



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 057 882 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
06.12.2000 Bulletin 2000/49

(21) Application number: **00111046.9**

(22) Date of filing: **31.05.2000**

(51) Int. Cl.⁷: **C10M 133/56**, C10M 141/12,
C10M 159/12
// (C10M141/12, 133:56,
137:02, 137:04, 137:10),
C10N60:14

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **04.06.1999 JP 15774299**

(71) Applicants:
• **IDEMITSU KOSAN CO., LTD.**
Tokyo (JP)
• **NSK LTD.,**
Shinagawa-ku, Tokyo 141-8560 (JP)

(72) Inventors:
• **Hata, Hitoshi**
Ichihara-shi, Chiba-ken (JP)
• **Machida, Hisashi**
Fujisawa-shi, Kanagawa-ken (JP)

(74) Representative:
Gille Hrabal Struck Neidlein Prop Roos
Patentanwälte
Brucknerstrasse 20
40593 Düsseldorf (DE)

(54) **Lubricating oil composition for cellulose base wet friction material**

(57) There is disclosed a lubricating oil composition for cellulose base wet friction material which comprises a base oil blended with (A) a boron-containing imide base dispersant (e.g. boron treated polyalkenyl succinimide) having a weight-average molecular weight in the range of 500 to 3000 and having a ratio by weight of boron to nitrogen (B/N) in the range of 0.1 to 1.5 in such a blending amount that the boron content and the nitrogen content each derived from the component (A) are made to be at least 60 ppm by weight and at least 100 ppm by weight, respectively based on the base oil. The above lubricating oil composition enhances peeling resistant durability for a friction material, especially a cellulose base friction material without impairing the wear resistance or scoring resistance of a steel material element, and is well suited for use in a cellulose base friction material for a starting and running device and a transmission clutch that are used in an automatic transmission of an automobile.

EP 1 057 882 A1

Description**BACKGROUND OF THE INVENTION**

1. Field of the Invention

[0001] The present invention relates to a lubricating oil composition for a cellulose base wet friction material. More particularly, the present invention is concerned with a lubricating oil composition which enhances peeling resistant durability for a friction material, especially a cellulose base wet friction material without impairing the wear resistance or scoring resistance of a steel material element, and which is well suited as a lubricating oil composition for use in a cellulose base friction material for a starting and running device and a transmission clutch that are employed in an automatic transmission of an automobile.

2. Description of the Related Arts.

[0002] It has become popular in recent years to employ as an automobile transmission, a conventional automatic transmission, a belt-drive continuously variable transmission, a traction drive continuously variable transmission and the like.

[0003] Accompanying the aforesaid widened variety of automobile transmissions, a transmission oil undergoes change in required characteristics.

[0004] Said belt-drive continuously variable transmission and traction drive continuously variable transmission are each equipped with a starting/running device and a lock-up clutch, and besides the belt-drive portion and traction drive portions each become a new lubricating element. Accompanying the recent progress of miniaturization, lightweightness and maximization of transmission capacity, a lubricating oil is called upon to have lubricating characteristics for lubricating portions of high surface pressure such as gears, roller bearings, belt-drive portions and traction drive portions in addition to the friction characteristics of a friction material, for instance, to have wear resistance and scoring (seizure) resistance therefor.

[0005] As mentioned before, a lubricating oil to be used in an automobile transmission is called upon to be imparted with friction characteristics for a friction material (wet clutch) and at the same time, wear resistance and scoring (seizure) resistance, thus bringing about a trend towards the use of an additive having high reactivity with a metallic surface.

[0006] However, an additive having high reactivity with a metallic surface, that is, an active additive is highly active also with cellulose which is a principal component of a friction material. Thus the aforesaid active additive suffers from such disadvantages that brings about cutoff of cellulose structure (cutoff of cellulose fibers in the form of rings and chains) and elution thereof in oil or the like, and are more prone to cause damage such as peeling to a friction material.

[0007] In such circumstances, there has eagerly been desired the development of a lubrication technology capable of alleviating and suppressing the attacking property (reactivity) for cellulose which reaction is responsible for peeling and the like of a friction material, without impairing the wear resistance and scoring resistance thereof.

[0008] There has scarcely been any report on the technique for alleviating and suppressing the peeling damage to a friction material except the working effect of a metal base detergent dispersant (calcium sulfonate having a total base number of 300) { refer to preliminary prints for scientific lecture, Japan Automotive Engineering Society, 952, 9535297, 1995-5 }. Nevertheless, in the case of blending the metal base detergent dispersant, there is caused the problem of a fear of clogging the pores on the surface of a friction material, thus deteriorating the lubricating characteristics and the like.

