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(54) Lubricating oil composition.

(57) A lubricating oil composition which comprises a base oil of (A) 100 to 5 % by weight of a mineral oil having a kinematic viscosity at 40 ° C of 2 to 2000 cSt, a viscosity index of 70 or higher, a nitrogen content of 20 ppm or less and a bromine value of 25 or less, and (B) 0 to 95 % by weight of polybutene having a molecular weight of 200 to 1000; and at least one additive selected from an extreme pressure agent, an anti-wear agent and an oiliness agent is disclosed.

when the lubricating oil composition is used, fatigue damage of a metal is decreased and it shows good oxidation resistance.

EP 0 341 574 A1

LUBRICATING OIL COMPOSITION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lubricating oil composition. More specifically, it is concerned with a lubricating oil composition which is low in fatigue failure of a metal under repeated high contact stress, and also high in a traction coefficient, and yet excellent in oxidation resistance. Thus, the lubricating oil composition is suitable for a lubricating oil for power transmitting devices such as gears, bearings, traction drive mechanisms, etc.

2. Description of the Prior Art

Heretofore, as lubricating oils for gear, bearing and traction drive mechanisms, a paraffin type mineral oil having a high viscosity index (that is, low temperature dependency of the viscosity) and a relatively high oxidation resistance has generally and widely been used.

Lubricating oils using such paraffin type mineral oils, however, are unsatisfactory in pitting resistance or traction coefficient under repeated high contact stress, and there also is a problem that oxidation resistance is not sufficiently satisfied.

SUMMARY OF THE INVENTION

The present inventor has conducted earnest research to overcome the problems of the aforesaid conventional lubricating oils and to develop a lubricating oil showing high fatigue failure resistance, high traction characteristics and excellent oxidation resistance under repeated high contact stress.

As the result, it has been found that the composition in which a mineral oil having a specific property or this mineral oil and a polybutene are used as base oil(s) and additives such as an extreme pressure agent, an anti-wear agent, an oiliness agent, etc. are added thereto, becomes one having the desired properties listed above. The present invention has been accomplished based on such findings.

That is, the present invention is to provide a lubricating oil composition which comprises a base oil of

(A) 100 to 5 % by weight of a mineral oil having a kinematic viscosity at 40 °C of 2 to 2000 cSt, a viscosity index of 70 or higher, a nitrogen content of 20 ppm or less and a bromine value of 25 or less (component(A)), and

(B) 0 to 95 % by weight of polybutene having a molecular weight of 200 to 1000 (component(B)); and at least one additive selected from an extreme pressure agent, an anti-wear agent and an oiliness agent.

DESCRIPTION OF PREFERRED EMBODIMENTS

In the composition of the present invention, the mineral oil alone of the component (A), or a mixture of the component A) and the component (B), a polybutene having a molecular weight of 200 to 1000, is used as the base oil for the lubricating oil. The mineral oil to be used as the component (A) has the kinematic viscosity at 40 °C of 2 to 2000 cSt, preferably 5 to 1000 and more preferably 10 to 500 cSt. If it is less than 2 cSt, oil film forming ability is low so that friction becomes undesirably marked. On the other hand, if it exceeds 2000 cSt, it causes the problem that power loss due to viscosity resistance becomes too large. Also, this mineral oil should have a viscosity index of 70 or higher, preferably 75 or higher. Here, if the viscosity index is less than 70, oxidation resistance of the composition is insufficient. Further, the above mineral oil should have a nitrogen content of 20 ppm or less, preferably 10 ppm or less. Regarding the bromine value, it should have 25 or less, preferably 10 or less. If either the nitrogen content exceeds 20 ppm or the bromine value exceeds 25, it is undesirable since fatigue lifetime lowers.

As the mineral oil of the component (A) to be used in the composition of the present invention, any mineral oils can be used so long as they have the aforesaid properties, but considering a low temperature

characteristic, it is preferred that they have a pour point of -20 ° C or lower, more preferably -30 ° C or lower.

