

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 305 538 B1

(12)

EUROPEAN PATENT SPECIFICATION

- (45) Date of publication of patent specification: **23.12.92** (51) Int. Cl.⁵: **C10M 141/02, C10N 30/00, C10N 40/04, //(C10M129/72, 129:74, 129:76, 129:95, 135:22), (C10N30/00, 40:04)**
- (21) Application number: **88902226.5**
- (22) Date of filing: **29.02.88**
- (86) International application number:
PCT/JP88/00221
- (87) International publication number:
WO 88/06616 (07.09.88 88/20)

The file contains technical information submitted
after the application was filed and not included in
this specification

(54) LUBRICATING OIL COMPOSITION.

- | | |
|--|--|
| <p>(30) Priority: 02.03.87 JP 47396/87</p> <p>(43) Date of publication of application:
08.03.89 Bulletin 89/10</p> <p>(45) Publication of the grant of the patent:
23.12.92 Bulletin 92/52</p> <p>(84) Designated Contracting States:
DE FR GB IT SE</p> <p>(56) References cited:
 EP-A- 0 021 838 GB-A- 2 097 813
 JP-A- 19 698 JP-B- 1 095
 JP-B- 49 284 US-A- 4 209 411 </p> <p>Sakurai Toshio "Sekiyu Seihin Tenkazai"
 10.08.74 Miyuki Shobo p. 225-227, 250</p> | <p>(73) Proprietor: IDEMITSU KOSAN COMPANY LIMITED
 1-1, Marunouchi 3-chome Chiyoda-ku Tokyo(JP)</p> <p>(72) Inventor: DASAI, Masashi
 24-14, Aobadai 4-chome
 Ichihara-shi Chiba 299-01(JP)
 Inventor: AKITA, Tsutomu
 17-1, Kimizuka Oaza Kitahata
 Ichihara-shi Chiba 290(JP)
 Inventor: SASAKI, Masaharu
 2189-1, Anesaki
 Ichihara-shi Chiba 299-1(JP)</p> <p>(74) Representative: Türk, Gille, Hrabal, Leifert
 Brucknerstrasse 20
 W-4000 Düsseldorf 13(DE)</p> |
|--|--|

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Description

Field of Technology

5 The present invention relates to a lubricating oil composition or, more particularly, relates to a lubricating oil composition which can be used satisfactorily for the lubrication of parts having a wet-type clutch or wet-type brake such as automatic transmissions, tractors and the like.

Background Technology

10

Lubricating oils used for the lubrication of the parts having a wet-type clutch or wet-type brake such as automatic transmissions, tractors and the like are required have properties including good friction characteristic, oxidation stability, corrosion resistance and rustpreventiveness as well as a large torque for power transmission. The friction characteristic here implied is a ratio of the coefficient of static friction and the coefficient of dynamic friction and it is required that this ratio is small and little influenced by the changes in the temperature or in the lapse of time.

In the prior art, there is known such a lubricating oil having a large coefficient of static friction and a good torque for power transmission. This lubricating oil, however, has defects that the friction characteristic thereof is not satisfactory so that a shift of the automatic transmission and the like causes a large shock.

20 In particular, the trend is more and more outstanding in recent years that automatic transmissions and the like are designed in a decreased size along with the prevalence of compact cars and so-called FF cars (front engine front wheel driven cars). This trend of automatic transmissions toward compact size promotes the adverse influence that the shift shock is felt sensitively by the driver. Accordingly, it is a technical problem to further improve the friction characteristics in order to improve the comfortableness of driving by decreasing the shift shock.

A proposal has been made accordingly of a lubricating oil by use of a friction modifier with an object of improving the friction characteristics. There is a problem, however, that the lubricating oil containing a friction modifier still has only insufficient friction characteristics along with variation of the friction characteristics by the change in the oil temperature and that the friction characteristics are subject to decrease by the degradation (changes in the lapse of time) of the oil after a long-term service.

30 For example, GB-A-2097813 discloses a lubricating oil composition comprising 0.2 % wt. of a glycerol mono-oleate which can be an ester made from high molecular weight dicarboxylic acids. Another proposal has been made in US-A-4209411 according to which the use of methanol polyester derivatives of C12/C22 hydrocarbon succinic anhydride of acid as additives for lubricants leads to reduction of friction, however, the obtained results are still to be improved.

Therefore, lubricating oils having good friction characteristics with small changes by oil temperature and in the lapse of time and having a large transmission torque have hitherto not been obtained.

40 The object of the present invention is to dissolve the above described problems in the prior art by a specific combination of compounds contained in a base oil and to provide a lubricating oil composition with a small shock and a large transmission torque and capable of being satisfactorily used for lubrication of automatic transmissions and the like.

