

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 987 312 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

22.03.2000 Bulletin 2000/12

(51) Int. Cl.⁷: **C10M 169/02**, G11B 19/20

// (C10M169/02, 105:48,

117:04), C10N40:02

(21) Application number: **99115246.3**

(22) Date of filing: **02.08.1999**

(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: **22.08.1998 JP 27423898**

(71) Applicant: **MINEBEA CO., LTD.**

Kitasaku-gun, Nagano-ken (JP)

(72) Inventors:

- **Miyamoto, Yasuhiro,**
c/o Nippon Grease Co., Ltd.
Kobe-shi, Hyogo (JP)

- **Akiyama, Motoharu,**

c/o Minebea Co., Ltd.

Kitasaku-gun, Nagano-ken (JP)

- **Okamura, Seiji,**

c/o Nippon Grease Co., Ltd.

Kobe-shi, Hyogo (JP)

(74) Representative:

Patentanwälte

Schaad, Balass, Menzl & Partner AG

Dufourstrasse 101

Postfach

8034 Zürich (CH)

(54) **Bearing grease composition**

(57) A bearing grease composition used under clean atmosphere, as in a bearing of hard disc drive, which has small dust generation (scatter), a long life, excellent acoustic performance and low torque.

It has been found that especially the bearing grease composition comprising a carbonate having a branched alkyl group of 13 to 15 carbon atoms and a metallic soap shows remarkable characteristics.

EP 0 987 312 A1

DescriptionFIELD OF THE INVENTION

5 [0001] The present invention relates to a bearing grease composition for hard disc drive or the like. More particularly, the invention relates to a bearing grease composition for spindle motors which are used under clean environment, as in memories such as hard disc drive (HDD) or floppy disc drive (FDD) in computers.

BACKGROUND OF THE INVENTION

10 [0002] In general, performances required for a bearing grease composition used in memories, for examples, HDD or FDD in computers are that dust generation (scatter) is low, torque is small, acoustic performance is excellent and life is long. In particular, in HDD used under a clean atmosphere, fine particles of gaseous oil or grease scattered from the inside of a bearing during revolution contaminates the surface of a disc, resulting in cause of wrong operation. There-
 15 fore, it is considered to be most important to suppress the amount of scatter.

[0003] A sodium complex soap-based grease comprising a mineral oil as a base oil or a lithium soap-based grease comprising as a base oil, a synthetic ester (diester oil or polyol ester oil) which is a reaction product of an organic acid and an alcohol has conventionally been used as HDD bearing grease.

20 [0004] The sodium complex soap-based grease comprising a mineral oil as a base oil has been used for a long time with appreciation that the amount of scatter is small. However, the grease had the problems that dispersion of a thickening agent in the grease is poor, and it is difficult to form a homogeneous mixture, so that acoustic and vibrating performances during evolution of the bearing is not good; moisture absorption is high, and the grease cures with the passage of time, so that flowability of the grease in the bearing becomes poor, causing defective lubrication.

25 [0005] Further, the lithium soap-based grease comprising as a base oil, a synthetic ester (diester or polyol ester oil) which is a reaction product of an organic acid and an alcohol had no problem due to that dispersibility of the lithium soap is good, and low torque property was good.

30 [0006] However, the lithium soap-based grease tends to scatter, and if the grease is used as it is, there is the great possibility to damage a hard disc. Therefore, in order to prevent the damage, the grease is used in combination with an expensive magnetic fluid seal which is used in a motor. This rather results in increase of cost of a motor and prevents the motor from being miniaturized. Further, for example, due to the demand of high speed revolution and high precision of the motor, this grease does not sufficiently withstand acoustic performance and torque, disorder has sometimes occurred in acoustic performance or torque.

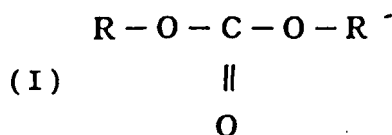
SUMMARY OF THE INVENTION

35 [0007] As a result of extensive investigations to overcome the above-described problems in the prior art, it has been found that properties required for a bearing grease composition which is used under a clean environment as in, for example, memories such as HDD or FDD are satisfied by using a metallic soap-based grease comprising as a base oil a carbonate containing an organic carbonate represented by the formula (I) described hereinafter. The present inven-
 40 tion has been completed based on this finding.

