



(11) **EP 2 518 135 B2**

(12) **NEW EUROPEAN PATENT SPECIFICATION**
After opposition procedure

(45) Date of publication and mention
of the opposition decision:
26.01.2022 Bulletin 2022/04

(45) Mention of the grant of the patent:
07.01.2015 Bulletin 2015/02

(21) Application number: **10839048.5**

(22) Date of filing: **08.10.2010**

(51) International Patent Classification (IPC):
C10M 143/10 ^(2006.01) **C10M 143/08** ^(2006.01)
C10M 143/02 ^(2006.01) **C10N 10/04** ^(2006.01)
C10N 20/00 ^(2006.01) **C10N 20/02** ^(2006.01)
C10N 30/02 ^(2006.01) **C10N 40/25** ^(2006.01)
C10N 30/08 ^(2006.01) **C10N 30/10** ^(2006.01)

(52) Cooperative Patent Classification (CPC):
(C-Sets available)
C10M 143/08; C10M 143/02; C10M 143/10;
C10M 2203/1006; C10M 2203/1025;
C10M 2203/1085; C10M 2205/022;
C10M 2205/026; C10M 2205/04; C10M 2207/028;
C10M 2207/262; C10M 2209/084; C10M 2215/28;
C10M 2219/044; C10M 2223/045; (Cont.)

(86) International application number:
PCT/JP2010/067773

(87) International publication number:
WO 2011/077811 (30.06.2011 Gazette 2011/26)

(54) **SYSTEM LUBRICANT OIL COMPOSITION FOR CROSSHEAD-TYPE DIESEL ENGINE**

SYSTEMSCHMIERÖLZUSAMMENSETZUNG FÜR DIESELMOTOR IN KREUZKOPFBAUART

COMPOSITION D'HUILE LUBRIFIANTE POUR SYSTÈMES POUR MOTEUR DIESEL DE TYPE À CROSSE

(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**

(30) Priority: **24.12.2009 JP 2009292336**
24.12.2009 JP 2009292337

(43) Date of publication of application:
31.10.2012 Bulletin 2012/44

(73) Proprietor: **JX Nippon Oil & Energy Corporation**
Chiyoda-ku
Tokyo 100-8162 (JP)

(72) Inventor: **TAKESHIMA, Shigeki**
Chiyoda-ku
Tokyo 100-8162 (JP)

(74) Representative: **Johnson, Stephen William**
Venner Shipley LLP
Byron House
Cambridge Business Park
Cowley Road
Cambridge CB4 0WZ (GB)

(56) References cited:
EP-A1- 1 126 010 EP-A1- 1 985 689
WO-A1-95/34617 WO-A1-2007/127661
WO-A1-2008/102114 JP-A- 1 204 994
JP-A- 10 512 301 JP-A- 2007 231 115
US-A- 5 789 355 US-B1- 6 586 374

EP 2 518 135 B2

(52) Cooperative Patent Classification (CPC): (Cont.)
C10N 2020/02; C10N 2020/073; C10N 2030/02;
C10N 2030/08; C10N 2030/10; C10N 2030/52;
C10N 2030/54; C10N 2040/25; C10N 2040/252;
C10N 2040/255

C-Sets

C10M 2205/022, C10M 2205/024;
C10M 2205/022, C10M 2205/028;
C10M 2205/04, C10M 2205/022;
C10M 2205/04, C10M 2205/028;
C10M 2205/04, C10M 2205/06;

C10M 2207/028, C10N 2010/04;
C10M 2207/262, C10N 2010/04;
C10M 2219/044, C10N 2010/04;
C10M 2223/045, C10N 2010/04

Description**Technical Field**

5 [0001] The present invention relates to a system lubricating oil composition for a crosshead-type diesel engine.

Background Art

10 [0002] For a crosshead-type diesel engine, a cylinder oil for lubricating the friction point between the cylinders and pistons and a system oil for lubricating and cooling other portions have been used. The cylinder oil is required to have a suitable viscosity needed to lubricate a friction portion between a cylinder and a piston (piston ring) and a function to maintain detergency needed to allow a piston and a piston ring to move appropriately. Furthermore, since for this engine, a high-sulfur content fuel is generally used for the economy reason, it has a problem that acidic components such as sulfuric acid generated by the combustion of the fuel corrode a cylinder. In order to avoid this problem, the cylinder oil is required to have a function to neutralize the acidic components such as sulfuric acid so as to prevent corrosion.

15 [0003] Whereas, the system oil does not contact combustion gas unlike the usual diesel engine oil and is a lubricating oil which is stored in a tank and supplied to bearings with a circulation pump for lubrication and cooling and is thus required to maintain a suitable viscosity for a long period of time because it is used for a long time unlike the cylinder oil (see, for example, Patent Literature 1 below). However, a crosshead-type engine for ships has a problem that the system oil is eventually increased in viscosity by being mixed with a drip oil, and how such viscosity increase should be suppressed has become a longstanding problem. In particular, due to the recent growing environment issue, emphasis has been on avoidance of a deterioration in fuel efficiency resulting from the increased friction loss at bearings involving the viscosity increase or of a decrease in the heat-exchange efficiency at piston surfaces to be cooled.

20 [0004] Patent Literature 2 describes a method of lubricating a two-stroke, diesel crosshead engine, comprising lubricating the engine with a cylinder oil and with a system oil, in which the system oil comprises (a) a base oil, (b) a detergent additive, and (c) an anti-wear additive.

25 [0005] Patent Literature 3 describes a lubricating oil composition containing a base oil of lubricating viscosity, overbased sulfurized alkyl-phenate detergent, an overbased alkylsulfonate detergent, an ashless dispersant, and a zinc dialkyldithiophosphate and/or zinc diaryldithiophosphate.

30

Citation List**Patent Literature**

35 [0006]

Patent Literature 1: Japanese Patent Laid-Open Publication No. 2002-275491

Patent Literature 2: EP 1985689

Patent Literature 3: EP 1126010

40

Summary of Invention**Technical Problem**

45 [0007] The present invention has an object to provide a system lubricating oil composition for a crosshead-type diesel engine, which can prevent fuel efficiency deterioration by suppressing the viscosity increase.

Solution to Problem

50 [0008] As the results of extensive study and research, the present invention was accomplished on the basis of the finding that a lubricating oil composition containing a specific polymer can balance a viscosity increase caused by being mixed with a drip oil and a viscosity decrease due to thermal decomposition of a polymer and thus is an advantageously effective system lubricating oil composition for a crosshead-type diesel engine.

55 [0009] Specifically, a system oil comprising a lubricating base oil blended with a star polymer having a vinyl aromatic hydrocarbon structure in the molecule and/or an olefin copolymer, which have characteristics that are excellent in shear stability but likely to decompose with heat makes it possible to decrease the viscosity of the system oil by the decomposition of the polymer at piston surfaces to be cooled and thus balance out the viscosity increase caused by being mixed with a cylinder drip oil thereby suppressing fuel efficiency deterioration.