Disclosure of the Invention

45 Namely, the present invention relates to a lubricating oil composition characterized in that a base oil contains (A) from 0.05 to 5% by weight of an ester of alkenyl substituted succinic acid and/or an ester of alkyl substituted succinic acid and (B) from 0.005 to 5% by weight of a fatty acid ester of a polyhydric alcohol wherein the base oil contains 0.5% by weight or less of sulfur.

50 The lubricating oil composition of the present invention has a good friction characteristic or, namely, a small (coefficient of static friction)/(coefficient of dynamic friction) ratio and gives a small shift shock. In addition, the change in the friction characteristics depending on the oil temperature is small, and also the changes in the lapse of time are small so that it is fully adaptable to the trend of transmissions and the like toward compact size.

Brief Description of the Drawing

Figure 1 and Figure 3 are each a graph showing the change in time of μ_0/μ_{1200} at each time up to 2000 cycles in Example and Comparative Example and Figure 2 is a graph showing the temperature

change thereof.

Best Mode Embodiment to Practice the Invention

5 The base oil used in the present invention is the principal ingredient of the lubricating oil composition and various kinds of mineral oils and/or synthetic oils can be used among those used in conventional lubricating oils.

The base oil should preferably have a viscosity of 1.5 to $30 \times 10^{-6} \text{ m}^2 \cdot \text{s}^{-1}$ (centistokes) at 100°C and, in particular, those of 2 to $20 \times 10^{-6} \text{ m}^2 \cdot \text{s}^{-1}$ (centistokes) are preferred when used as an oil for automatic
10 transmissions and an oil for wet-type brakes in agricultural tractors.

To show particular examples of the base oil, the mineral oils include 60 neutral oil, 100 neutral oil, 150 neutral oil, 300 neutral oil and 500 neutral oil by the solvent refining or hydrogenation refining.

On the other hand, the synthetic oils include polyolefins, polyglycol esters, esters of dibasic acids, polyol esters, phosphoric acid esters, silicone oils, alkyl benzenes and alkyl diphenyls as well as condensed
15 ring and/or non-condensed ring saturated hydrocarbons and those mainly composed thereof can be used as the base oil.

When a mineral oil is used as the base oil in the present invention, incidentally, various ones can be used provided that the kinematic viscosity at 100°C is from 1.5 to $30 \times 10^{-6} \text{ m}^2 \cdot \text{s}^{-1}$ (centistokes) or, preferably, from 2 to $20 \times 10^{-6} \text{ m}^2 \cdot \text{s}^{-1}$ (centistokes) and those to be used contain 0.5% by weight or less
20 or, preferably, 0.1% by weight or less or, particularly preferably, 100 ppm or less of sulfur.

An excess amount of the sulfur over 0.5% by weight is not preferable here due to the decrease in the oxidation stability.

Mineral oils having a low pour point can also be used. It should have a pour point of, preferably, -15°C or below or, more preferably, -25°C or below or, particularly preferably, -35°C or below. This is because
25 the friction characteristics can be further improved along with mitigation of the limitation relative to the temperature range for use.

Incidentally, the preferable conditions for the mineral oil are that the content of aromatic hydrocarbons (% C_A) is 20 or smaller or, more preferably, 10 or smaller, that the total acid value is 0.1 mg KOH/g or smaller or, preferably, 0.05 mg KOH/g or smaller.

30 Mineral oil having the properties as described above can be obtained by refining a distillate (boiling point under atmospheric pressure, about 250 - 450°C) as obtained by distillation of paraffin base crude oil, intermediate base crude oil or naphthene base crude oil, by the usual method, or by applying deep dewaxing treatment to thus obtained oil.

The distillate means an oil obtained either by atmospheric distillation of crude oil or by vacuum
35 distillation of residual oil resulting from atmospheric distillation of crude oil. A method of refining is not critical, and any of the methods (1) to (5) as described below can be employed.

(1) The distillate is subjected to hydrogenation treatment, or alternatively, after hydrogenation treatment, the distillate is subjected to alkali distillation or sulfuric acid washing (treating).

(2) The distillate is subjected to solvent refining treatment, or alternatively, after solvent refining
40 treatment, the distillate is subjected to hydrogenation treatment, alkali distillation or sulfuric acid washing (treating).

(3) The distillate is subjected to hydrogenation treatment followed by second hydrogenation treatment.

(4) The distillate is subjected to hydrogenation treatment, then to second hydrogenation treatment, and further to third hydrogenation treatment.

45 (5) The distillate is subjected to hydrogenation treatment followed by second hydrogenation treatment, and further to alkali distillation or sulfuric acid washing (treating).

One of the methods will hereinafter be explained.

A crude starting material for lubricating oil is produced from paraffin base crude oil or intermediate base crude oil by the usual method and then is subjected to severe hydrogenation treatment. In this treatment,
50 undesirable components, such as aromatics, for the lubricating oil fraction are removed or converted into useful components. Almost all of sulfur and nitrogen components are removed at the same time.