SUMMARY OF THE INVENTION

[0009] Under such circumstances, a general object of the present invention is to provide a lubricating oil composition which enhances peeling resistant durability for a friction material, especially a cellulose base wet friction material without impairing the wear resistance or scoring resistance of a steel material element, and which is well suited as a lubricating oil composition for use in a cellulose base friction material for a starting and running device and a transmission clutch that are employed in an automatic transmission of an automobile.

[0010] Other objects of the present invention will be obvious from the text of this specification hereinafter disclosed.

[0011] In view of the foregoing, intensive extensive research and investigation were accumulated by the present inventors in order to achieve the above-mentioned objects. As a result, it has been found that the objects can effectively be attained by a lubricating oil composition which comprises a base oil blended with a specific boron-containing imide base dispersant so that the boron content and the nitrogen content in the base oil are made to be at least a prescribed value, respectively based on said base oil. The present invention has been accomplished by the foregoing findings and information.

[0012] Specifically, the present invention provides a lubricating oil composition for a cellulose base wet friction material which comprises a base oil blended with (A) a boron-containing imide base dispersant having a weight-average molecular weight in the range of 500 to 3000 and a ratio by weight of boron to nitrogen (B/N) in the range of 0.1 to 1.5 in such blending amounts that the boron content and the nitrogen content each derived from the component (A) in the base oil are made to be at least 60 ppm by weight and at least 100 ppm by weight, respectively based on said base oil.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The base oil to be used in the lubricating oil composition according to the present invention is not specifically limited, but may be properly and optionally selected for use from the base oils which have heretofore been customarily used as a lubricating oil composition in an automatic transmission of an automobile, and which are exemplified by mineral oils and synthetic oil as described hereunder.

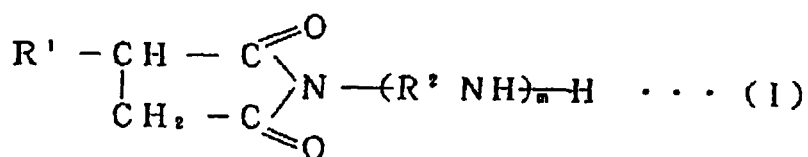
[0014] Examples of the mineral oils include neutral oils that are produced by solvent refining or hydrotreating such as 60 neutral oil, 100 neutral oil, 150 neutral oil, 300 neutral oil and 500 neutral oil, and base oils having a low pour point and improved in low temperature fluidity by removing wax component therefrom. Any of the aforesaid mineral oils may be used alone or in combination with at least one other species.

[0015] On the one hand, examples of the synthetic oils include synthetic naphthene base oil, poly α -olefin oligomer and ester base synthetic oils such as diester base, polyol ester base and polyglycol ester base. Any of the aforesaid synthetic oils is usually used alone, but may be used as a blend with the above exemplified mineral oils.

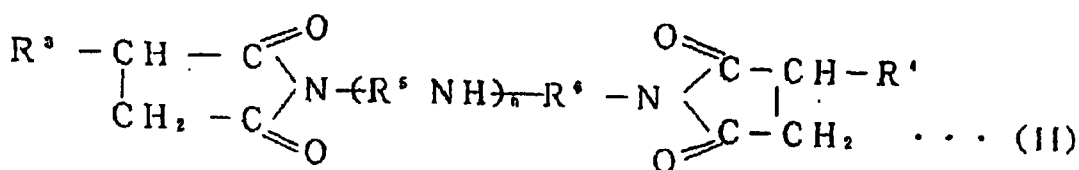
[0016] In the present invention, the base oil is used usually in an amount of at least 80% by weight based on the lubricating oil composition.

[0017] In the lubricating oil composition according to the present invention, there is used as the component (A), a boron-containing imide base dispersant having a weight average molecular weight in the range of 500 to 3000 and a ratio by weight of boron to nitrogen (B/N) in the range of 0.1 to 1.5. In the case where the weight-average molecular weight departs from the aforesaid range, or the ratio by weight of boron to nitrogen (B/N) deviates from said range, it is made impossible to obtain the lubricating oil composition imparted with the prescribed performances, thus failing to achieve the objects of the present invention. In view of the performances of the lubricating oil composition, the suitable boron-containing imide base dispersant is that which has a weight-average molecular weight in the range of 700 to 2500 and a ratio by weight of boron to nitrogen (B/N) in the range of 0.2 to 1.0.