[0010] That is, the present invention relates to the use of a system lubricating oil composition in a crosshead-type diesel engine, the system lubricating oil composition comprising a mineral base oil and/or a synthetic base oil, and (A) (a-1) a star polymer having a vinyl aromatic hydrocarbon structure in the molecule and/or (a-2) an ethylene- α -olefin copolymer or a hydrogenated compound thereof, and having a base number of 4 to 20 mgKOH/g and a 100°C kinematic viscosity of 7.5 to 15.0 mm²/s; wherein Component (A) is contained in an amount of 2 to 15 percent by mass on the basis of the total mass of the composition. The present invention further relates to a system lubricating oil composition for a crosshead-type diesel engine comprising a mineral base oil and/or a synthetic base oil, and (A) (a-1) a star polymer having a vinyl aromatic hydrocarbon structure in the molecule and/or (a-2) an ethylene- α -olefin copolymer or a hydrogenated compound thereof, and having a base number of 4 to 20 mgKOH/g and a 100°C kinematic viscosity of 7.5 to 12.5 mm²/s; wherein Component (A) is contained in an amount of 2 to 15 percent by mass on the basis of the total mass of the composition.

[0011] The present invention also relates to the foregoing system lubricating oil composition for a crosshead-type diesel engine wherein Component (a-1) is a compound having a structure wherein the polymer or copolymer of a diene extends radially from the core of the vinyl aromatic hydrocarbon located in the center of the molecule.

[0012] The present invention also relates to the foregoing system lubricating oil composition for a crosshead-type diesel engine wherein the vinyl aromatic hydrocarbon is divinylbenzene.

[0013] The present invention also relates to the foregoing system lubricating oil composition for a crosshead-type diesel engine wherein the polymer or copolymer of a diene is polyisoprene or an isoprene-styrene copolymer.

[0014] The present invention also relates to the foregoing system lubricating oil composition for a crosshead-type diesel engine further comprising at least one type selected from the group consisting of (B) metal detergents, (C) zinc dialkyldithiophosphates, (D) rust inhibitors and (E) ashless dispersants.

[0015] The present invention also relates to the foregoing system lubricating oil composition for a crosshead-type diesel engine wherein the base oil has a 100°C kinematic viscosity of 3.5 to 9.3 mm²/s.

Advantageous Effects of Invention

[0016] The use of the system lubricating oil composition for a crosshead-type diesel engine of the present invention makes it possible to suppress the viscosity from increasing, resulting in inhibition of fuel efficiency deterioration.

Description of Embodiments

[0017] The present invention will be described in details below.

[0018] No particular limitation is imposed on the type of lubricating base oil to be used in the system lubricating oil composition for a crosshead-type diesel engine of the present invention (hereinafter merely referred to as "the lubricating oil composition of the present invention"), which may be a mineral oil, a synthetic oil, or a mixture thereof.

[0019] Specific examples of the mineral base oil include those which can be produced by subjecting a lubricating oil fraction produced by vacuum-distilling an atmospheric distillation bottom oil resulting from atmospheric distillation of a crude oil, to any one or more treatments selected from solvent deasphalting, solvent extraction, hydrocracking, solvent dewaxing, and hydrorefining; wax-isomerized mineral oils; and those produced by isomerizing GTL WAX (Gas to Liquid Wax) produced through Fischer-Tropsch process.

[0020] Specific examples of the synthetic base oil include polybutenes and hydrogenated compounds thereof; poly- α -olefins such as 1-octene oligomer and 1-decene oligomer, and hydrogenated compounds thereof; copolymers of ethylene having a weight average molecular weight of 8,000 or less and α -olefins having 3 to 30 carbon atoms; diesters such as ditridecyl glutarate, di-2-ethylhexyl adipate, diisodecyl adipate, ditridecyl adipate and di-2-ethylhexyl sebacate; polyol esters such as trimethylolpropane caprylate, trimethylolpropane pelargonate, pentaerythritol 2-ethylhexanoate and pentaerythritol pelargonate; copolymers of dicarboxylic acids such as dibutyl maleate and α -olefins having 2 to 30 carbon atoms; aromatic synthetic oils such as alkylnaphthalenes, alkylbenzenes, and aromatic esters; and mixtures of the foregoing.

[0021] The lubricating base oil used in the lubricating oil composition of the present invention may be any one or more type of the mineral base oils or synthetic base oils or a mixture of one or more of the mineral base oils and one or more of the synthetic base oils.

[0022] The 100°C kinematic viscosity of the lubricating base oil used in the present invention is preferably 9.3 mm²/s or lower, more preferably 8.5 mm²/s or lower, more preferably 8.0 mm²/s or lower. Whereas, the 100°C kinematic viscosity is preferably 3.5 mm²/s or higher, more preferably 3.8 mm²/s or higher, more preferably 4.0 mm²/s or higher. The 100°C kinematic viscosity referred herein denotes one defined by ASTM D-445. If the 100°C kinematic viscosity is higher than 9.3 mm²/s, the resulting composition could be less in viscosity decrease and thus might not exhibit the effect of suppressing the viscosity increase when mixed with a cylinder drip oil. If the 100°C kinematic viscosity is lower than 3.5 mm²/s, the resulting composition could be decreased in viscosity too much and thus could be deteriorated in oil film

formation capability at bearings, possibly causing seizure.

[0023] No particular limitation is imposed on the 40°C kinematic viscosity of the lubricating base oil used in the present invention, which is, however, preferably 150 mm²/s or lower, more preferably 120 mm²/s or lower, more preferably 90 mm²/s or lower. Whereas, the 40°C kinematic viscosity is preferably 15 mm²/s or higher, more preferably 20 mm²/s or higher, more preferably 25 mm²/s or higher. If the 40°C kinematic viscosity is higher than 200 mm²/s, the resulting composition could be less in viscosity decrease and thus might not exhibit the effect of suppressing the viscosity increase when mixed with a cylinder drip oil. If the 40°C kinematic viscosity is lower than 50 mm²/s, the resulting composition could be decreased in viscosity too much and thus could be deteriorated in oil film formation capability at bearings, possibly causing seizure.

[0024] The viscosity index of the lubricating base oil used in the present invention is preferably 85 or greater, more preferably 90 or greater, more preferably 95 or greater. No particular limitation is imposed on the upper limit of the viscosity index. Normal paraffin, slack wax or GTL wax or isoparaffinic mineral oils produced by isomerizing the foregoing may also be used.

[0025] The viscosity index referred herein denotes one measured in accordance with JIS K 2283-1993.

[0026] The lubricating oil composition of the present invention contains necessarily (a-1) a star polymer having a vinyl aromatic hydrocarbon structure in the molecule and/or (a-2) an ethylene- α -olefin copolymer or a hydrogenated compound thereof, as Component (A).

[0027] The star polymer having a vinyl aromatic hydrocarbon structure in the molecule that is Component (a-1) is a compound having a structure wherein the arms of polymers or copolymers of a number of (two or more) dienes extend radially from the core of the vinyl aromatic hydrocarbon located in the center of the molecule.