Such fractional distillation as to obtain the necessary viscosity is carried out by vacuum distillation. Then, the known solvent dewaxing treatment is carried out so as to dewax to the pour point that the usual paraffin base oil has, that is, about -15 to -10°C .

55 After the dewaxing treatment, if necessary, hydrogenation is carried out to hydrogenate the major portion of aromatic components into saturated components, thereby increasing thermal and chemical stability of the base oil. When the thus obtained mineral oil is insufficient because the pour point is still high, deep dewaxing treatment can be applied subsequently. For this treatment, there are employed a solvent

dewaxing method which is carried out under severe conditions, and a catalytic hydrogenation dewaxing method in which a zeolite catalyst is used and paraffin (mainly n-paraffin) adsorbed on fine pores of the catalyst is selectively decomposed under hydrogen atmosphere to remove components to be converted into wax components.

Conditions for hydrogenation treatment vary with the properties, of the feed oil. Usually, the reaction temperature is 200 to 480 °C and preferably 250 to 480 °C, the hydrogen pressure is $4,9 \times 10^5$ to $2,94 \times 10^7$ Pa (5 to 300 kg/cm²) and preferably $2,94 \times 10^6$ to $2,45 \times 10^7$ Pa (30 to 250 kg/cm²), and the amount of hydrogen introduced (per kiloliter of the feed distillate) is 30 to 3,000 Nm³ and preferably 100 to 2,000 Nm³. In this hydrogenation treatment, there are used catalysts which are prepared by depositing catalyst components such as Groups VI, VIII group metals, preferably cobalt, nickel, molybdenum and tungsten on carriers such as alumina, silica, silica alumina, zeolite, active carbon and bauxite using the known method. It is preferred that the catalyst be previously subjected to preliminary sulfurization.

As described above, after hydrogenation treatment, the distillate is subjected to various treatments. When second hydrogenation treatment or further third hydrogenation treatment is applied, the treatment may be carried out under conditions falling within the ranges as described above. Conditions at the first, second and third stage hydrogenation treatments may be the same or different. Usually the second hydrogenation treatment is carried out under more severe conditions than the first stage hydrogenation treatment, and the third stage hydrogenation treatment, under more severe conditions than the second stage hydrogenation treatment.

Alkali distillation is carried out as a step where small amounts of acidic substances are removed to improve the stability of distillate. In this alkali distillation, alkalis such as NaOH and KOH are added and vacuum distillation is conducted.

Sulfuric acid washing (treating) is generally carried out as a finishing step of oil products, in which aromatic hydrocarbons, especially polycyclic aromatic hydrocarbons, olefins and sulfur compounds are removed to improve the characteristics of distillate. In the present invention, 0.5 to 5% by weight of concentrated sulfuric acid is added to the distillate, the treatment is carried out at a temperature ranging between room temperature and 60 °C, and thereafter neutralization using NaOH is applied.

The aforementioned methods (1) to (5) to be employed in treatment of distillate comprise combinations of the operations as described above. Of these methods, the methods (1), (3) and (4) are particularly suitable.

The distilled oil obtained by the treatment described above has properties including a kinematic viscosity of 1.5 to 30×10^{-6} m²·s⁻¹ (centistokes) (100 °C), content of sulfur of 0.5% by weight or less and pour point of -15 °C or below. Also, the content of the aromatic hydrocarbons (% C_A) is 20% or smaller and the total acid value is 0.1 mg KOH/g or smaller.

The use of such a mineral oil can provide a lubricating oil composition having a smaller (coefficient of static friction)/(coefficient of dynamic friction) ratio.

And, preferable synthetic oils include polyolefins and condensed ring and non-condensed ring saturated hydrocarbons.

Among various ones named as such a saturated hydrocarbon, saturated hydrocarbons having a cyclohexyl group and/or a decalyl group and having 10 to 40 carbon atoms are preferred. The saturated hydrocarbons having a cyclohexyl group and/or a decalyl group here are exemplified particularly by 2-methyl-2,4-dicyclohexyl pentane, cyclohexyl methyl decalin, 1-(methyl decalyl)-1-cyclohexyl ethane, 2,4-dicyclohexyl pentane and isododecyl cyclohexane.

The base oil can be admixed according to need with a viscosity index improver and corrosion inhibitor.

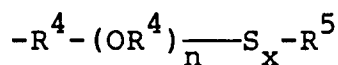
In the present invention, an ester of alkenyl substituted succinic acid and/or an ester of alkyl substituted succinic acid are used as the component (A). The ester of alkenyl substituted succinic acid or ester of alkyl substituted succinic acid can be used particularly efficiently when it is represented by the general formula [I] given below.



In the above given formula [I], R¹ is an alkenyl group or an alkyl group having 6 to 30 carbon atoms or, preferably, 12 to 24 carbon atoms.