As the mineral oil to be used as the component (A), any materials which can be obtained by various methods are acceptable so long as they have the aforesaid properties, but more preferably, there may be mentioned a purified oil which is obtained by purifying a distillate oil with the usual method, said distillate oil having been obtained by atmospheric distillation of a paraffin base crude oil or an intermediate base crude oil, or by vacuum distillation of a residual oil resulting from the atmospheric distillation, and a deep dewaxed oil which is obtained by subjecting the above purified oil to deep dewaxing treatment. In this case, the process for purification of the distillate oil is not critical, and various methods can be employed. Usually, the distillate oil is purified by applying such treatments as (a) hydrogenation, (b) dewaxing (solvent dewaxing or hydrogenation dewaxing), (c) solvent extraction, (d) alkali distillation or sulfuric acid treatment, and (e) clay filtration, alone or in combination with one another. It is also effective to apply the same treatment repeatedly in multi-stages. For example, (1) a method in which the distillate oil is hydrogenated, or after hydrogenation, further subjected to alkali distillation or sulfuric acid treatment, (2) a method in which the distillate oil is hydrogenated and then is subjected to dewaxing treatment, (3) a method in which the distillate oil is subjected to solvent extraction treatment and then to hydrogenation treatment, (4) a method in which the distillate oil is subjected to two or three-stage hydrogenation treatment, or after the treatment further subjected to alkali distillation or sulfuric acid treatment, (5) a method in which after the treatment of the distillate oil by the methods (1) to (4) as described above, it is again subjected to dewaxing treatment to obtain a deep dewaxed oil, and so forth can be employed.

In utilizing any of the above methods, it suffices that processing conditions be controlled so that the resulting base oil has a kinematic viscosity, a viscosity index, a nitrogen content and a bromine value each falling within the above-specified range.

In particular, in the present invention, a mineral oil obtained by deep dewaxing is preferred as the base oil. This deep dewaxing treatment is carried out by solvent dewaxing under severe conditions, or by catalytic hydrogenation dewaxing using a Zeolite catalyst.

In the composition of the present invention, the above mineral oil of the component (A) may be singly used as the base oil, and a combination of a polybutene having a molecular weight of 200 to 1000 of the component (B) and the mineral oil may be also used as the base oil. Here, the polybutene of the component (B) has a molecular weight of 200 to 1000 (this corresponds to a kinematic viscosity at 40 ° C of 2 to 4000 cSt), and preferably 300 to 800. Also, this polybutene may be one which is hydrogenated or not hydrogenated.

By adding such polybutenes to the above mineral oils to make a base oil for the lubricating oil, elongation of life time and greater improvement in traction property can be established while maintaining oxidation resistance.

The base oil for the lubricating oil of the present invention contains 100 to 5 % by weight, preferably 100 to 20 % by weight, most preferably 90 to 20 % by weight of the mineral oil of the component (A), and 0 to 95 % by weight, preferably 0 to 80 % by weight, most preferably 10 to 80 % by weight of the polybutene of the component (B). If the ratio of the mineral oil is less than 5 % by weight, it causes the problem that the anti-wear resistance and anti-seizure property become insufficient under severe conditions (poor lubricating condition).

Also, in the composition of the present invention, to the base oil for the lubricating oil comprising the above component (A) or a mixture of the component (A) and the component (B), at least one additive selected from an extreme pressure agent, an anti-wear agent and an oiliness agent, is necessarily formulated. Here, as the extreme pressure agent, various compounds can be used. Specifically, sulfur-based extreme pressure agents such as sulfides, sulfoxides, sulfone, thiophosphinates, thiocarbonates, dithiocarbamates, alkylthiocarbamoyls, fats and oils, sulfurized fats and oils, sulfurized olefin and the like; phosphorus-based extreme pressure agents such as phosphoric acid esters, phosphorous acid esters, phosphoric acid ester amine salts, phosphorous acid ester amine salts, and the like; halogen-based extreme pressure agents such as chlorinated hydrocarbons, chlorinated oils and fats, and the like; organometallic extreme pressure agents such as thiophosphoric acid salts (e.g., zinc dithiophosphate (ZnDTP)) and thiocarbamic acid salts, and so on can be used.

Anti-wear agents which can be used include organomolybdenum compounds such as molybdenum dithiophosphate (MoDTP), molybdenum dithiocarbamate (MoDTC) and the like; organoboric compounds such as alkylmercaptyl borate and the like; solid lubricant-based anti-wear agents such as graphite, molybdenum disulfide, antimony sulfide, boron-containing compound, polytetrafluoroethylene and the like, and so on.