[0028] Examples of the vinyl aromatic hydrocarbon located in the center of the molecule include divinylbenzene, trivinylbenzene, tetravinylbenzene, divinylortho-, divinylmetha- or divinylpara-xylene, trivinylortho-, trivinylmetha- or trivinylpara-xylene, tetravinylortho-, tetravinylmetha- or tetravinylpara-xylene, divinyl-naphthalene, divinylethylbenzene, divinylbiphenyl, diisobutenylbenzene, diisopropenylbenzene, and diisopropenylbiphenyl. Among these compounds, preferred is divinylbenzene.

[0029] The diene monomer constituting the polymer or copolymer of dienes has preferably 4 to 12 carbon atoms. Specific examples include 1,3-butadiene, isoprene, piperylene, methylpentadiene, phenylbutadiene, 3,4-dimethyl-1,3-hexadiene, and 4,5-diethyl-1,3-octadiene. Preferred are 1,3-butadiene and isoprene.

[0030] Examples of the polymer or copolymer of dienes that will be a star polymer include homopolymers of diene such as polyisoprene and copolymers of diene such as isoprene-butadiene copolymer. Alternatively, copolymers of diene and other monomer that is not diene (for example, isoprene-styrene copolymer) may be used. The copolymer may be a random copolymer or a block copolymer.

[0031] Component (a-1) that is a star polymer having a vinyl aromatic hydrocarbon structure in the molecule used as Component (A) in the present invention has a weight average molecular weight (Mw) of preferably 10,000 or greater, more preferably 50,000 or greater, more preferably 100,000 or greater and preferably 1,000,000 or less, more preferably 800,000 or less, more preferably 500,000 or less. If the weight average molecular weight is less than 10,000, the resulting composition might not exhibit sufficiently an viscosity adjustment effect but also the production cost could be increased. If the weight average molecular weight is greater than 1,000,000, the resulting composition could be poor in shear stability and might not exhibit an viscosity adjustment effect as well.

[0032] The PSSI (permanent shear stability index) of (a-1) the star polymer having a vinyl aromatic hydrocarbon structure in the molecule used in the present invention is preferably from 1 to 40, more preferably from 1 to 35, more preferably 1 to 30, particularly preferably from 1 to 25. If the PSSI is greater than 40, the resulting composition may be poor in shear stability and thus might not exhibit sufficiently an viscosity adjustment effect. If the PSSI is less than 1, the resulting composition might not exhibit sufficiently an viscosity adjustment effect as well.

[0033] The term "PSSI" used herein denotes the permanent shear stability index of a polymer calculated on the basis of the data measured with ASTM D 6278-02 (Test Method for Shear Stability of Polymer Containing Fluids Using a European Diesel Injector Apparatus) in conformity with ASTM D 6022-01 (Standard Practice for Calculation of Permanent Shear Stability Index).

[0034] The ethylene- α -olefin copolymer or a hydrogenated compound thereof that is Component (a-2) is a copolymer of ethylene and an α -olefin or a compound produced by hydrogenating the copolymer. Specific examples of the α -olefin include propylene, isobutylene, 1-butene, 1-pentene, 1-hexene, 1-octene, 1-decene, and 1-dodecene. The ethylene- α -olefin copolymer may be one consisting of hydrocarbons that is of non-dispersant type or one produced by reacting a copolymer with a polar compound such as a nitrogen-containing compound that is a dispersant-type ethylene- α -olefin copolymer. Among these compounds, the most preferred is an ethylene- α -propylene copolymer.

[0035] The ethylene- α -olefin copolymer or a hydrogenated compound thereof that is (a-2) used as Component (A) in the present invention has a weight average molecular weight (Mw) of preferably 10,000 or greater, more preferably 20,000 or greater, more preferably 50,000 and preferably 500,000 or less, more preferably 400,000 or less, more preferably 300,000. If the weight average molecular weight is less than 10,000, the resulting composition might not

exhibit sufficiently an viscosity adjustment effect but also the production cost could be increased. If the weight average molecular weight is greater than 500,000, the resulting composition could be poor in shear stability and thus might not exhibit an viscosity adjustment effect as well.

[0036] The PSSI (permanent shear stability index) of (a-2) the ethylene- α -olefin copolymer or a hydrogenated compound thereof is preferably from 1 to 75, more preferably from 3 to 50, more preferably from 5 to 30, particularly preferably from 10 to 28. If the PSSI is greater than 75, Component (a-2) could be poor in shear stability and thus might not exhibit a viscosity adjustment effect when added to a system oil. If the PSSI is less than 1, the resulting composition might not exhibit a viscosity adjustment effect as well.

[0037] The content of Component (A) in the lubricating oil composition of the present invention is from 2 to 15 percent by mass, more preferably from 3 to 12 percent by mass, most preferably from 4 to 10 percent by mass on the basis of the total mass of the composition. If the content is less than 1 percent by mass, the resulting composition might not exhibit sufficiently a viscosity adjustment effect. If the content is more than 20 percent by mass, the resulting composition could be poor in handling properties, possibly causing adverse affects on the production of the composition and also could be deteriorated in detergency due to the generation of deposit caused by the degradation of the polymer.

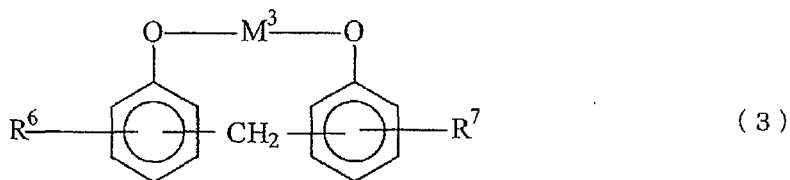
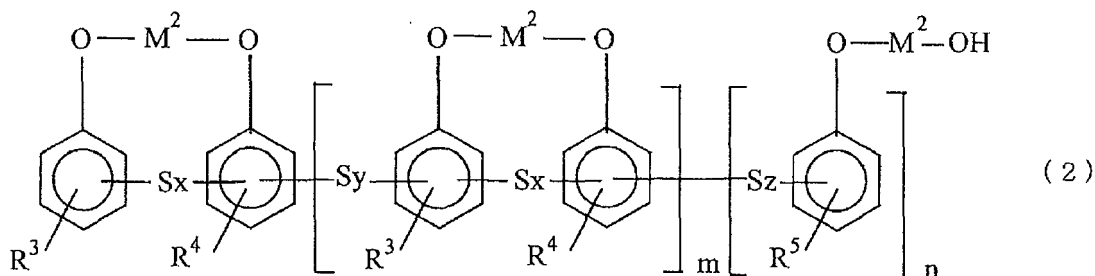
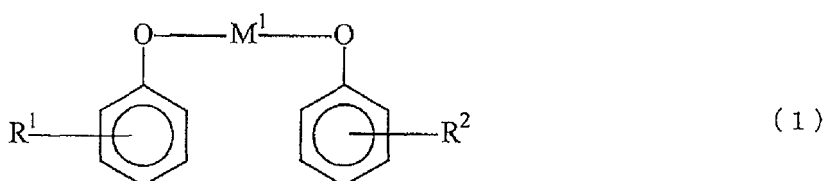
[0038] The ethylene- α -olefin copolymer or hydrogenated compound thereof is provided in a state wherein it is diluted with 1 to 90 percent by mass of a mineral oil.