[0018] The aforesaid boron-containing imide base dispersant as the component (A) is not specifically limited, provided that it is imparted with the above-mentioned properties, and it may be properly and optionally selected for use from among the additives for a lubricating oil that have heretofore been customarily used therefor. The foregoing boron-containing imide base dispersant is exemplified by the compound obtained by treating, with a boron compound, a monopolyalkenyl or polyalkyl succinimide represented by the general formula (I):



or bispolyalkenyl or polyalkyl succinimide represented by the general formula (II):



[0019] In the general formulae (I) and (II), R^1 , R^3 and R^4 are each independently an oligomer residue of an α -olefin having approximately 2 to 8 carbon atoms or a hydrate thereof, R^3 and R^4 may be the same or different, R^2 , R^5 and R^6 are each independently an alkylene group having 2 to 4 carbon atoms, R^5 and R^6 may be the same or different, m is an integer from 1 to 10, and n is 0 or an integer from 1 to 10.

[0020] In the present invention, the boron-containing imide base dispersant as the component (A) may be any of the boron-treated mono-compound represented by the general formula (I), the boron treated bis-compound represented by the general formula (II) and a mixture of the above two.

[0021] The aforesaid polyalkenyl or polyalkyl succinimide represented by the general formula (I) or (II) can be produced usually by allowing polyalkenyl succinimide anhydride which is obtained by the reaction between a polyolefin and maleic anhydride or the hydride thereof, namely polyalkyl succinimide anhydride to react with a polyalkylene polyamine. The above-mentioned mono-compound or bis-compound of the polyalkenyl or polyalkyl succinimide can be produced usually by altering the reaction ratio of the polyalkenyl or polyalkyl succinimide anhydride to the polyalkylene polyamine.

[0022] The polyolefin which is used as a starting raw material in the production of the aforesaid polyalkenyl or polyalkyl succinimide, is properly and optionally selected for use from the polyolefin which is obtained by polymerizing an α -olefin having approximately 2 to 8 carbon atoms so that the boron containing succinimide base dispersant as the final objective product has a weight-average molecular weight in the range of 500 to 3000. Moreover the α -olefin which constitutes the polyolefin may be used alone or in combination with at least one other species. As the polyolefin, polybutene is particularly preferable.

[0023] On the one hand, the foregoing polyalkylene polyamine is exemplified by polyethylene polyamine, polypropylene polyamine and polybutylene polyamine, of which polyethylene polyamine is preferable.

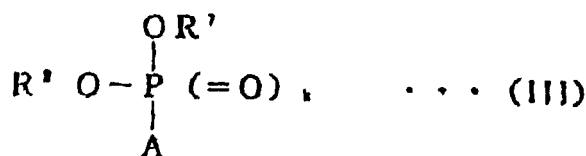
[0024] Of the aforesaid polyalkenyl or polyalkyl succinimide, there is preferably usable polyalkenyl succinimide, especially polybutenyl succinimide having a weight-average molecular weight of approximately 500 to 3000.

[0025] In the lubricating oil composition according to the present invention, it is necessary that the boron-containing imide base dispersant as the components (A) be blended so that the boron content and the nitrogen content that are derived from the component (A) are made to be at least 60 ppm by weight and 100 ppm by weight, respectively on the basis of the base oil. In the case where the boron content is less than 60 ppm by weight or the nitrogen content is less than 100 ppm by weight, it is made impossible to alleviate or suppress the unfavorable attack by active phosphate ester base compounds and active sulfur base compound against the cellulose base friction material (acceleration of cutoff and dissolution of cellulose chains due to the reaction between the cellulose and the active phosphorus base compounds and/or the active sulfur base compounds). Further, the friction material is more liable to be early peeled or damaged on the surface thereof. Taking into consideration the effective suppression of damage to the surface of the friction material, economical efficiency relating to the blending of the component, the boron content is in the range of preferably 60 to 500 ppm by weight, more preferably 60 to 300 ppm by weight and at the same time, the nitrogen content is in the range of preferably 100 to 2000 ppm by weight, more preferably 100 to 1200 ppm by weight.

[0026] In the lubricating oil composition according to the present invention, there is usually incorporated therein as the component (B), at least one member selected from the group consisting of active phosphorus base compounds and active sulfur base compounds.

[0027] The above-mentioned active phosphorus base compound to be used as the component (B) is not specifically limited, but may be properly and optionally selected for use in accordance with the situation from among the well known active phosphorus base compounds that have heretofore been used as an extreme pressure agent, an wear resistant agent, a friction modifying agent and the like, for instance, acidic phosphate esters, phosphite esters, acidic phosphite esters and hypophosphite esters.

[0028] As the active phosphate ester base compound to be used in the lubricating oil composition according to the present invention, there are preferably used the acidic phosphate esters and/or phosphite esters represented by the general formula (III):



wherein A is hydrogen atom or hydroxyl group, k is 0 or 1 with the proviso that A is hydroxyl group when k is 0, and A is hydrogen atom or hydroxyl group when k is 1, and R^7 and R^8 are each hydrogen atom or a hydrocarbon group which has 1 to 18 carbon atoms and may contain at least one oxygen atom and/or at least one sulfur atom.