And, R² and R³ in the above given formula [I] are each a hydrogen, an alkyl group having 1 to 20

carbon atoms, a hydroxyalkyl group having 1 to 20 carbon atoms or a group represented by the general formula



(in the formula, R^4 is an alkylene group having 1 to 4 carbon atoms, R^5 is an alkyl group having 1 to 20 carbon atoms or a hydroxy-substituted group thereof, n is an integer of 0 to 6 and x is 1 or 2).

R^2 and R^3 here can be the same ones or different from each other excepting the case where R^2 and R^3 are both hydrogens.

Particular examples of the ester of alkenyl substituted succinic acid and ester of alkyl substituted succinic acid include monomethyl ester of octadecenyl succinic acid, dimethyl ester of octadecenyl succinic acid, monoethyl ester of octadecenyl succinic acid, diethyl ester of octadecenyl succinic acid, monooctyl ester of octadecenyl succinic acid, dioctyl ester of octadecenyl succinic acid, monononyl ester of octadecenyl succinic acid, dinonyl ester of octadecenyl succinic acid, monolauryl ester of octadecenyl succinic acid, dilauryl ester of octadecenyl succinic acid, monolauryl ester of dodecyl succinic acid, dilauryl ester of dodecyl succinic acid, monomethyl ester of hexadecyl succinic acid, dimethyl ester of hexadecyl succinic acid, monoethyl ester of hexadecyl succinic acid, diethyl ester of hexadecyl succinic acid, monomethyl ester of octadecyl succinic acid, dimethyl ester of octadecyl succinic acid, monoethyl ester of octadecyl succinic acid, diethyl ester of octadecyl succinic acid, monooctyl ester of octadecyl succinic acid, dioctyl ester of octadecyl succinic acid, monolauryl ester of octadecyl succinic acid, monolauryl ester of octadecyl succinic acid, dilauryl ester of octadecyl succinic acid, a reaction product of an alkenyl succinic acid of a propylene oligomer having 18 carbon atoms on an average and a propylene glycol, a reaction product of a polybutenyl succinic acid of a polybutene having an average molecular weight of 400 and a propylene glycol, octyl mercaptan ethylene oxide ester of octadecenyl succinic acid, octyl mercaptan propylene oxide ester of octadecenyl succinic acid, nonyl mercaptan ethylene oxide ester of octadecenyl succinic acid, nonyl mercaptan propylene oxide ester of octadecenyl succinic acid, lauryl mercaptan ethylene oxide ester of octadecenyl succinic acid, lauryl mercaptan propylene oxide ester of octadecenyl succinic acid, 5-hydroxy-3-thiapentyl ester of octadecenyl succinic acid and 6-hydroxy-3,4-dithiahexyl ester of octadecenyl succinic acid.

In the present invention, either one of the ester of alkenyl substituted succinic acid and the ester of alkyl substituted succinic acid or a mixture thereof is added as the component (A) while the amount of addition thereof depends on the properties of the desired lubricating oil composition and cannot be definitely selected. It is, however, from 0.05 to 5.0% by weight or preferably from 0.1 to 3.0% by weight. No sufficient effect can be obtained with an amount of addition smaller than 0.05% by weight while an undesirably adverse decrease is caused in the oxidation stability with an excess over 5.0% by weight.

In the next place, a fatty acid ester of a polyhydric alcohol, is used as the component (B) in the present invention. The polyhydric alcohol here implied includes glycerin, trimethylol propane, pentaerythritol and sorbitol of which glycerin is particularly preferable. And, the fatty acid includes those having 8 to 30 carbon atoms which may be either saturated or unsaturated. Particular examples of the fatty acid include pelargonic acid, lauric acid, palmitic acid, stearic acid, behenic acid, undecylenic acid, oleic acid, linoleic acid and linolenic acid. Exemplary of the more preferable esters are partial esters of polyhydric alcohols such as oleic acid monoglyceride, oleic acid diglyceride, stearic acid monoglyceride and stearic acid diglyceride.

The amount of addition of the above mentioned component (B) is from 0.005 to 5% by weight or, preferably, from 0.01 to 3% by weight. No sufficient improvement can be obtained in the friction characteristics with an amount of addition smaller than 0.005% by weight. On the other hand, the oxidation stability is undesirably affected adversely by the addition in excess of 5% by weight.

The lubricating oil composition of the present invention can be obtained basically by admixing the above described components (A) and (B) with the base oil but it is optional to add an acid amide or a boron derivative thereof with an object to improve the friction characteristics and simultaneously to enhance the physical properties as a lubricating oil. The acid amide is a reaction product of a carboxylic acid having 12 to 30 carbon atoms and an amine compound and the particular examples thereof include the reaction products of isostearic acid or oleic acid with diethylene triamine, triethylene tetramine, tetraethylene pentamine and hexaethylene pentamine. And, examples of the boron-containing derivatives of an acid amide include the reaction products of an acid amide and a boron compound (boric acid, salts of boric acid and esters of boric acid). Particular examples include those obtained by the reaction of boric acid with the above mentioned acid amide, e.g., the reaction product of isostearic acid and tetraethylene pentamine. The

amount of addition is 0.01 to 10% by weight or, preferably, 0.05 to 3% by weight. No sufficient improving effect of the friction characteristics and cleaning and dispersing effect can be obtained with an amount of addition smaller than 0.01% by weight while, on the other hand, addition in excess of 10% by weight is undesirable due to the decrease in the coefficient of static friction resulting in a decreased transmission torque.