[0039] The lubricating oil composition of the present invention contains preferably at least one type selected from the group consisting of (B) metal detergents, (C) zinc dialkyldithiophosphates, (D) rust inhibitors and (D) ashless dispersants.

[0040] Component (B) that is a metal detergent may be one or more metal detergents selected from phenate detergents, sulfonate detergents, salicylate detergents, carboxylate detergents and phosphonate detergents.

[0041] The phenate metal detergent is a phenate metal detergent containing an alkaline earth metal salt of an alkylphenol, an alkylphenolsulfide or a Mannich reaction product of an alkylphenol represented by formulas (1) to (3) below or an (overbased) basic salt of the alkaline earth metal salt.

[0042] Examples of the alkaline earth metal include magnesium, barium, and calcium. Preferred are magnesium and calcium, and particularly preferred is calcium.



[0043] In formulas (1) to (3), R¹, R², R³, R⁴, R⁵, R⁶ and R⁷ may be the same or different from each other and are each independently a straight-chain or branched alkyl group having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms. If the carbon number is fewer than 4, Component (B) could be poor in dissolubility in the lubricating base oil. If the carbon number is more than 30, Component (B) could be difficult to produce and poor in heat resistance. Specific examples of the alkyl group for R¹, R², R³, R⁴, R⁵, R⁶, and R⁷ are butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, and triacontyl groups. These alkyl groups may be straight-chain or branched and may be of primary, secondary, or tertiary.

[0044] M^1 , M^2 and M^3 are each independently an alkaline earth metal, preferably calcium and/or magnesium, x, y and z are each independently an integer of 1 to 3, m is 0, 1 or 2, and n is 0 or 1.

[0045] The sulfonate detergent may be an alkali metal salt or alkaline earth metal salt of an alkyl aromatic sulfonic acid produced by sulfonating an alkyl aromatic compound having a molecular weight of 300 or more, preferably 400 to 700 and/or an (overbased) basic salt of the alkali metal salt or alkaline earth metal salt. Examples of the alkali metal or alkaline earth metal include sodium, potassium, magnesium, barium and calcium. Preferred are magnesium and/or calcium. Particularly preferred is calcium.

[0046] Specific examples of the alkyl aromatic sulfonic acid include petroleum sulfonic acids and synthetic sulfonic acids. The petroleum sulfonic acids may be those produced by sulfonating an alkyl aromatic compound contained in the lubricant fraction of a mineral oil or may be mahogany acid by-produced upon production of white oil. The synthetic sulfonic acids may be those produced by sulfonating an alkyl benzene having a straight-chain or branched alkyl group, produced as a by-product from a plant for producing an alkyl benzene used as the raw material of a detergent or produced by alkylating polyolefin to benzene, or those produced by sulfonating alkylnaphthalenes such as dinonylnaphthalene. No particular limitation is imposed on the sulfonating agent used for sulfonating these alkyl aromatic compounds. In general, fuming sulfuric acids or sulfuric acid may be used.

[0047] The salicylate detergent may be an alkali metal or alkaline earth metal salicylate having one hydrocarbon group having 1 to 19 carbon atoms and/or an (overbased) basic salt thereof; an alkali metal or alkaline earth metal salicylate having one hydrocarbon group having 20 to 40 carbon atoms and/or an (overbased) basic salt thereof; or an alkali metal or alkaline earth metal salicylate having two or more hydrocarbon groups having 1 to 40 carbon atoms and/or an (overbased) basic salt thereof (these alkyl groups may be the same or different). Among these compounds, preferred are alkali metal or alkaline earth metal salicylates having one hydrocarbon group having 8 to 19 carbon atoms and/or (overbased) basic salts thereof because they are excellent in low-temperature flowability. Examples of the alkali metal or alkaline earth metal include sodium, potassium, magnesium, barium, and calcium. Preferred are magnesium and/or calcium. Particularly preferred is calcium.

[0048] The base number of Component (B) that is a metal detergent used in the present invention is preferably from 50 to 500 mgKOH/g, more preferably from 100 to 450 mgKOH/g, more preferably from 150 to 350 mgKOH/g. If the base number is less than 100 mgKOH/g, corrosive wear could be increased because the resulting composition could be insufficient in acid neutralization properties. If the base number is greater than 500 mgKOH/g, a problem regarding dissolubility could arise.

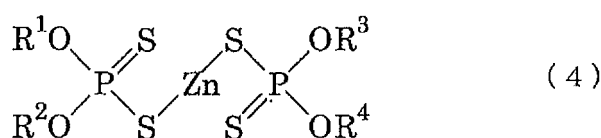
[0049] The term "base number" used herein denotes one measured by the perchloric acid potentiometric titration method in accordance with section 7 of JIS K2501 "Petroleum products and lubricants-Determination of neutralization number".

[0050] No particular limitation is imposed on the metal ratio of (B) the metal detergent. The lower limit is, however, 1 or greater, preferably 2 or greater, particularly preferably 2.5 or greater while the upper limit is 20 or less, preferably 15 or less, more preferably 10 or less.

[0051] The term "metal ratio" used herein is represented by "valence of metal element x metal element content (mole%) / soap group content (mole%)" in (B) the metal detergent". The metal element denotes an alkaline earth metal such as calcium and magnesium. The soap group denotes phenol group.

[0052] The content of (B) the metal detergent if contained in the composition of the present invention is usually from 0.5 to 15 percent by mass, preferably from 1 to 12 percent by mass, particularly preferably from 1.5 to 10 percent by mass.

[0053] The lubricating oil composition of the present invention contains preferably (C) zinc dialkyldithiophosphates represented by formula (4):



[0054] In formula (4), R^1 , R^2 , R^3 and R^4 may be the same or different from each other and are each independently an alkyl group having 1 to 30 carbon atoms, which may be straight-chain or branched and of primary, secondary, or an alkylaryl group having 7 to 30 carbon atoms.

[0055] No particular limitation is imposed on the method for producing zinc dithiophosphates that is Component (C) since any conventional method may be used. For example, an alcohol having alkyl groups corresponding to R^1 , R^2 , R^3 and R^4 above is reacted with phosphorus pentasulfide to produce dithiophosphoric acid, which is then neutralized with zinc oxide thereby synthesizing zinc dithiophosphate.

[0056] The content of (C) the zinc dithiophosphate if contained in the lubricating oil composition of the present invention is preferably from 0.005 to 0.12 percent by mass, more preferably from 0.01 to 0.10 percent by mass, more preferably

from 0.02 to 0.08 percent by mass on the basis of phosphorus of the total mass of the composition. If the content is less than 0.005 percent by mass, the resulting composition could fail to obtain extreme pressure properties or gear characteristics required for a system oil. If the content is more than 0.12 percent by mass, the resulting composition could corrode bearings, seal rings in a stuffing box or oil scraper rings.