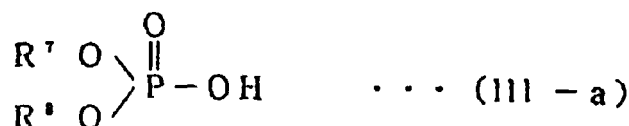
[0029] Examples of the aforesaid hydrocarbon group which has 1 to 18 carbon atoms include a straight chain or

branched alkyl group having 1 to 18 carbon atoms; a cycloalkyl group having 3 to 18 carbon atoms; a straight chain or branched alkenyl group having 2 to 18 carbon atoms; an aryl group having 6 to 18 carbon atoms; and an aralkyl group having 7 to 18 carbon atoms. Examples of the alkyl group having 1 to 18 carbon atoms include methyl group, ethyl group, n-propyl group, isopropyl group, n-butyl group, isobutyl group, sec-butyl group, tert-butyl group, pentyl group, hexyl group, octyl group, 2-ethylhexyl group, decyl group, dodecyl group, tetradecyl group, hexadecyl group and octadecyl group. Examples of the cycloalkyl group having 3 to 18 carbon atoms group include cyclopentyl group, cyclohexyl group, methylcyclohexyl group and cyclooctyl group. Examples of alkenyl group having 2 to 18 carbon atoms include allyl group, propenyl group, butenyl group, octenyl group, decenyl group and oleyl group. Examples of aryl group having 6 to 18 carbon atoms include phenyl group, tolyl group, xylyl group and naphthyl group. Examples of aralkyl group having 7 to 18 carbon atoms include benzyl group, phenethyl group and naphthylmethyl group.

[0030] In addition, the hydrocarbon group having 1 to 18 carbon atoms may contain at least one oxygen atom and/or at least one sulfur atom. That is to say, the above-mentioned hydrocarbon group may contain at least one ether group, or at least one thioether group, or both said groups in its main chain. Examples of the aforesaid hydrocarbon group include hexyloxymethyl group, hexyloxyethyl group, octyloxymethyl group, octyloxyethyl group, dodecyloxymethyl group, dodecyloxyethyl group, hexadecyloxymethyl group, hexadecyloxyethyl group, hexylthiomethyl group, hexylthioethyl group, octylthiomethyl group, octylthioethyl group, dodecylthiomethyl group, dodecylthioethyl group, hexadecylthiomethyl group and hexadecylthioethyl group.

[0031] The R^7 and R^8 may be the same as or different from each other, but are not simultaneously hydrogen atom.

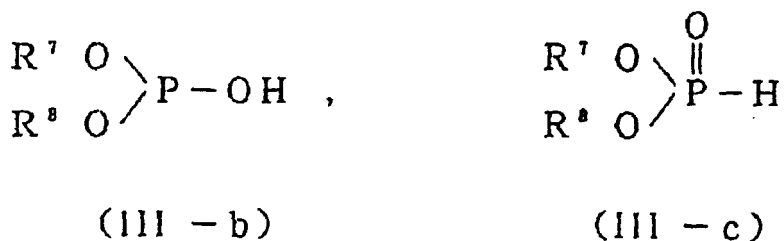
[0032] Examples of the acidic phosphate ester among the compound represented by the general formula (III) include the compound having the structure represented by the general formula (III-a)



wherein R^7 and R^8 are each as previously defined.

[0033] Examples of the acidic phosphate ester represented by the general formula (III-a) include mono- or di-hexylhydrogen phosphate, mono- or di-octylhydrogen phosphate, mono- or di-dodecylhydrogen phosphate, mono- or di-hexadecylhydrogen phosphate, mono- or di-(hexylthioethyl)hydrogen phosphate, mono- or di-(octylthioethyl)hydrogen phosphate, mono- or di-(dodecylthioethyl)hydrogen phosphate, mono- or di-(hexadecylthioethyl)hydrogen phosphate, mono- or di-octenylhydrogen phosphate, mono- or di-oleylhydrogen phosphate, mono- or di-cyclohexylhydrogen phosphate, mono- or di-phenylhydrogen phosphate, mono- or di-tolylhydrogen phosphate, mono- or di-benzylhydrogen phosphate, mono- or di-phenethylhydrogen phosphate and the like.

[0034] Examples of the phosphite ester among the compound represented by the general formula (II) include the acidic phosphite ester having the structure represented by the general formula (III-b) or (III-c):



wherein R^7 and R^8 are each as previously defined.