To the lubricating oil composition of the present invention, if desired, an antioxidant, a detergent-dispersant and a viscosity index improver can be added. As the antioxidant, those commonly used such as phenol base compounds, amine base compounds and zinc dithiophosphate can be used. Representative examples are 2,6-di-tert-butyl-4-methyl-phenol; 2,6-di-tert-butyl-4-ethyl-phenol; 4,4'-methylenebis(2,6-di-tert-butyl-phenol); phenyl- α -naphthylamine, dialkyldiphenylamine, zinc di-2-ethylhexyldithiophosphate, zinc diamyldithiocarbamate, and pinene pentasulfide.

The amount of addition is 0.01 to 3% by weight or, preferably, 0.05 to 2% by weight. No effect can be obtained with an amount smaller than 0.01% by weight while no remarkable improvement can be achieved even with an amount in excess of 3% by weight.

Detergent-dispersants which can be used include an ashless base dispersant and a metal-based detergent. For example, alkenylsuccinic acid imide, sulphonates and phenates are preferred. Representative examples of such preferred compounds are polybutenylsuccinic acid imide, calcium sulphonate, barium sulphonate, calcium phenate, barium phenate and calcium salicylate.

The amount of addition is 0.1 to 10% by weight or, preferably, 0.5 to 5% by weight. The dispersibility is insufficient with an amount smaller than 0.1% by weight while an amount in excess of 10% by weight is undesirable due to the decrease in the friction characteristics.

Though not particularly limitative, polymethacrylates and copolymers of olefin can be used as the viscosity index improver. Particularly preferable are the polymethacrylates having a molecular weight not exceeding 100,000 or, preferably, not exceeding 50,000 having excellent shearing stability and capable of preventing any viscosity changes over a long period of time. The amount of addition is 0.5 to 15% by weight or, preferably, 2 to 10% by weight. No improvement can be achieved in the viscosity-temperature characteristics with an amount smaller than 0.5% by weight while an amount in excess of 15% by weight is undesirable due to the decrease in the wearing resistance and the like as a result of the use of a low-viscosity base oil.

Besides, the lubricating oil composition of the present invention can be admixed according to need with a corrosion inhibitor, rubber swelling agent and defoaming agent.

In the following, the present invention is described in more detail by way of examples.

Examples 1 and 2 and Comparative Examples 1 and 2

As a base oil, a mineral oil I having a kinematic viscosity of $5 \times 10^{-6} \text{ m}^2 \cdot \text{s}^{-1}$ (centistokes) at 100°C and containing 200 ppm of sulfur was admixed with 4.0% by weight of a polymethacrylate (molecular weight 42,000), 4.0% by weight of polybutenyl succinic acid imide (molecular weight of the polybutenyl group 1000) and 0.5% by weight of an acid amide to give a base oil which was admixed with a compound in an amount indicated in Table 1 to give a lubricating oil composition.

The thus obtained lubricating oil composition was subjected to testing according to the following methods.

SAE No. 2 friction test

The friction characteristics were evaluated under the experimental conditions described below by using a SAE No. 2 testing machine manufactured by Greening Co. (U.S.).

[Experimental conditions]

Discs:	Japanese-made paper-based discs for automatic transmission (2 sheets)
Plates:	Japanese-made steel plates for automatic transmission (4 plates)
Revolution of motor:	3000 rpm
Thrusting pressure on piston:	3 kg/cm ²
Oil temperature:	50°C, 80°C, 100°C and 120°C

The coefficient of dynamic friction at the revolution of 1200 rpm μ_{1200} and the coefficient of static friction at a moment of coming into stoppage μ_0 were determined under the above described experimental

conditions and μ_0/μ_{1200} was calculated. The change in time and the change by temperature of this μ_0/μ_{1200} were respectively determined to evaluate the friction characteristics.

Namely, the change in time of μ_0/μ_{1200} was determined up to 2000 cycles at an oil temperature of 100 °C. Figure 1 illustrates the change in time of μ_0/μ_{1200} at the respective moments up to 2000 cycles (100, 200, 300, 400, 500, 1000, 1500 and 2000 cycles). Further, the values of μ_0/μ_{1200} at 200 cycles and at 2000 cycles are shown in Table 1 as the results of the durability test.

In the next place, the oil temperature was varied stepwise at 50, 80, 100 and 120 °C after a break-in up to 200 cycles at an oil temperature of 100 °C and the μ_0/μ_{1200} was determined at each temperature. The results are shown in Figure 2. Further, the values of μ_0/μ_{1200} at 50 °C and 120 °C are shown in Table 1 as the results of the temperature dependency test.