[0057] The lubricating oil composition of the present invention contains preferably (D) rust inhibitors. Examples of the rust inhibitors include sulfonic acid salts (salts of sodium, calcium or barium), succinic acid derivatives, organic acid esters such as fatty acid esters and sorbitan acid esters, carboxylic acid salts (sodium, magnesium, barium and zinc salts of stearic acid or naphthenic acid), polyhydric alcohol partial esters such as sorbitan monoester and pentaerythritol monoester, oxidized paraffin (oxidized wax), carboxylic acid, and phosphoric acid esters. Preferred are sulfonates.

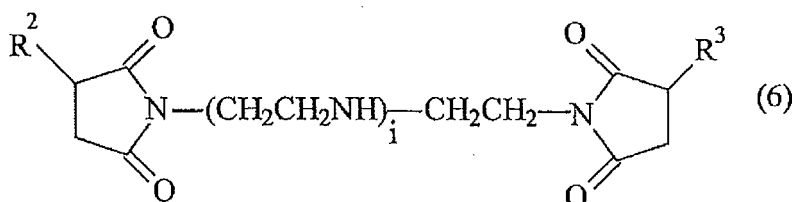
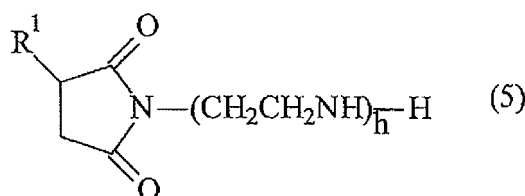
[0058] The content of (D) the rust inhibitor if contained in the lubricating oil composition of the present invention is preferably from 0.005 to 5 percent by mass on the basis of the total mass of the composition.

[0059] The lubricating oil composition of the present invention contains preferably (E) ashless dispersants.

[0060] The ashless dispersant may be any ashless dispersant that has been used in a lubricating oil. The ashless dispersant may be succinic acid imide, benzylamine, or polyamine having in their molecules at least one straight-chain or branched alkyl or alkenyl group having 40 to 400, preferably 60 to 350 carbon atoms, or modified products thereof.

[0061] The alkyl or alkenyl group may be straight-chain or branched but is preferably a branched alkyl or alkenyl group derived from oligomers of olefins such as propylene, 1-butene or isobutylene or a cooligomer of ethylene and propylene.

[0062] Among these compounds, preferred are succinimide or products modified with boron represented by the following formulas:



[0063] In formula (5), R^1 is an alkyl or alkenyl group having 40 to 400, preferably 60 to 350, and h is an integer of 1 to 5, preferably 2 to 4. In formula (6), R^2 and R^3 are each independently an alkyl or alkenyl group having 40 to 400, preferably 60 to 350 carbon atoms, and particularly preferably polybutenyl group, and i is an integer of 0 to 4, preferably 1 to 3.

[0064] The content of the ashless dispersant if contained in the lubricating oil composition of the present invention is preferably from 1 to 8 percent by mass on the basis of the total mass of the composition.

[0065] In addition to the above-described components in order to further improve the properties of the lubricating oil composition of the present invention or add other required properties thereto, any additives that have been conventionally used in a lubricating oil may be added in accordance with the purposes. Examples of such additives include antioxidants, extreme pressure additives, corrosion inhibitors, demulsifiers, metal deactivators, pour point depressants, and anti-foaming agents.

[0066] Examples of the antioxidants include phenolic antioxidants such as DBPC, bisphenol, and hindered phenols, aminic antioxidants such as diphenylamine and N-phenyl- α -naphthylamine, and metal antioxidants such copper and molybdenum antioxidants.

[0067] The content of the antioxidant if contained in the lubricating oil composition is preferably from 0.05 to 5 percent by mass on the basis of the total mass of the composition.

[0068] Eligible extreme pressure additives are any extreme pressure additives and anti-wear agents that have been used in a lubricating oil. For example, sulfuric-, phosphoric- and sulfuric-phosphoric extreme pressure additives may be used. Specific examples include phosphorus acid esters, thiophosphorus acid esters, dithiophosphorus acid esters, trithiophosphorus acid esters, phosphoric acid esters, thiophosphoric acid esters, dithiophosphoric acid esters, trithiophosphoric acid esters, amine salts, metal salts or derivatives thereof, dithiocarbamates, zinc dithiocarbamates, molybdenum dithiocarbamates, disulfides, polysulfides, sulfurized olefins, and sulfurized fats and oils.

[0069] The content of the extreme pressure additive if contained in the lubricating oil composition of the present invention is preferably from 0.05 to 5 percent by mass on the basis of the total mass of the composition.

[0070] Examples of the corrosion inhibitor include benzotriazole-, tolyltriazole-, thiadiazole-, and imidazole-types compounds.

[0071] Examples of the demulsifier include polyalkylene glycol-based non-ionic surfactants such as polyoxyethylene-alkyl ethers, polyoxyethylenealkylphenyl ethers, and polyoxyethylenealkylnaphthyl ethers.

[0072] Examples of the metal deactivator include imidazolines, pyrimidine derivatives, alkylthiadiazoles, mercapto-benzothiazoles, benzotriazoles and derivatives thereof, 1,3,4-thiadiazolepolysulfide, 1,3,4-thiadiazolyl-2,5-bisdi-alkyldithiocarbamate, 2-(alkyldithio)benzimidazole, and β -(o-carboxybenzylthio)propionitrile.

[0073] The pour point depressant may be a polymethacrylate polymer that is suitable for a lubricating base oil to be used.

[0074] Examples of the anti-foaming agent include silicone oil with a 25°C kinematic viscosity of 100 to 100,000 mm²/s, alkenylsuccinic acid derivatives, esters of polyhydroxy aliphatic alcohols and long-chain fatty acids, aromatic amine salts of methylsalicylate and o-hydroxybenzyl alcohol, aluminum stearate, potassium oleate, N-dialkyl-allylamine nitroamino-alkanol, and isoamyloltylphosphate, alkylalkylenediphosphates, metal derivatives of thioethers, metal derivatives of disulfides, fluorine compounds of aliphatic hydrocarbons, triethylsilane, dichlorosilane, alkylphenyl polyethylene glycol ether sulfide, and fluoroalkyl ethers.

[0075] When these additives are contained in the lubricating oil composition of the present invention, the corrosion inhibitor, rust inhibitor and demulsifier are each contained in an amount of usually 0.005 to 5 percent by mass, the metal deactivator is usually contained in an amount of usually 0.005 to 1 percent by mass, and the anti-foaming agent is usually contained in an amount of usually 0.0005 to 1 percent by mass, all on the basis of the total mass of the composition.