[0035] Examples of the acidic phosphite ester represented by the general formula (III-b) or (III-c) include mono- or di-hexylhydrogen phosphite, mono- or di-octylhydrogen phosphite, mono- or di-dodecylhydrogen phosphite, mono- or di-hexadecylhydrogen phosphite, mono- or di-(hexylthioethyl)hydrogen phosphite, mono- or di-(octylthioethyl)hydrogen phosphite, mono- or di-(dodecylthioethyl)hydrogen phosphite, mono- or di-(hexadecylthioethyl)hydrogen phosphite, mono- or di-octenylhydrogen phosphite, mono- or di-oleylhydrogen phosphite, mono- or di-cyclohexylhydrogen phosphite, mono- or di-phenylhydrogen phosphite, mono- or di-tolylhydrogen phosphite, mono- or di-benzylhydrogen phosphite, mono- or di-phenethylhydrogen phosphite and the like.

phite, mono- or di-phenylhydrogen phosphite, mono- or di-toluyhydrogen phosphite, mono- or di-benzylhydrogen phosphite, mono- or di-phenetylhydrogen phosphite and the like.

[0036] On the one hand, the above-mentioned active sulfur base compound to be used as the component (B) is not specifically limited, but may be properly and optionally selected for use from among the well known active sulfur base compounds that have heretofore been used as an extreme pressure agent, an anti-wear agent, a friction modifier and the like, for instance, a sulfurized fat and oil, that is, a sulfurized animal oil, vegetable oil or synthetic oil; an olefin mono- or poly-sulfide; a dihydrocarbyl mono- or poly-sulfide; a sulfurized mineral oil; a thiocarbamate; thioterpene; and dialkylthiodipropionate.

[0037] Examples of the sulfurized fat and oil include sulfurized lard, sulfurized rapeseed oil, sulfurized castor oil, sulfurized soybean oil, sulfurized bran oil, disulfurized fatty acid such as sulfurized oleic acid and sulfurized ester such as sulfurized methyl oleate. Examples of the aforesaid olefin mono- or poly-sulfide include a product which is produced by reacting an olefin having 3 to 20 carbon atoms, preferably propylene, isobutene or diisobutene or any of its dimer, trimer and tetramer with a sulfurizing agent specifically exemplified by sulfur, sulfur chloride and other sulfur halogenides.

[0038] The above-cited dihydrocarbyl mono- or poly-sulfide is a compound represented by the general formula (IV):



wherein R^9 and R^{10} are each an alkyl group having 1 to 20 carbon atoms, an aryl group having 6 to 20 carbon atoms, an alkylaryl group having 7 to 20 carbon atoms, or an aralkyl group having 7 to 20 carbon atoms, and may be the same as or different from each other, and x is a real number from 1 to 8, more specifically a rational number.

[0039] Specific examples of the R^9 and R^{10} in the foregoing general formula (IV) include methyl group, ethyl group, n-propyl group, isopropyl group, n-butyl group, isobutyl group, sec-butyl group, tert-butyl group, each pentyl group, each hexyl group, each heptyl group, each octyl group, each nonyl group, each decyl group, each dodecyl group, cyclohexyl group, cyclooctyl group, phenyl group, naphthyl group, tolyl group, xylyl group, benzyl group and phenethyl group.

[0040] The above-cited dihydrocarbyl mono- or poly-sulfide is preferably exemplified by dibenzyl mono- or poly-sulfide, di-tert-nonyl mono- or poly-sulfide and didodecyl mono- or poly-sulfide.

[0041] Examples of the thiocarbamate are zinc dithiocarbamate, etc., those of the thioterpene are a reaction product between phosphorus pentasulfide and pinene, and the like, and those of the dialkylthio-dipropionate are dilaurylthio-dipropionate, distearylthio-dipropionate, and the like.

[0042] In the present invention, the active phosphorus base compound or the active sulfur base compound as the component (B) may be used alone or in combination with at least one other species. The blending amount of the component (B) is not specifically limited provided that said amount falls within the scope of the amount usually employed in a transmission lubricating oil for automobiles.

[0043] In the case where the active phosphorus base compound is used as the component (B) in the present invention, the above-mentioned boron-containing imide base dispersant as the component (A) and the active phosphorus base compound as the component (B) can be blended in the base oil after mixing in advance both the components as desired, and then subjecting the resultant mixture to heating treatment at a temperature in the range of 120 to 150°C for at least 5 hours. It is acceptable in this case to mix the component (A) in part and the active phosphorus base compound as the component (B) in part that are to be blended, subject the resultant mixture to heating treatment, and subsequently mix into the base oil, the heated mixture and the remainders of the component (A) and the component (B). Alternatively, it is also acceptable in this case to mix the component (A) in whole and the component (B) in whole that are to be blended, subject the resultant mixture to heating treatment, and subsequently mix the heated mixture into the base oil.

