841	0.0840	0.0849	0.0800	0.0849	0.0740
μ Decrease ratio (%)	-	1.1	2.4	1.4	2.8	1.6	1.9	2.4	0.8	1.1	1.2	0.1	5.9	0.1	12.9

[0084] The following are understood from Tables 1 and 2. The lubricating oil compositions of the Examples could allow the base number to thoroughly remain even after the long-term use under high-temperature circumstances. This matter means that the base always exists even in the use under severe conditions, and the oxidation stability is favorable. In addition, the lubricating oil compositions of the Examples could preserve the seizure resistance without causing seizure even at a load of 13,340 N and did not generate precipitation by the addition of the base. In addition, the lubricating oil compositions of the Examples were less in a lowering of the traction coefficient relative to Comparative Example 1 as a reference and could inhibit a lowering of the traction coefficient.

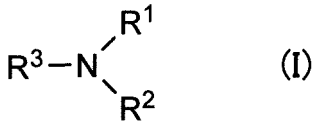
[0085] In contrast, the lubricating oil compositions of Comparative Examples 1 to 7, 9 to 10, and 12 to 15 could not allow the base number to thoroughly remain after the long-term use under high-temperature circumstances. This matter means that the amount of the base is not sufficient in the use under severe conditions, and the oxidation stability is not satisfactory. In addition, in Comparative Examples 7 and 8, in view of the fact that the primary amine or secondary amine was used, the precipitation was generated. In addition, in Comparative Examples 9 to 11, in view of the fact that the metal-based detergent dispersant was used, the effect for preserving the seizure resistance of the phosphate ester-based compound as the B component was impaired.

INDUSTRIAL APPLICABILITY

[0086] According to the present invention, it is possible to provide a lubricating oil composition capable of improving oxidation stability by allowing a base number to remain, preserving seizure resistance, preventing generation of precipitation to be caused due to addition of a base, and inhibiting a lowering of traction coefficient. In consequence, the lubricating oil composition of the present invention is able to be effectively utilized as a lubricating oil composition for traction drive transmission (T-CVT).

Claims

1. A lubricating oil composition for traction drive transmission preparing by blending (A) a base oil, (B) a phosphate ester-based compound, (C) an antioxidant, and (D) an amine represented by the following general formula (I) and/or an amine oxide of the amine:



(I)

wherein each of R^1 and R^2 independently represents a linear, branched, or cyclic alkyl group having 1 to 26 carbon atoms, a linear, branched, or cyclic alkenyl group having 1 to 26 carbon atoms, $(R^4\text{-}O)_m\text{-}H$, or $(R^5\text{-}O)_{n1}\text{-}(R^6\text{-}O)_{n2}\text{-}H$, and R^1 and R^2 may be the same as or different from each other; each of R^4 to R^6 independently represents an alkylene group having 2 to 3 carbon atoms; each of m, n1, and n2 independently represents a number of 2 to 25; and R^3 represents a substituted or unsubstituted, linear, branched, or cyclic alkyl group having 1 to 26 carbon atoms, or a substituted or unsubstituted, linear, branched, or cyclic alkenyl group having 1 to 26 carbon atoms.

2. The lubricating oil composition for traction drive transmission according to claim 1, wherein the base oil as the (A) component is a naphthene-based synthetic oil.

3. The lubricating oil composition for traction drive transmission according to claim 1 or 2, wherein in the amine represented by the general formula (I), the sum total of carbon number of R^1 to R^3 is 10 to 40.

4. The lubricating oil composition for traction drive transmission according to any one of claims 1 to 3, wherein in the amine represented by the general formula (I), R^1 and/or R^2 is a methyl group, and R^3 is an unsubstituted alkyl group having 8 to 22 carbon atoms.

5. The lubricating oil composition for traction drive transmission according to any one of claims 1 to 4, wherein the phosphate ester-based compound as the (B) component and the amine represented by the general formula (I) and/or the amine oxide of the amine as the (D) component are blended in a mass ratio of 35/1 to 2/1.

6. The lubricating oil composition for traction drive transmission according to any one of claims 1 to 5, wherein 80 to

99% by mass of the base oil as the (A) component, 0.05 to 10% by mass of the phosphate ester-based ester compound as the (B) component, 0.1 to 1.6% by mass of the antioxidant as the (C) component, and 0.05 to 4% by mass of the amine represented by the general formula (I) and/or the amine oxide of the amine as the (D) component are blended.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/073568

A. CLASSIFICATION OF SUBJECT MATTER
C10M133/06(2006.01)i, *C10M101/02*(2006.01)i, *C10M129/74*(2006.01)i, *C10M137/04*(2006.01)i, *C10M141/10*(2006.01)i, *C10M169/04*(2006.01)i, *C10N20/00*(2006.01)n, *C10N30/06*(2006.01)n, *C10N40/04*(2006.01)n
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)
C10M133/06, C10M101/02, C10M129/74, C10M137/04, C10M141/10, C10M169/04, C10N20/00, C10N30/06, C10N40/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/137258 A1 (Idemitsu Kosan Co., Ltd.), 19 September 2013 (19.09.2013), claims 1 to 8; paragraphs [0011], [0019] to [0023], [0028] to [0034], [0039]; examples 1 to 3 & JP 2013-189565 A	1-6
X	WO 2011/037054 A1 (Idemitsu Kosan Co., Ltd.), 31 March 2011 (31.03.2011), claims 1 to 6; paragraphs [0013] to [0022], [0027]; examples 1, 2 & US 2012/0149619 A1 & EP 2481790 A1	1-6

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 December, 2014 (02.12.14)	16 December, 2014 (16.12.14)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/073568

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/090914 A1 (Idemitsu Kosan Co., Ltd.), 23 July 2009 (23.07.2009), claims 1 to 7; paragraphs [0010] to [0027], [0035], [0036]; examples 1 to 7 & JP 2009-167337 A & US 2011/0053816 A1 & EP 2246412 A1	1-6
A	JP 2007-332377 A (Afton Chemical Corp.), 27 December 2007 (27.12.2007), claims 1 to 7; paragraphs [0029] to [0033], [0039]; examples & US 2007/0293406 A1 & GB 2439172 A & DE 102007021044 A1 & FR 2902437 A1 & KR 10-2007-0120025 A & CN 101323810 A	1-6
A	JP 2001-81489 A (Asahi Denka Co., Ltd.), 27 March 2001 (27.03.2001), claims 1 to 4; products 1 to 10 (Family: none)	1-6
A	JP 59-71395 A (Mitsubishi Oil Co., Ltd.), 23 April 1984 (23.04.1984), claims; examples 1 to 3 (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 6293892 A **[0004]**
- JP 2010202680 A **[0004]**