[0076] The kinematic viscosity at 100°C of the lubricating oil composition of the present invention is necessarily 7.5 mm²/s or higher, preferably 9.3 mm²/s or higher, more preferably 10 mm²/s or higher. The kinematic viscosity at 100°C is necessarily 15.0 mm²/s or lower, preferably 14.5 mm²/s or lower, more preferably 12.5 mm²/s or lower. If the 100°C kinematic viscosity is lower than 7.5 mm²/s, the resulting composition could be poor in film formation capability and thus could cause seizure at bearings. If the 100°C kinematic viscosity is higher than 15.0 mm²/s, the resulting composition might not sufficiently cool piston surfaces to be cooled, causing burn of pistons and also could deteriorate fuel efficiency due to the increased friction loss.

[0077] The base number of the lubricating oil composition of the present invention is necessarily from 4 to 20 mgKOH/g. The lower limit is preferably 5 mgKOH/g or greater, more preferably 5.5 mgKOH/g or greater while the upper limit is preferably 15 mgKOH/g or less, more preferably 10 mgKOH/g or less. If the base number is less than 4 mgKOH/g, the resulting composition could be poor in detergency. If the base number is greater than 20 mgKOH/g, the composition could be less likely to remove mixed foreign substances in a purifier.

[0078] The lubricating oil composition of the present invention is not only suitably applicable as a system oil for a crosshead-type diesel engine but also can be used for trunk-piston-type diesel engines as well as gasoline, diesel and gas engines of motorcycles, automobiles, power generators and cogeneration units.

Examples

[0079] The present invention will be described in more detail with reference to the following Examples and Comparative Examples but are not limited thereto.

(Examples 1 to 18, and Comparative Examples 1 to 4)

[0080] Lubricating oil compositions of the present invention (Examples 1 to 18) and those for comparison (Comparative Examples 1 to 4) as set forth in Tables 1 and 2 were prepared. Each of the resulting compositions was subjected to a hot tube test, and the results thereof are also set forth in Tables 1 and 2. For Examples 1 to 7 and 10 to 16 and Comparative Examples 1, 3 and 4, the content of the polymer compound and the ratio of the base oil were adjusted so that the 100°C kinematic viscosity of each composition mixed with additives was 11.5 mm²/s.

(Base Oil)

[0081]

Base Oil A: 100 neutral (kinematic viscosity at 100°C: 4.42 mm²/s)

Base Oil B: 250 neutral (kinematic viscosity at 100°C: 7.12 mm²/s)

Base Oil C: 500 neutral (kinematic viscosity at 100°C: 10.8 mm²/s)

Base Oil D: 150 bright stock (kinematic viscosity at 100°C: 31.7 mm²/s)

EP 2 518 135 B2

(Additive)

(1) Polymer Compound

5 **[0082]**

A-1: Polyisoprene star polymer (polymer wherein polyisoprene bonds as arms to divinylbenzene, PSSI=2)

A-2: Polyisoprene-polystyrene star polymer (polymer wherein an isoprene-styrene copolymer bonds as arms to divinylbenzene, PSSI=25)

10 A-3: Ethylene-propylene copolymer (PSSI=25)

PMA: Polymethacrylate (PSSI=5)

PB: Polybutene (molecular weight: 800)

(2) Additives other than the polymer compounds

15

[0083]

B-1: Metal Detergent (overbased basic calcium phenate, base number: 255 mgKOH/g, Ca content: 9.25 mass%)

B-2: Metal Detergent (overbased calcium salicylate, base number: 170 mgKOH/g, Ca content: 6.2 mass%)

20 Zinc dialkyldithiophosphate: Primary zinc dialkyldithiophosphate (alkyl=2-ethylhexyl, P content: 7.4 mass%)

Rust Inhibitor: Neutral calcium sulfonate (base number: 20 mgKOH/g, Ca content: 2.35 percent by mass)

Ashless Dispersant: alkenyl succinimide (bis-type, nitrogen content: 1 mass%)

Other Additives (antioxidant, extreme pressure additive, pour point depressant, anti-foaming agent)

25 (Hot Tube Test)

[0084] This test was carried out in accordance with JPI-5S-55-99. At a test temperature of 250°C, the oil flowing out from each glass tube was collected, and the viscosity of the oil was measured with an automatic capillary viscometer (CACV) manufactured by Canon Inc. Six types of sample oils were tested for the following two cases.

30

A) Fresh Oil 100%

B) Mixture of 85% fresh oil and 15 mass% of cylinder drip oil collected from a crosshead-type diesel engine mounted on VLCC (Middle East to Japan), properties of the cylinder drip oil are as follows: kinematic viscosity (100°C): 28.1 mm²/s, acid number: 7.5 mgKOH/g, base number (perchloric acid method) : 24.1 mgKOH/g, pentane insoluble (A method): 6.0 mass%

35

40

45

50

55

[Table 1]

	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Example 9	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Base Oil Composition	mass%												
Base Oil A (100 neutral)		100	100	100	100	100	100	100	100				
Base Oil B (250 neutral)	100										100	100	100
Base Oil C (500 neutral)										92			
Base Oil D (150 bright stock)										8			
Polymer Compounds													
A-1 (Polyisoprene star polymer)	4.0	8.5											
A-2 (Polyisoprene-polystyrene star polymer)			9.0	9.5	8.7	8.4	8.9	6.5	10.7				
PMA (Polymethacrylate)												4.5	
PB (Polybutene)													19.0
Additives other than polymer compounds													
B-1 (Metal Detergent)	2.35	2.35	2.35		3.60	5.00	2.50	2.35	2.35	2.35	2.35	2.35	2.35
B-2 (Metal Detergent)				3.65			3.70						
Zinc dialkyldithiophosphate	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
Rust inhibitor	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Ashless Detergent					1.00	1.00	1.00						
Other Additives	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Properties of composition													
Kinematic Viscosity at 100°C	mm ² /s	11.5	11.5	11.5	11.5	11.5	11.5	10.0	12.5	11.5	7.4	11.5	11.5
Base Number	mgKOH/g	5.9	5.9	5.9	5.2	9.0	12.5	5.9	5.9	5.9	5.9	5.9	5.9
Hot Tube Test Results (100°C kinematic viscosity)													
Evaluation 1													
Before Test : Fresh Oil 100%	mm ² /s	11.5	11.5	11.5	11.5	11.5	11.5	10.0	12.5	11.5	7.4	11.5	11.5
Oil collected through Hot Tube Test	mm ² /s	11.4	11.1	11.0	11.0	11.2	11.2	9.8	12.2	11.6	7.3	11.3	11.3
Evaluation 2													
Before Test : Mixed Oil of 85% Fresh Oil and 15% Cylinder Drip Oil	mm ² /s	13.3	13.3	13.3	13.2	13.4	13.3	11.9	14.4	13.4	8.7	13.5	13.5
Oil collected through Hot Tube Test	mm ² /s	12.4	11.5	11.4	11.3	11.4	11.5	10.5	12.1	13.3	8.8	13.2	13.6

[Table 2]