[0044] In more detail, the above-mentioned method for heating treatment of both the components comprises the steps of mixing the component (A) and the component (B) at a prescribed ratio, agitating the resultant mixture at a temperature in the range of approximately 40 to 70°C for approximately 10 minutes to 3 hours to carry out homogenization treatment, and subsequently subjecting the resultant homogenized mixture to heating treatment at a temperature in the range of 120 to 150°C for at least 5 hours, preferably for 5 to 24 hours, wherein said heating treatment may be put into practice under standing still or under stirring.

[0045] The lubricating oil composition according to the present invention may be properly and optionally incorporated at need with any of other well known additives, which are exemplified by antioxidants of phenol base, amine base and zinc dithiophosphate base; detergents / dispersants of imide base, ester base, benzylamine base, phenate base and salicylate base; friction modifiers of amide base, ester base and fatty acid base; rust preventive agents of metal sulfonate base, succinate ester base and sorbitan ester base; metal deactivators of bentotriazole base and thiadiazole base; and anti-foam agents of silicone base; and the like.

[0046] The lubricating oil composition according to the present invention enhances peeling resistant durability for a friction material, especially a cellulose base wet friction material without impairing the wear resistance or scoring resist-

ance of a steel material element, and thus is well suited for use in a cellulose base friction material for a starting and running device and a transmission clutch that are employed in an automatic transmission of an automobile.

[0047] In the following, the present invention will be described in further detail with reference to comparative examples and working examples, which however shall never limit the present invention thereto.

[0048] The performances of the lubricating oil composition according to the present invention were evaluated in accordance with the procedures as described hereunder.

(weight loss of filter paper)

[0049] Filter paper immersion test was carried out by placing 75ml of a sample oil in a 100 ml wide mouthed vessel, immersing two sheets of # 51 B filter paper manufactured by ADVA NTEC Co. Ltd. (measuring 20 × 80 mm, made of pure cellulose) in the sample oil, covering the vessel with a lid made of aluminum foil, and heating the vessel in a thermostat (air bath) at 175°C for 40 hours under standing still condition. The filter paper was weighed before and after the test, and the weight loss of the filter paper was calculated by the following formula, in which the more the weight loss thereof, the severer the attack to the cellulose as the filter paper material.

$$\text{weight loss (\%)} = \{(\text{weight before test} - \text{weight after test}) / \text{weight before test}\} \times 100$$

[0050] In the following, some description will be given of the various additives that were used in the above-mentioned tests.

Additive (1); boronated polybutenyl succinimide (manufactured by Lubrizol Co., Ltd. under the trade name "Lz935") having a weight-average molecular weight of 950, a B content of 1.98% by weight, an N content of 2.05% by weight, a total acid number of 7.3 mg KOH/g, a base number of 65.8 mg KOH/g and a B/N ratio by weight of 0.97

Additive (2); boronated polybutenyl succinimide (manufactured by Exxon Chemical Co., Ltd. under the trade name "ECA 5025") having a weight-average molecular weight of 950, a B content of 0.33% by weight, an N content of 1.35% by weight, a total acid number of 6.5 mg KOH/g, a base number of 32.5 mg KOH/g and a B/N ratio by weight of 0.24

Additive (3); boronated polybutenyl succinimide (manufactured by Ethyl Japan Co., Ltd. under the trade name "EOA 8015") having a weight-average molecular weight of 950, a B content of 1.15% by weight, an N content of 1.46% by weight, a total acid number of 0.65 mg KOH/g, a base number of 45.2 mg KOH/g and a B/N ratio by weight of 0.79

Additive (4); mono (2-ethylhexyl) hydrogenphosphate (manufactured by Sakai Chemical Industry Co., Ltd.) having a P content of 12% by weight and a total acid number of 320 mg KOH/g

Additive (5); phosphorus/ sulfurized terpene (manufactured by Ethyl Japan Co., Ltd.) having an S content of 13% by weight, a P content of 4.8% by weight and a total acid number of 6.6 mg KOH/g

Additive (6); polybutenyl succinimide (manufactured by Lubrizol Co., Ltd. under the trade name "Lz6406") having an N content of 1.76% by weight, a total acid number of 1.5 mg KOH/g and a base number of 46.8 mg KOH/g

Additive (7); polybutenyl succinimide (manufactured by Oronite Japan Ltd. under the trade name "OLOA 373") having an N content of 1.05% by weight, a total acid number of 4.5 mg KOH/g and a base number of 20.1 mg KOH/g