[0008] Accordingly, an object of the present invention is to provide a grease composition which can maintain stable low torque property, low noise property and low scatter property even at high speed revolution.

[0009] According to the present invention, there is provided a bearing grease composition comprising:

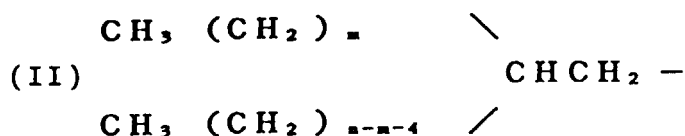
45 (a) a carbonate compound represented by the following formula (I)



50 wherein R and R', which may be the same or different, each represent a branched alkyl group having 13 to 15 carbon atoms; and

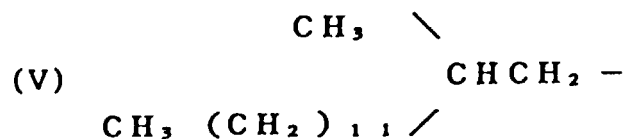
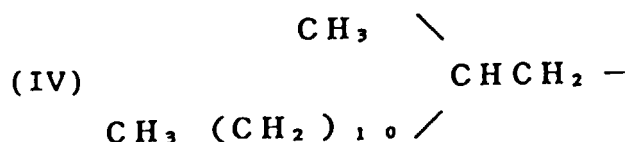
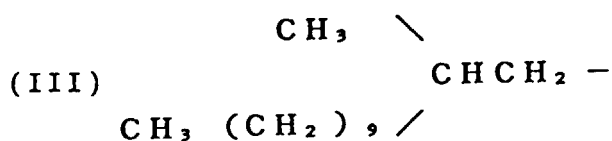
(b) a group consisting of an alkali metal salt and/or an alkaline earth metal salt, which are synthesized from a hydroxide of an alkali metal or an alkaline earth metal and a higher hydroxyfatty acid having 10 or more carbon atoms or a higher hydroxyfatty acid having at least one hydroxyl group and having 10 or more carbon atoms.

[0010] The branched alkyl group R and R' in the carbonate compound represented by the formula (I) is represented by the following formula (II):



wherein n is a number of 13 to 15 and m is a number of 0 to 6.

[0011] The representative examples of the branched alkyl group are groups represented by the following formulae (III), (IV) and (V):



[0012] The bearing grease composition of the present invention preferably comprises 70 to 95 parts by weight of component (a) of the carbonate compound, and 5 to 30 parts by weight of component (b) of the alkali metal salt and/or alkaline earth metal salt.

[0013] If the amount of component (b) of the alkali metal salt and/or alkaline earth metal salt is less than 5 parts by weight, a worked penetration becomes soft, and as a result, the grease composition leaks or scatters during revolution of a bearing, resulting in possibility of contaminating HDD, FDD and the like.

[0014] On the other hand, if the above amount of component (b) exceeds 30 parts by weight, the grease composition becomes too hard, and flowability of grease in the bearing becomes poor. As a result, there is the possibility of causing defective lubrication.

[0015] The bearing grease composition according to the present invention can contain, in addition to the components (a) and (b) described above, lubricants other than the component (a), and various additives, as a third component.

[0016] Examples of the lubricants used in the present invention include mineral oils, synthesized hydrocarbon oils, ether oils and ester oils, which are generally used as a base oil of grease compositions.

[0017] The additives used in the present invention are additives generally used in grease composition, and the examples thereof include antioxidants and rust inhibitors.

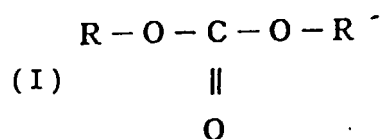
[0018] The grease composition of the present invention may further contain one or more of thickening agents.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] The present invention described in detail below.