	Example 10	Example 11	Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Example 18	Comparative Example 1	Comparative Example 2	Comparative Example 3
Base Oil Composition												
Base Oil A (100 neutral)		100		100	100	100	100	100	100			
Base Oil B (250 neutral)	100		100								100	100
Base Oil C (500neutral)										92		
Base Oil D (150 bright stock)										8		
Polymer Compounds												
A-3 (Ethylene-propylene copolymer)	4.0	8.5	4.5	9.0	8.2	7.9	8.5	6.0	10.2			
PMA (Polymethacrylate)												4.5
Additives other than polymer compounds												
B-1 (Metal Detergent)	2.35	2.35			3.60	5.00	2.50	2.35	2.35	2.35	2.35	2.35
B-2 (Metal Detergent)			3.65	3.65			3.70					
Zinc dialkyldithiophosphate	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Rust inhibitor	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Ashless Dispersant					1.00	1.00	1.00	1.00	1.00			
Other Additives	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Properties of composition												
Kinematic Viscosity at 100°C	11.5	11.5	11.5	11.5	11.5	11.5	11.5	10.0	12.5	11.5	7.4	11.5
Base Number	5.9	5.9	6.2	6.2	9.0	12.5	12.5	5.9	5.9	5.9	5.9	5.9
Hot Tube Test Results (100°C kinematic viscosity)												
Evaluation 1												
Before Test : Fresh Oil 100%	11.5	11.5	11.5	11.5	11.5	11.5	11.5	10.0	12.5	11.5	7.4	11.5
Oil collected through Hot Tube Test	11.4	11.3	11.3	11.2	11.3	11.2	11.2	9.8	12.3	11.6	7.3	11.3
Evaluation 2												
Before Test : Mixed Oil of 85% Fresh Oil and 15% Cylinder Drip Oil	13.4	13.3	13.2	13.1	13.4	13.3	13.3	11.8	14.5	13.4	8.7	13.5
Oil collected through Hot Tube Test	12.8	11.9	12.7	11.8	12.1	12.3	12.0	10.8	12.8	13.3	8.8	13.2

[0085] As apparent from the results set forth in Tables 1 and 2, the lubricating oil compositions of the present invention has no difference in viscosity change over those of Comparative Examples when tested by 100% fresh oils but are smaller in viscosity increase than the comparative oils when mixed with a cylinder drip oil.

Industrial Applicability

[0086] The lubricating oil composition of the present invention is smaller in viscosity increase even when mixed with a cylinder drip oil and thus excellent in fuel efficiency and exhibits excellent effects in particular as a system lubricating oil for a crosshead-type diesel engine.

Claims

1. A system lubricating oil composition for a crosshead-type diesel engine comprising:
 - a mineral base oil and/or a synthetic base oil;
 - (A) (a-1) a star polymer having a vinyl aromatic hydrocarbon structure in the molecule and/or (a-2) an ethylene- α -olefin copolymer or a hydrogenated compound thereof,
 - and having a base number of 4 to 20 mgKOH/g and a 100°C kinematic viscosity of 7.5 to 12.5 mm²/s;
 - wherein Component (A) is contained in an amount of 2 to 15 percent by mass on the basis of the total mass of the composition.
2. The system lubricating oil composition for a crosshead-type diesel engine according to claim 1 wherein Component (a-1) is a compound having a structure wherein the polymer or copolymer of a diene extends radially from the core of the vinyl aromatic hydrocarbon located in the center of the molecule.
3. The system lubricating oil composition for a crosshead-type diesel engine according to claim 1 or 2 wherein the vinyl aromatic hydrocarbon is divinylbenzene.
4. The system lubricating oil composition for a crosshead-type diesel engine according to any one of claims 1 to 3 wherein the polymer or copolymer of a diene is polyisoprene or an isoprene-styrene copolymer.
5. The system lubricating oil composition for a crosshead-type diesel engine according to any one of claims 1 to 4 further comprising at least one type selected from the group consisting of (B) metal detergents, (C) zinc dialkyldithiophosphates, (D) rust inhibitors and (E) ashless dispersants.
6. The system lubricating oil composition for a crosshead-type diesel engine according to any one of claims 1 to 5 wherein the base oil has a 100°C kinematic viscosity of 3.5 to 9.3 mm²/s.
7. Use of a system lubricating oil composition in a crosshead-type diesel engine, the system lubricating oil composition comprising:
 - a mineral base oil and/or a synthetic base oil;
 - (A) (a-1) a star polymer having a vinyl aromatic hydrocarbon structure in the molecule and/or (a-2) an ethylene- α -olefin copolymer or a hydrogenated compound thereof,
 - and having a base number of 4 to 20 mgKOH/g and a 100°C kinematic viscosity of 7.5 to 15.0 mm²/s;
 - wherein Component (A) is contained in an amount of 2 to 15 percent by mass on the basis of the total mass of the composition.
8. The use according to claim 7 wherein Component (a-1) is a compound having a structure wherein the polymer or copolymer of a diene extends radially from the core of the vinyl aromatic hydrocarbon located in the center of the molecule.
9. The use according to claim 7 or 8 wherein the vinyl aromatic hydrocarbon is divinylbenzene.
10. The use according to any one of claims 7 to 9 wherein the polymer or copolymer of a diene is polyisoprene or an isoprene-styrene copolymer.
11. The use according to any one of claims 7 to 10 wherein the system lubricating oil composition further comprises at least one type selected from the group consisting of (B) metal detergents, (C) zinc dialkyldithiophosphates, (D) rust inhibitors and (E) ashless dispersants.

12. The use according to any one of claims 7 to 11 wherein the base oil has a 100°C kinematic viscosity of 3.5 to 9.3 mm²/s.

Patentansprüche

5

1. Systemschmierölzusammensetzung für einen Dieselmotor vom Kreuzkopf-Typ, umfassend:

ein Mineralgrundöl und/oder ein synthetisches Grundöl;

10

(A) (a-1) ein Sternpolymer mit einer vinylaromatischen Kohlenwasserstoffstruktur im Molekül und/oder (a-2) ein Ethylen- α -Olefin-Copolymer oder eine hydrierte Verbindung davon, und mit einer Basenzahl von 4 bis 20 mg KOH/g und einer kinematischen Viskosität bei 100°C von 7,5 bis 12,5 mm²/s;

wobei Komponente (A) in einer Menge von 2 bis 15 Massenprozent, bezogen auf die Gesamtmasse der Zusammensetzung, enthalten ist.

15

2. Systemschmierölzusammensetzung für einen Dieselmotor vom Kreuzkopf-Typ nach Anspruch 1, wobei es sich bei Komponente (a-1) um eine Verbindung mit einer Struktur handelt, in der das Polymer oder Copolymer eines Diens sich radial vom Kern des sich im Zentrum des Moleküls befindenden vinylaromatischen Kohlenwasserstoffs erstreckt.

20

3. Systemschmierölzusammensetzung für einen Dieselmotor vom Kreuzkopf-Typ nach Anspruch 1 oder 2, wobei es sich bei dem vinylaromatischen Kohlenwasserstoff um Divinylbenzol handelt.