Also, oiliness agents which can be used include higher fatty acids such as oleic acid, stearic acid, and the like; higher alcohols such as oleyl alchol and the like; amines; esters; oils and fats and so on.

These extreme pressure agents, anti-wear agents and oiliness agents cannot be strictly distinguished, and they are generally referred to as load carrying additives together. Also, in the compounds as mentioned above, there exist compounds in which some functions are combined.

In the composition of the present invention, to the base oil for the lubricating oil comprising the above component (A) or the combination of the component (A) and the component (B), one or more agents selected from these extreme pressure agents, anti-wear agents and oiliness agents may be added in a suitable amount. In general, these agents are added in the range of 0.01 to 20 parts by weight based on 100 parts by weight of the base oil for the lubricating oil.

In the composition of the present invention, various known additives including antioxidants, rust preventives, metal deactivators, viscosity index improvers, pour point depressors, deforming agents, etc. may further be effectively formulated depending on the purpose. Here, as antioxidants, various kinds thereof are included, for example, phenol-based antioxidants as exemplified by 2,6-di-t-butyl-p-cresol; amine-based antioxidants as exemplified by dioctyldiphenylamine; sulfur, phosphorus-based antioxidants such as zinc dithiophosphate; and so on.

Also, as rust preventives, various compounds can be used. For example, carboxylic acids or esters or salts thereof as exemplified by alkylsuccinic acid, alkenylsuccinic acid and esters thereof, sulfonic acid salts as exemplified by calcium sulfonate, barium sulfonate, sodium sulfonate, alcohols, phosphoric acids or phosphoric acid salts, etc.

Metal deactivators may be those which have been employed conventionally and may include, for example, thiazole-based or dithiazole-based metal deactivators. Regarding viscosity index improvers, polymers such as polymethacrylate, etc. can suitably be used.

As described above, when the lubricating oil composition of the present invention is used, fatigue damage of a metal is decreased and it shows good oxidation resistance. Further, it shows a high traction coefficient and also has excellent low temperature properties.

Accordingly, the lubricating composition of the present invention can be widely and effectively utilized as a lubricating oil for power transmission devices, particularly as a lubricating oil for gears, rolling bearings and traction drive mechanisms

The present invention will be described in more detail with reference to the following Examples and Comparative Examples.

EXAMPLES 1 TO 8, AND COMPARATIVE EXAMPLES 1 TO 3

Firstly, base oils as shown in the following Table 1 were prepared.

Then, by formulating various additives to these base oils, lubricating oil compositions were prepared. Thereafter, with respect to these lubricating compositions, various characteristic tests were carried out. The results are shown in Table 2.

In the above characteristic tests, fatigue lifetime was measured by the rolling four-ball test (as described in Japanese Patent Application Laid-Open No. 147263/1984), oxidation resistances were measured in accordance with JIS K 2514 item 3.3 and traction coefficients were measured in accordance with the method as described in Japanese Patent Application Laid-Open No. 53398/1987.

Table 1

	Base oil (a)	Base oil (b)	Base oil (c)	Base oil (d)	Base oil (e)
Kinds	Deep dewaxed oil	Two-stage hydrogenated oil	Hydrogenated polybutene	Unhydrogenated polybutene	Solvent purified oil
Kinematic viscosity at 40°C (cSt)	105.6	99.9	105.2	103.6	105.0
Viscosity index	93	106	72	92	95
Nitrogen content (ppm)	5>	5>	5>	5>	50
Bromine value	3.5	0.5	3.2	9.2	39.0
Pour point (°C)	-40	-17.5	-40>	-40>	-15

Table 2

Composition ratio (parts by weight)	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comparative example 1	Comparative example 2	Example 7	Example 8	Comparative example 3
Base oil (a)	100	-	25	50	50	75	-	-	100	50	-
Base oil (b)	-	100	-	-	-	-	-	-	-	-	
Base oil (c)	-	-	75	50	-	25	-	50	-	50	50
Base oil (d)	-	-	-	-	50	-	-	-	-	-	-
Base oil (e)	-	-	-	-	-	-	100	50	-	-	50
Additive I	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	-	-	-
Additive II	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-
Additive III	-	-	-	-	-	-	-	-	6.55	6.55	6.55
Characteristics											
Fatigue lifetime (min)	46	48	56	53	52	50	39	42	57	61	44
Oxidation resistance (min)	310	342	356	336	324	319	264	278	343	372	280
Traction coefficient	0.056	0.050	0.072	0.068	0.068	0.063	0.051	0.061	0.058	0.068	0.061

*1 SP type extreme pressure agent (trade name: Lubrizol 5034, available from The Lubrizol Corp.)