(1) According to the preferred embodiments of the present invention, a bearing grease composition preferably comprises:

(a) a carbonate compound represented by the following formula (I)

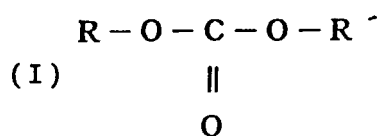


wherein R and R' which may be the same or different each represent a branched alkyl group having 13 to 15 carbon atoms; and

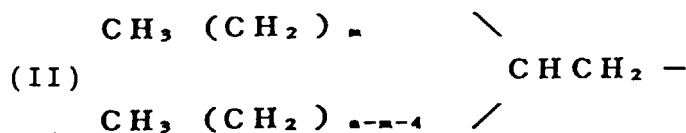
(b) a group consisting of an alkali metal salt and/or an alkaline earth metal salt, synthesized from a hydroxide of an alkali metal or an alkaline earth metal and a higher hydroxyfatty acid having 10 or more carbon atoms or a higher hydroxyfatty acid having at least one hydroxyl group and having 10 or more carbon atoms.

(2) Preferably, the bearing grease composition comprises:

(a) a carbonate compound represented by the following formula (I)



wherein R and R', which may be the same or different, each represent a branched alkyl group having 13 to 15 carbon atoms, wherein the branched alkyl group R and R' in the carbonate compound represented by the formula (I) is represented by the following formula (II):



wherein n is a number of 13 to 15 and m is a number of 0 to 6; and

(b) a group consisting of an alkali metal salt and/or an alkaline earth metal salt, synthesized from a hydroxide of an alkali metal or an alkaline earth metal and a higher hydroxyfatty acid having 10 or more carbon atoms or a higher hydroxyfatty acid having at least one hydroxyl group and having 10 or more carbon atoms.

(3) The bearing grease composition comprises 70 to 95 parts by weight of the carbonate compound represented by formulas (I) and (II) and 5 to 30 parts by weight of the member selected from the group consisting of an alkali metal salt and/or an alkaline earth metal salt, synthesized from a hydroxide of an alkali metal or an alkaline earth metal and a higher hydroxyfatty acid having 10 or more carbon atoms or a higher hydroxyfatty acid having at least one hydroxyl group and having 10 or more carbon atoms.

(4) The bearing grease composition for hard disc drive includes preferably a plurality of carbonate compounds.

(5) The bearing grease composition for hard disc drive in which the carbonate compound preferably has a dynamic viscosity of 10 to 50 mm²/sec at 40 °C

(6) Preferably, the bearing grease composition further comprises one or more thickening agents.

(7) The bearing grease composition as in any of the above-described aspects (1) to (6) comprising further lubricants and/or additives.

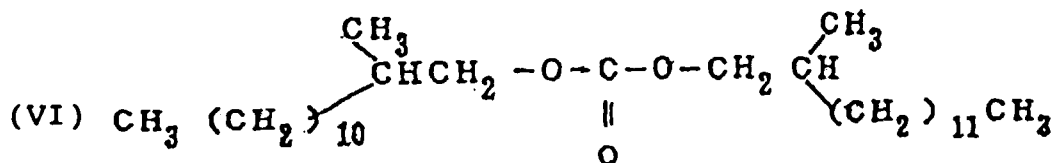
[0020] The carbonate compound can be used alone or as mixtures thereof.

[0021] The present invention will now be described in more detail below by referring to the following examples, but the invention should not be limited thereto.

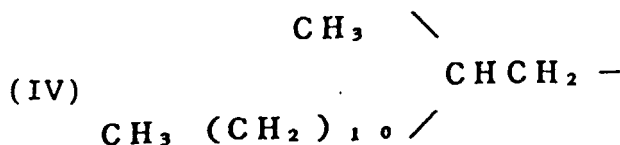
EXAMPLES 1 TO 6

[0022] Those examples are the preparation example of the typical bearing grease composition consisting of component (a) and component (b).

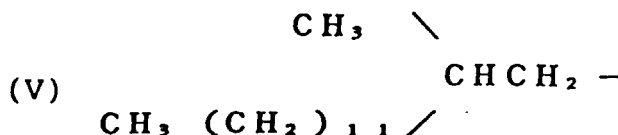
[0023] A carbonate represented by the following formula (VI):



that is, in the formula (I), R is the branched alkyl group represented by the following formula (IV):



and R' is the branched alkyl group represented by the following formula (V):



(this carbonate is hereinafter referred to as "carbonate oil A") alone, or a mixed oil of a carbonate containing commercially available organic carbonate having different structure of an alkyl group (CYCRANT T-394, trade name, a product of Mitsui Petrochemical Industries, Ltd.) (this ester is hereinafter referred to as "carbonate ester oil B") and the carbonate ester oil A was mixed with lithium stearate and/or lithium 12 hydroxystearate in the proportions as shown in Table 1 such that the sum of those was 100 mass%. The resulting mixture was heated to 220-230 °C while stirring until the whole of mixture became liquid. The liquid thus obtained was poured into a stainless steel vessel at a depth of 3-5 mm. The liquid was cooled at 50 °C or less and then homogenized with three rollers to obtain a grease composition.