Comparative Example 3

A commercial product was subjected to the evaluation of the friction characteristics in the same manner as in Example 1. The results are shown in Table 1, Figure 1 and Figure 2.

Examples 3 and 4 and Comparative Example 4

The lubricating oil compositions indicated in Table 1 were obtained in the same manner as in Examples 1 and 2 and Comparative Examples 1 and 2 excepting the use of a mineral oil II having following properties as the base oil and testing was undertaken. Figure 3 shows the changes in time of the μ_0/μ_{1200} at the respective moments up to 2000 cycles. Further, Table 1 shows the results of the durability test and the temperature dependency test.

Properties of the mineral oil II	
Kinematic viscosity (100 °C)	$5.0 \times 10^{-6} \text{ m}^2 \cdot \text{s}^{-1}$ (centistokes)
Sulfur content (ppm)	1
Pour point	-45 °C
% C _A	0.1 >

Examples 5 to 10 and Comparative Example 5

Testing was undertaken for the lubricating oil compositions indicated in Table 1 in the same manner as in Examples 1 and 2 and Comparative Examples 1 and 2. Table 1 shows the results of the durability test and the temperature dependency test. Incidentally, the base oil was admixed, in the same manner as in Examples 1 and 2 and Comparative Examples 1 and 2 (in the same manner as in the other Examples and Comparative Examples) with 4.0% by weight of a polymethacrylate (molecular weight 42,000), 4.0% by weight of a polybutenyl succinic acid imide (molecular weight of the polybutenyl group 1000) and 0.5% by weight of an acid amide.

Table 1

	Base Oil		Component A (% by weight)			Component B (% by weight)		Durability Test		Temperature De- pendency Test	
	Type	% by weight	A ₁	A ₂	A ₃	B ₁	B ₂	200 cycle	2000 cycle	50°C	120°C
Comparative Example 1	Mineral Oil I	99.0	1.0	-	-	-	-	1.09	1.10	1.18	1.09
Example 1	" I	98.5	1.0	-	-	0.5	-	1.05	1.06	1.02	1.05
" 2	" I	98.5	1.0	-	-	-	0.5	1.08	1.09	1.03	1.08
Comparative Example 2	" I	99.5	-	-	-	-	0.5	1.26	1.21	1.20	1.27
" 3	Commercial Product										
" 4	" II	99.0	1.0	-	-	-	-	1.14	1.16	1.25	1.14
Example 3	" II	98.5	1.0	-	-	0.5	-	1.03	1.04	1.02	1.04
" 4	" II	98.5	1.0	-	-	-	0.5	1.01	1.01	1.02	1.02
" 5	" I	98.5	-	1.0	-	0.5	-	1.04	1.05	1.03	1.05
" 6	" II	98.5	-	1.0	-	0.5	-	1.02	1.03	1.02	1.03
" 7	Synthetic Oil III	98.5	1.0	-	-	-	0.5	1.09	1.10	1.05	1.09
" 8	" III	98.5	-	1.0	-	-	0.5	1.09	1.10	1.04	1.08
" 9	" IV	98.5	-	1.0	-	0.5	-	0.99	1.00	0.98	1.00
Comparative Example 5	Mineral Oil I	99.0	-	1.0	-	-	-	1.08	1.09	1.19	1.09
Example 10	" I	98.5	-	-	1.0	0.5	-	1.05	1.05	1.03	1.06

*1

Mineral oil I : kinematic viscosity at 100°C $5 \times 10^{-6} \text{m}^2 \cdot \text{s}^{-1}$ (centistokes);

content of sulfur 200 ppm; pour point

-17.5°C; and % C_A 6

Mineral oil II: kinematic viscosity at 100°C $5.0 \times 10^{-6} \text{m}^2 \cdot \text{s}^{-1}$ (centistokes);

content of sulfur (ppm) 1> ; pour point

-45°C; and % C_A 0.1 >

Synthetic oil III : α -olefin oligomer (kinematic viscosity

at 100°C $4 \times 10^{-6} \text{m}^2 \cdot \text{s}^{-1}$ (centistokes))

Synthetic oil IV : 2-methyl-2,4-dicyclohexyl pentane

(kinematic viscosity at 100°C $3.7 \times 10^{-6} \text{m}^2 \cdot \text{s}^{-1}$ (centistokes))

*2 A₁ : monolauryl ester of octadecenyl succinic acid

*3 A₂ : octylmercaptan propylene oxide ester of octadecenyl

succinic acid

*4 A₃ : 5-hydroxy-3-thiapentyl ester of octadecenyl

succinic acid

*5 B₁ : oleic acid monoglyceride

*6 B₂ : sorbitan monooleate

It is understood from Table 1 and Figures 1 to Figure 3 that the lubricating oil composition of the present invention has excellent friction characteristics. In particular, it is understood from the results of the temperature dependency test that the changes in the friction characteristics depending on the oil temperature are extremely small.