Examples 1 to 5 and Comparative Examples 1 to 6

[0051] Various lubricating oil compositions were each prepared by blending at least one of the additives 1 to 7, the blending amounts of which are shown in Table 1 with a 150 neutral oil as a paraffin base mineral oil (manufactured by Idemitsu Kosan Co., Ltd.) having kinematic viscosity of 30.7 mm²/sec at 40°C and 5.25 mm²/sec at 100°C and a viscosity index of 104, and further blending therewith, 0.5% by weight of 4, 4'-methylenebis(2, 6-di-tert-butylphenol) {manufactured by Ethyl Japan Co., Ltd.}, 0.5% by weight of 4, 4'-dioctylphenylamine {manufactured by Kawaguchi Chemical Co., Ltd.}, 0.3% by weight of oleic acid monoglyceride {manufactured by Kao Corporation}, 0.02% by weight of 1, 2, 3-benzotriazole {manufactured by Johoku Chemical Co., Ltd.} and 0.002% by weight of polydimethylsiloxane {manufactured by Shin-Etsu Chemical Co., Ltd.} each based on the whole amount of the lubricating oil composition in question. Thus, the above-described tests were carried out, and evaluations were made of the performances of each of the lubricating oil compositions thus prepared.

[0052] The results of evaluating the performances of the various lubricating oil compositions are given in Table 1.

Table 1-1

5			Example				
			1	2	3	4	5
10	Component(A) (wt%)	Additive 1	0.5	1.0	-	-	0.5
		Additive 2	-	-	2.0	-	-
		Additive 3	-	-	-	0.7	-
	Component(B) (wt%)	Additive 4	0.2	0.2	0.2	0.2	-
Additive 5		-	-	-	-	1.0	
15	Other component (wt%)	Additive 6	-	-	-	-	-
		Additive 7	-	-	-	-	-
20	Boron content in oil derived from component (A) in lubricating oil composition (wt ppm)		100	200	66	80	100
	Nitrogen content in oil derived from component (A) or other components in lubricating oil composition (wt ppm)		103	205	270	102	103
	Weight loss of filter paper (wt%)		10.6	5.8	7.4	12.6	6.4

Table 1-2

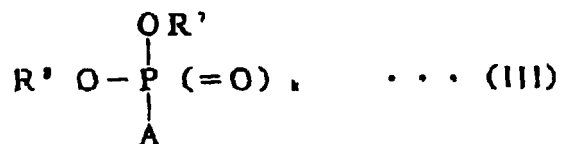
30			Comparative Example					
			1	2	3	4	5	6
35	Component(A) (wt%)	Additive 1	-	-	0.3	-	-	-
		Additive 2	-	-	-	-	-	-
		Additive 3	-	-	-	0.5	-	-
	Component(B) (wt%)	Additive 4	0.2	-	0.2	0.2	0.2	0.2
		Additive 5	-	1.0	-	-	-	-
40	Other component (wt%)	Additive 6	-	-	-	-	2.0	-
		Additive 7	-	-	-	-	-	2.0
	Boron content in oil derived from component (A) in lubricating oil composition (wt ppm)		0	0	59	58	0	0
45	Nitrogen content in oil derived from component (A) or other components in lubricating oil composition (wt ppm)		0	0	62	73	350	210
	Weight loss of filter paper (wt%)		45.6	24.6	29.5	24.7	17.8	28.6

50 Claims

1. A lubricating oil composition for cellulose base wet friction material which comprises a base oil blended with (A) a boron-containing imide base dispersant having a weight-average molecular weight in the range of 500 to 3000 and having a ratio by weight of boron to nitrogen (B/N) in the range of 0.1 to 1.5 in such a blending amount that the boron content and the nitrogen content each derived from the component (A) are made to be at least 60 ppm by weight and at least 100 ppm by weight, respectively based on said base oil.
2. The lubricating oil composition according to Claim 1, wherein the boron-containing imide base dispersant as the

component (A) has a ratio by weight of boron to nitrogen (B/N) in the range of 0.2 to 1.0.