EXAMPLES 7 AND 8

[0024] Grease compositions were obtained in the same manner as in Examples 1 to 6 above except that an alkyl diphenyl ether or a polyol ester was further used as a third component other than components (a) and (b) in the proportion as shown in Table 1.

COMPARATIVE EXAMPLES 1 AND 2

[0025] Two kinds of commercially available greases in which a base oil and a thickening agent are known were used for the sake of comparison. In Table 2, reference sign + means that such a compound is contained.

COMPARATIVE EXAMPLE 3 AND 4

[0026] Grease compositions were obtained in the same manner as in Examples 1-6 except that a base oil and a lithium soap were used in the proportions as shown in Table 2.

[0027] The grease compositions obtained in the above Examples and Comparative Examples were measured for a worked penetration and a dropping point, and were subjected to motor characteristic test, under the same conditions. The results obtained are shown in Tables 1 and 2.

[0028] The worked penetration was measured according to JIS K2220, 5.3, and the dropping point was measured

according to JIS K2220, 5.4.

[0029] The motor characteristic test was conducted such that a bearing having included therein a grease composition to be tested was incorporated in a spindle motor, the motor was rotated at 10,000 rpm at a normal temperature, and noise generated, amount of evaporation (scatter) and rotating torque were measured.

5 **[0030]** Noise was measured with a microphone at a place which is 30 cm apart from a hub edge of the motor during rotation of motor.

[0031] The amount of evaporation (scatter) was determined by the difference between weight of motor before rotation and weight of motor after rotation.

10 **[0032]** The torque was determined by measuring electric current value at the rotation of motor with an ammeter, and the torque stability was determined by the difference between the maximum electric current value and the minimum electric current value.

[0033] The judgement results according to performances required for a bearing grease composition for HDD or the like on each evaluation item are shown in Table 1 (Examples) and Table 2 (Comparative Examples).

15 **[0034]** The smaller the value, the better the low noise property; the smaller the amount of evaporation (scatter), the better the low scatter property; the lower the value, the better the low torque property; and the smaller the fluctuation, the better the torque stability.

[0035] The tests were evaluated with the following four grades.

20 A: Particularly excellent
B: Excellent
C: Moderate
D: Poor

TABLE 1

Example	1	2	3	4	5	6	7	8
Thickening agent								
StLi	25		25	10		15	20	20
12OH St-Li		15			10	5		
Base oil								
Carbonate A	75	85	38	90	90	80	70	70
Carbonate B			37					
ADE							10	
POE								10
Viscosity of base oil (40°C)	18	18	50	18	18	18	25	21
Worked Penetration (25 °C)	198	203	196	305	247	181	210	205
Dropping point (°C) Motor characteristic	197	194	198	193	193	195	197	195
Test								
Low noise property	A	A	B	B	B	A	B	B
Low scatter property	A	B	A	B	B	B	A	A
Low torque property	A	A	B	A	A	A	B	B
Torque stability	A	A	B	B	B	A	A	A
Total evaluation	A	A	B	B	B	A	B	B

Notes:

StLi : Lithium stearate

12OH St-Li : Lithium 12 hydroxystearate

ADE : Alkyl diphenyl ether

POE : Polyol ester oil

TABLE 2

COMPARATIVE EXAMPLE	1	2	3	4
Thickening agent				
StLi	+		25	25
12OH St-Li	+			
Na-Complex		+		
Base oil				
Carbonate ester A				75
Carbonate ester B				
Diester oil	+		38	
POE	+		37	
Mineral oil		+		
Viscosity of base oil (40 °C)	26	145	18	130
Worked penetration	250	205	197	181
Dropping point (°C)	194	>260	197	199
Motor characteristic test				
Low noise property	C	D	D	B
Low scatter property	B	A	D	A
Torque	C	B	B	D
Torque stability	D	C	D	C
Total evaluation	C	C	D	C
Unit of base oil viscosity shown in Tables 1 and 2 is mm ² /S.				