25

4. Systemschmierölzusammensetzung für einen Dieselmotor vom Kreuzkopf-Typ nach einem der Ansprüche 1 bis 3, wobei es sich bei dem Polymer oder Copolymer eines Diens um Polyisopren oder ein Isopren-Styrol-Copolymer handelt.

30

5. Systemschmierölzusammensetzung für einen Dieselmotor vom Kreuzkopf-Typ nach einem der Ansprüche 1 bis 4, ferner umfassend mindestens einen Typ aus der Gruppe bestehend aus (B) Metaldetergentien, (C) Zinkdialkyldithiophosphaten, (D) Rostschutzmitteln und (E) aschefreien Dispergiermitteln.

35

6. Systemschmierölzusammensetzung für einen Dieselmotor vom Kreuzkopf-Typ nach einem der Ansprüche 1 bis 5, wobei das Grundöl eine kinematische Viskosität bei 100°C von 3,5 bis 9,3 mm²/s aufweist.

40

7. Verwendung einer Systemschmierölzusammensetzung für einen Dieselmotor vom Kreuzkopf-Typ, wobei die Systemschmierölzusammensetzung Folgendes umfasst:

ein Mineralgrundöl und/oder ein synthetisches Grundöl;

45

(A) (a-1) ein Sternpolymer mit einer vinylaromatischen Kohlenwasserstoffstruktur im Molekül und/oder (a-2) ein Ethylen- α -Olefin-Copolymer oder eine hydrierte Verbindung davon, und mit einer Basenzahl von 4 bis 20 mg KOH/g und einer kinematischen Viskosität bei 100°C von 7,5 bis 15,0 mm²/s;

wobei Komponente (A) in einer Menge von 2 bis 15 Massenprozent, bezogen auf die Gesamtmasse der Zusammensetzung, enthalten ist.

50

8. Verwendung nach Anspruch 7, wobei es sich bei Komponente (a-1) um eine Verbindung mit einer Struktur handelt, in der das Polymer oder Copolymer eines Diens sich radial vom Kern des sich im Zentrum des Moleküls befindenden vinylaromatischen Kohlenwasserstoffs erstreckt.

9. Verwendung nach Anspruch 7 oder 8, wobei es sich bei dem vinylaromatischen Kohlenwasserstoff um Divinylbenzol handelt.

55

10. Verwendung nach einem der Ansprüche 7 bis 9, wobei es sich bei dem Polymer oder Copolymer eines Diens um Polyisopren oder ein Isopren-Styrol-Copolymer handelt.

11. Verwendung nach einem der Ansprüche 7 bis 10, wobei die Systemschmierölzusammensetzung ferner mindestens einen Typ aus der Gruppe bestehend aus (B) Metaldetergentien, (C) Zinkdialkyldithiophosphaten, (D) Rostschutzmitteln und (E) aschefreien Dispergiermitteln umfasst.

12. Verwendung nach einem der Ansprüche 7 bis 11, wobei das Grundöl eine kinematische Viskosität bei 100°C von 3,5 bis 9,3 mm²/s aufweist.

5 **Revendications**

1. Composition d'huile lubrifiante de système pour un moteur diesel de type à crosse comprenant :

une huile basique minérale et/ou une huile basique synthétique ;

10 (A) (a-1) un polymère en étoile ayant une structure d'hydrocarbure aromatique vinylique dans la molécule et/ou (a-2) un copolymère d'éthylène- α -oléfine ou un composé hydrogéné de celui-ci, et ayant un indice d'alcalinité de 4 à 20 mg de KOH/g et une viscosité cinématique à 100 °C de 7,5 à 12,5 mm²/s ; le composant (A) étant contenu dans une quantité de 2 à 15 pour cent en masse sur la base de la masse totale de la composition.

- 15 2. Composition d'huile lubrifiante de système pour un moteur diesel de type à crosse selon la revendication 1, dans laquelle le composant (a-1) est un composé ayant une structure dans laquelle le polymère ou copolymère d'un diène s'étend radialement depuis le cœur de l'hydrocarbure aromatique vinylique situé au centre de la molécule.

- 20 3. Composition d'huile lubrifiante de système pour un moteur diesel de type à crosse selon la revendication 1 ou 2 dans laquelle l'hydrocarbure aromatique vinylique est le divinylbenzène.

- 25 4. Composition d'huile lubrifiante de système pour un moteur diesel de type à crosse selon l'une quelconque des revendications 1 à 3 dans laquelle le polymère ou copolymère d'un diène est le polyisoprène ou un copolymère isoprène-styrène.

- 30 5. Composition d'huile lubrifiante de système pour un moteur diesel de type à crosse selon l'une quelconque des revendications 1 à 4 comprenant en outre au moins un type choisi dans le groupe constitué par (B) les détergents métalliques, (C) les dialkyldithiophosphates de zinc, (D) les produits antirouille et (E) les dispersants sans cendres.

- 35 6. Composition d'huile lubrifiante de système pour un moteur diesel de type à crosse selon l'une quelconque des revendications 1 à 5 dans laquelle l'huile basique a une viscosité cinématique à 100 °C de 3,5 à 9,3 mm²/s.

- 40 7. Utilisation d'une composition d'huile lubrifiante de système dans un moteur diesel de type à crosse, la composition d'huile lubrifiante de système comprenant :

une huile basique minérale et/ou une huile basique synthétique ;

45 (A) (a-1) un polymère en étoile ayant une structure d'hydrocarbure aromatique vinylique dans la molécule et/ou (a-2) un copolymère d'éthylène- α -oléfine ou un composé hydrogéné de celui-ci, et ayant un indice d'alcalinité de 4 à 20 mg de KOH/g

et une viscosité cinématique à 100 °C de 7,5 à 15,0 mm²/s ;

le composant (A) étant contenu dans une quantité de 2 à 15 pour cent en masse sur la base de la masse totale de la composition.

- 50 8. Utilisation selon la revendication 7, le composant (a-1) étant un composé ayant une structure dans laquelle le polymère ou copolymère d'un diène s'étend radialement du noyau de l'hydrocarbure aromatique vinylique situé dans le centre de la molécule.

9. Utilisation selon la revendication 7 ou 8, dans laquelle l'hydrocarbure aromatique vinylique est le divinylbenzène.

- 55 10. Utilisation selon l'une quelconque des revendications 7 à 9, dans laquelle le polymère ou copolymère d'un diène est le polyisoprène ou un copolymère isoprène-styrène.

11. Utilisation selon l'une quelconque des revendications 7 à 10, dans laquelle la composition d'huile lubrifiante de système comprend en outre au moins un type choisi dans le groupe constitué par (B) les détergents métalliques, (C) les dialkyldithiophosphates de zinc, (D) les produits antirouille et (E) les dispersants sans cendres.

EP 2 518 135 B2

12. Utilisation selon l'une quelconque des revendications 7 à 11, dans laquelle l'huile basique a une viscosité cinématique à 100 °C de 3,5 à 9,3 mm²/s.

5

10

15

20

25

30

35

40

45

50

55

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 2002275491 A [0006]
- EP 1985689 A [0006]
- EP 1126010 A [0006]