3. The lubricating oil composition according to Claim 1, wherein the boron-containing imide base dispersant as the component (A) is produced by treating polyalkenyl succinimide with a boron compound.
4. The lubricating oil composition according to Claim 3, wherein the polyalkenyl succinimide is polybutenyl succinimide.
5. The lubricating oil composition according to Claim 1, wherein the boron content derived from the component (A) is in the range of 60 to 300ppm based on said base oil.
6. The lubricating oil composition according to Claim 1, wherein the nitrogen content derived from the component (A) is in the range of 100 to 1200 ppm based on said base oil.
7. The lubricating oil composition according to Claim 1, which further comprises (B) at least one member selected from the group consisting of an active phosphorus base compound and an active sulfur base compound.
8. The lubricating oil composition according to Claim 7, wherein the active phosphorus base compound is at least one member selected from the group consisting of the acidic phosphate esters and phosphite esters represented by the general formula (III):



wherein A is hydrogen atom or hydroxyl group; k is 0 or 1 with the proviso that A is hydroxyl group when k is 0, and A is hydrogen atom or hydroxyl group when k is 1; and R⁷ and R⁸ are each hydrogen atom or a hydrocarbon group which has 1 to 18 carbon atoms, and which may contain at least one member selected from the group consisting of oxygen atom and sulfur atom with the proviso that R⁷ and R⁸ may be the same as or different from each other, but are not simultaneously hydrogen atom.

European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 11 1046

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 136 185 A (COOPER EDWIN INC) 3 April 1985 (1985-04-03) * page 13, line 28 - page 14, line 26; examples 1-5 *	1-7	C10M133/56 C10M141/12 C10M159/12 //(C10M141/12, 133:56,137:02, 137:04, 137:10), C10N60:14
X	EP 0 628 623 A (IDEMITSU KOSAN CO) 14 December 1994 (1994-12-14) * page 2, line 13-22; table 1 *	1-8	
X	EP 0 562 172 A (IDEMITSU KOSAN CO) 29 September 1993 (1993-09-29) * table 1 *	1-4,6,7	
X	EP 0 695 799 A (LUBRIZOL CORP) 7 February 1996 (1996-02-07) * page 2, line 5-13; example VI *	1-8	
X	EP 0 646 639 A (LUBRIZOL CORP) 5 April 1995 (1995-04-05) * page 2, line 6-14; examples I-VIII *	1-8	
X	US 4 634 543 A (OKADA TAHEI ET AL) 6 January 1987 (1987-01-06) * examples 3-6,8; table 1 *	1-8	TECHNICAL FIELDS SEARCHED (Int.Cl.7) C10M
X	US 4 428 849 A (WISOTSKY MAX J) 31 January 1984 (1984-01-31) * column 2, line 23-29; example 1 *	1-8	
A	DE 44 38 456 A (DEUTSCHE FORSCH LUFT RAUMFAHRT) 2 May 1996 (1996-05-02) * column 4, line 4-9 *	1	
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 21 September 2000	Examiner Kazemi, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 11 1046

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-09-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0136185 A	03-04-1985	CA 1237959 A	14-06-1988
		JP 60149697 A	07-08-1985
EP 0628623 A	14-12-1994	JP 2859083 B	17-02-1999
		JP 6330069 A	29-11-1994
		US 5547596 A	20-08-1996
EP 0562172 A	29-09-1993	JP 2911668 B	23-06-1999
		JP 5163497 A	29-06-1993
		CA 2085074 A	13-06-1993
		DE 69228677 D	22-04-1999
		DE 69228677 T	22-07-1999
		US 5458807 A	17-10-1995
EP 0695799 A	07-02-1996	AU 702409 B	18-02-1999
		AU 2830595 A	15-02-1996
		BR 9502407 A	21-05-1996
		JP 8060172 A	05-03-1996
		NZ 272682 A	26-05-1997
		ZA 9506413 A	11-03-1996
EP 0646639 A	05-04-1995	AU 687826 B	05-03-1998
		AU 7028794 A	02-03-1995
		CA 2130139 A	21-02-1995
		JP 7150183 A	13-06-1995
		US 5767044 A	16-06-1998
US 4634543 A	06-01-1987	JP 2044879 B	05-10-1990
		JP 58045293 A	16-03-1983
US 4428849 A	31-01-1984	US 4338205 A	06-07-1982
		AR 231646 A	31-01-1985
		BE 890050 A	24-02-1982
		BR 8105389 A	11-05-1982
		CA 1148528 A	21-06-1983
		DE 3132220 A	13-05-1982
		FR 2488906 A	26-02-1982
		GB 2083048 A,B	17-03-1982
		GB 2140811 A,B	05-12-1984
		IT 1137899 B	10-09-1986
		JP 1700911 C	14-10-1992
		JP 3059118 B	09-09-1991
		JP 57074393 A	10-05-1982
		NL 8103948 A	16-03-1982
DE 4438456 A	02-05-1996	WO 9613471 A	09-05-1996

EPO FORM P449

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 11 1046

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-09-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4438456 A		EP 0797555 A	01-10-1997
		JP 3053874 B	19-06-2000
		JP 10507733 T	28-07-1998
		US 6042935 A	28-03-2000

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82