Notes:

Na-Complex : Sodium complex soap

12OH St-Li : Lithium 12 hydroxystearate

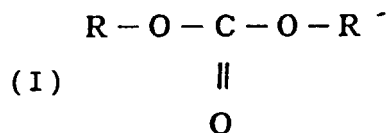
POE : Polyol ester oil

[0036] As shown in Table 1 above, the bearing grease composition of the present invention shows low evaporation (scatter), low noise, low torque property and stable torque.

Claims

1. A bearing grease composition comprising:

(a) a carbonate compound represented by the following formula (I)

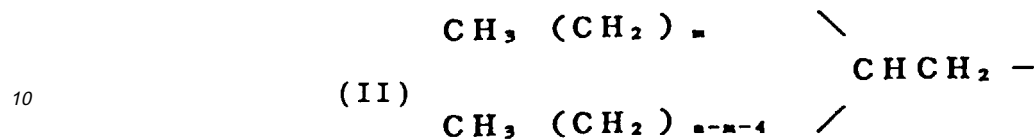


wherein R and R', which may be the same or different, each represent a branched alkyl group having 13 to 15 carbon atoms; and

(b) a group consisting of an alkali metal salt and/or an alkaline earth metal salt, synthesized from a hydroxide

of an alkali metal or an alkaline earth metal and a higher hydroxyfatty acid having 10 or more carbon atoms or a higher hydroxyfatty acid having at least one hydroxyl group and having 10 or more carbon atoms.

2. The bearing grease composition as claimed in claim 1, wherein the branched alkyl group R and R' in the carbonate compound represented by the formula (I) is represented by the following formula (II):



wherein n is a number of 13 to 15 and m is a number of 0 to 6.

- 20
3. The bearing grease composition as claimed in claim 1, which comprises 70 to 95 parts by weight of the component (a) and 5 to 30 parts by weight of the component (b).
 4. The bearing grease composition as claimed in claim 1, 2 or 3, wherein the component (a) includes a plurality of carbonate compounds.
 5. The bearing grease composition as claimed in claim 1, 2, 3 or 4, which further comprises one or more thickening agents.
 - 25 6. The bearing grease composition as claimed in claim 1, 2, 3, 4 or 5, which further comprises lubricants and/or additives.



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 11 5246

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	US 2 739 127 A (A.J.MORWAY) 20 March 1956 (1956-03-20) * column 1, line 15 - line 28 * * column 2, line 57 - line 69 * * column 4, line 44 - column 5, line 19 * ---	1-6	C10M169/02 G11B19/20 //(C10M169/02, 105:48, 117:04), C10N40:02
A	US 5 714 444 A (YAMAMOTO ATSUSHIRO ET AL) 3 February 1998 (1998-02-03) * column 1, line 5 - line 12 * ---	6	
A	EP 0 482 693 A (AGIP PETROLI) 29 April 1992 (1992-04-29) * page 2, line 20 - page 3, line 8 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			C10M G11B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20 December 1999	Examiner Rotsaert, L
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 03.82 (P04C01)

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

EP 99 11 5246

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.

20-12-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2739127 A	20-03-1956	NONE	
US 5714444 A	03-02-1998	JP 8143884 A	04-06-1996
EP 0482693 A	29-04-1992	IT 1243858 B	28-06-1994
		AT 100488 T	15-02-1994
		AU 640823 B	02-09-1993
		AU 8561591 A	30-04-1992
		CA 2053691 A	20-04-1992
		CN 1060866 A, B	06-05-1992
		DE 69101047 D	03-03-1994
		DE 69101047 T	19-05-1994
		DK 482693 T	02-05-1994
		ES 2048555 T	16-03-1994
		HU 213625 B	28-08-1997
		JP 4339895 A	26-11-1992
		KR 9408391 B	14-09-1994
		MX 173927 B	08-04-1994
		PL 167993 B	30-12-1995
		PT 99284 A, B	31-08-1992
		RU 2012591 C	15-05-1994
		US 5290464 A	01-03-1994