Industrial Utilizability

Accordingly, the lubricating oil composition of the present invention is very effective as a lubricating oil for automatic transmissions, lubricating oil for the parts having a wet-type clutch or wet-type brake in tractors.

Besides, the composition having such characteristics in combination is also effective as a lubricating oil in shock absorbers, power steerings, hydraulic suspensions and as a combined-use oil for a plurality of these objects.

Claims

1. A lubricating oil composition characterized in that the base oil contains
 - (A) from 0,05 to 5 % by weight of an ester of alkenyl substituted succinic acid and/or an ester of alkyl substituted succinic acid and
 - (B) from 0,005 to 5 % by weight of a fatty acid ester of a polyhydric alcohol,
 wherein the base oil contains 0,5 % by weight or less of sulfur.

Patentansprüche

1. Schmierölzusammensetzung, dadurch gekennzeichnet, daß das Basisöl

(A) von 0,05 bis 5 Gewichts-% eines Esters einer Alkenyl-substituierten Succinsäure und/oder eines Esters einer Alkylsubstituierten Succinsäure und

(B) von 0,05 bis 5 Gewichts-% eines Fettsäureesters eines mehrwertigen Alkohols
enthält, worin das Basisöl 0,5 Gewichts-% oder weniger Schwefel enthält.

5

Revendications

1. Composition d'huile lubrifiante caractérisée en ce que l'huile de base contient :

(A) de 0,05 à 5% en poids d'un ester de l'acide succinique substitué par un groupe alkényle et/ou
un ester de l'acide succinique substitué par un groupe alkyle, et

(B) de 0,005 à 5% en poids d'un ester d'acide gras et d'un polyol,
dans laquelle l'huile de base contient tout au plus 0,5% en poids de soufre.