*2 A mixture of antioxidant (2,6-di-t-butyl-p-cresol), pour point depressant (polymethacrylate, weight average molecular weight: 40,000) and rust preventive agent (alkenylsuccinate)

*3 A mixture of extreme pressure agent (anti-abrasive agent) (1 part by weight of ZnDTP and 0.5 part by weight of tricresylphosphate), viscosity index improver (polymethacrylate, weight average molecular weight of 40,000, 5 parts b weight) and rust preventive agent (alkenylsuccinate, 0.05 part by weight)

EP 0 341 574 A1

As can be seen from the above Table 2, samples in Examples 1 to 6 each have long fatigue lifetimes and good oxidation resistance. Particularly, the samples of Examples 3 to 6 in which mixed base oils are used, have high performance and great improvements in traction coefficient. Also, in the samples of Examples 7 and 8, fatigue life-times are extremely long, they have excellent oxidation resistance and also in the sample of Example 8, traction coefficient is remarkably improved.

Claims

1. A lubricating oil composition which comprises a base oil of
(A) 100 to 5 % by weight of a mineral oil having a kinematic viscosity at 40 °C of 2 to 2000 cSt, a viscosity index of 70 or higher, a nitrogen content of 20 ppm or less and a bromine value of 25 or less, and
(B) 0 to 95 % by weight of polybutene having a molecular weight of 200 to 1000; and
at least one additive selected from an extreme pressure agent, an anti-wear agent and an oiliness agent.

2. The lubricating oil composition as claimed in Claim 1, wherein said mineral oil has a pour point of -20 °C or lower.

3. The lubricating oil composition as claimed in Claim 1, wherein said mineral oil has a pour point of -30 °C or lower.

4. The lubricating oil composition as claimed in Claim 1, wherein said mineral oil has a kinematic viscosity at 40 °C of 5 to 1000 cSt.

5. The lubricating oil composition as claimed in Claim 1, wherein said mineral oil has a viscosity index of 75 or higher.

6. The lubricating oil composition as claimed in Claim 1, wherein said mineral oil has a nitrogen content of 10 ppm or less.

7. The lubricating oil composition as claimed in Claim 1, wherein said mineral oil has a bromine value of 10 or less.

8. The lubricating oil composition as claimed in Claim 1, wherein said polybutene has a molecular weight of 300 to 800.

9. The lubricating oil composition as claimed in Claim 1, wherein the base oil is composed of (A) 100 to 20 % by weight of the mineral oil and (B) 0 to 80 % by weight of the polybutene.

10. The lubricating oil composition as claimed in Claim 1, wherein the base oil is composed of (A) 90 to 20 % by weight of the mineral oil and (B) 10 to 80 % by weight of the polybutene.

11. The lubricating oil composition as claimed in Claim 1, wherein the additive is added in the range of 0.01 to 20 parts by weight based on 100 parts by weight of the base oil.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 10 8062

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.4)
X,Y	CH-A- 475 340 (LABOFINA) * Column 3, lines 22-55; claims 1-3 *	1-11	C 10 M 111/04 C 10 M 169/04 C 10 M 101/02 // (C 10 M 169/04 C 10 M 101:02 C 10 M 107:08 C 10 M 167:00) (C 10 M 111/04 C 10 M 101:02 C 10 M 107:08) C 10 N 20:00 C 10 N 40:04
X,Y	US-A-3 838 049 (G.J. SOUILLARD) * Column 2, lines 24-72; column 3, line 42 - column 4, line 3; example 1 *	1-11	
Y	US-A-3 912 617 (I.W. MILLS) * Column 2, lines 6-47; column 12, lines 39-45; claims 1,2 *	1-11	
P,A	EP-A-0 291 006 (IDEMITSU KOSAN CO., LTD) * Column 1, line 45 - column 2, line 38; column 4, lines 6-20; table 1; examples 1,2 *	1-11	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

C 10 M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31-07-1989	HILGENGA K.J.

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
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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