10

15

20

25

30

35

40

45

50

55

Fig. 1

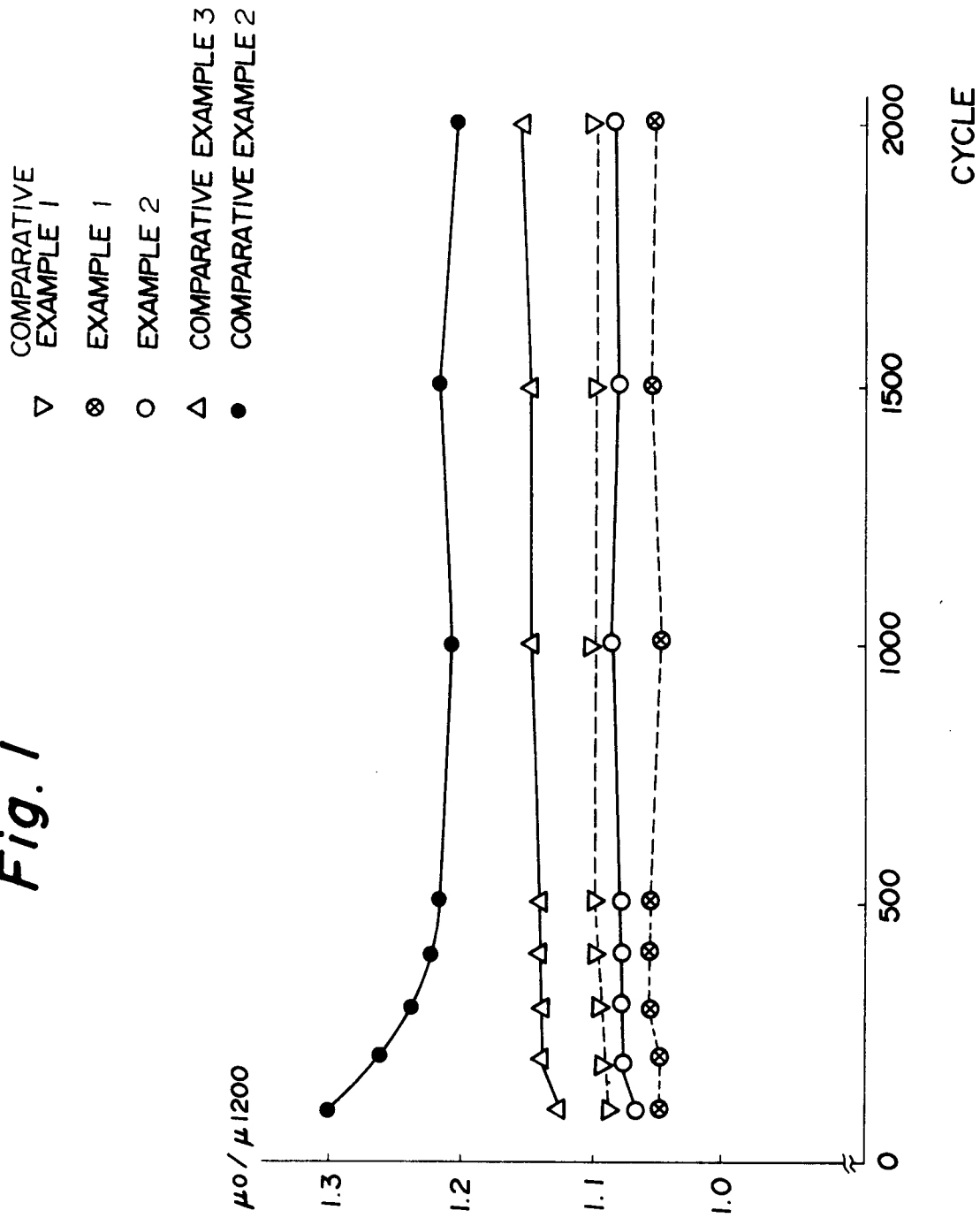


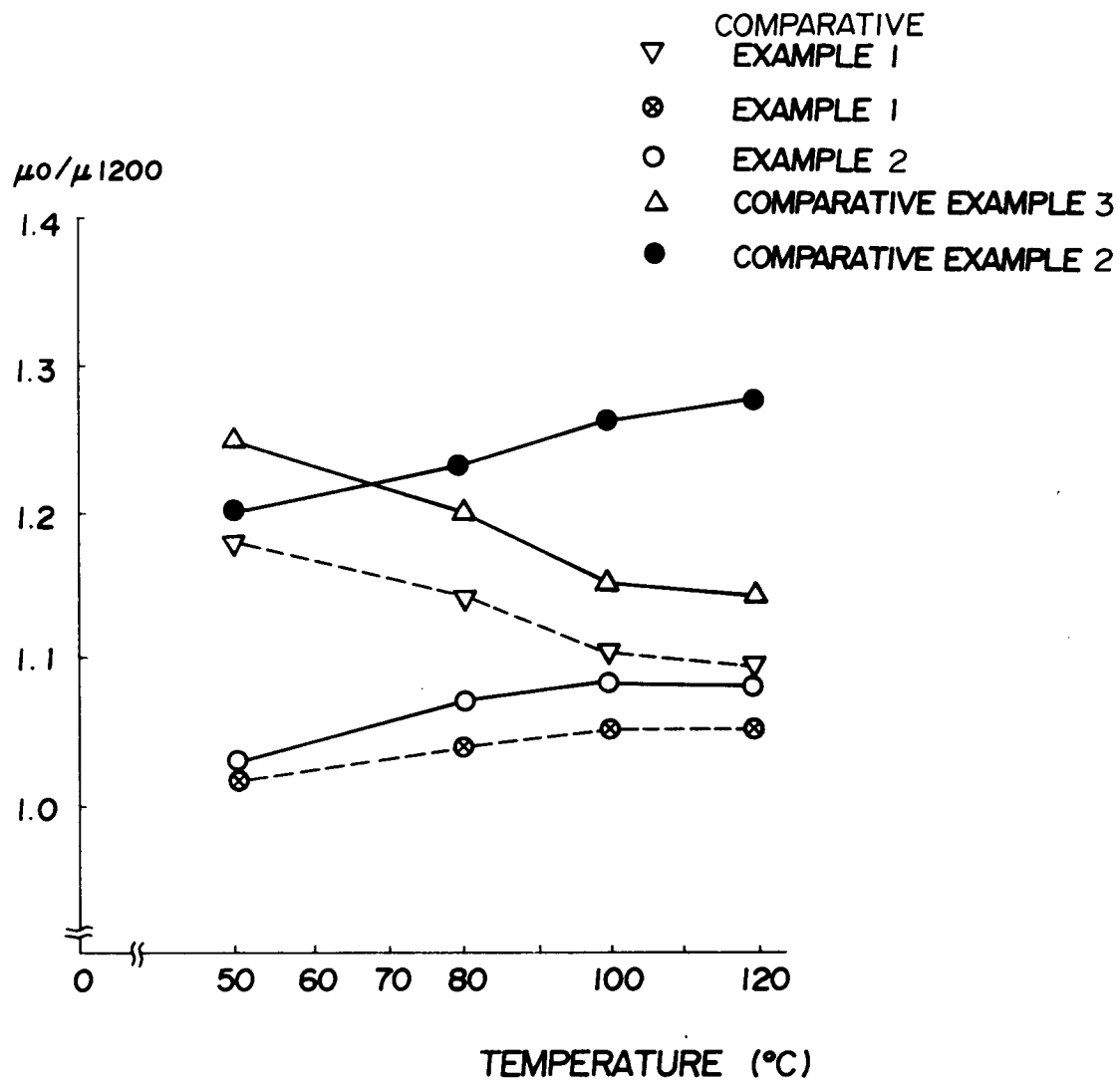
Fig. 2

Fig. 3