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(54) Lubricating composition

Schmiermittelzusammensetzung

Composition lubrifiante

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Remarks:

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

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Description

[0001] This invention relates generally to lubricating compositions and has particular reference to a lubricant composition containing a base lubricating oil and one or more molybdenum compounds and having a content of total alkali metal containing sodium below 100ppm.

[0002] In the present situation surrounding automotive vehicles, controls regarding fuel economy, exhaust gas emissions and the like have become stricter. Behind these controls lie concerns about the environmental protection from global warming, air pollution, acid rain and the like as well as the protection of natural resources, especially out of concern about the exhaustion of limited petroleum deposits. In copying with the above trend, automotive fuel economy is most effective means available at present. To this end, it is of importance that the automobile itself be enhanced in respect to body weight, engine performance and the like, whereas improvements in engine oil in regards to lowered viscosity, the addition of suitable friction regulating additives, etc. is also very important.

[0003] Automotive engine oils, however, must now be used under more severe conditions than in the past. This is partly due to the impaired or adverse frictional conditions between engine oil and the engine, and elevated oil temperatures of accompanying increases in engine performance output. Another cause is seen in reduced quantities of engine oil used in order to reduce automobile weight. Thus, reductions in viscosity are a cause of engine wear or seizing.

[0004] A keen demand, therefore, has been voiced for the development of an additive that can overcome those problems stemming from engine oils that have reduced viscosities. An engine oil generally contains, to maintain desired performance, various additives such as friction regulating additives, antioxidants, cleaning agents, dispersants, extreme pressure agents, viscosity index improvers, pour point depressants, antiwear agents and the like. For instance, Japanese Patent Laid-Open No. 5-508188 discloses a lubricating composition in which an overbasified alkali metal salt such as of a sodium, potassium, lithium or like metal of an acidic organic compound, a dispersant, dihydrocarbyl dithiophosphate and an antioxidant are incorporated to reduce deterioration and prevent wear of the engine, and to present sludge formation. However, in order to solve the problems of wear and seizing noted above, organomolybdenum compounds are now being seen as essential additives.

[0005] Also, Japanese Patent Laid-Open No. 5-279686 suggests that the friction characteristics of an engine oil can be improved, without wear resistance and other important qualities impaired, by formulation of an organomolybdenum compound, a fatty ester, a metallic cleaning agent (calcium sulfonate, magnesium sulfonate, calcium phenate and magnesium phenate), an ashless cleaning dispersant (benzylamine, its boron derivative, an imide of alkenyl succinate and its boron derivative) and an antiwear agent [zinc dithiophosphate (ZDTP) and zinc dithiocarbamate (ZDTC)].

[0006] Constant velocity joints (CVJ) are being widely used for the rapidly growing numbers of FF and 4WD vehicles or FR vihicles with indepedent suspension. Although CVJ's are used to transmit engine-power to the wheels, smooth power transmission is also required even in when the steering wheel has been turned left or right. To this end, CVJ's are generally a plunger type joint that is axially slidable on the engine side and a fixed type joint that is fixed axially on the wheel side. The plunger joint involves sliding resistance arising in the axial direction from its rolling and sliding movements as it reciprocates, thus leading to undesirable noise and vibration in an automatic transmission car, namely vibration during idling, rolling during startup and acceleration of the car, and beat frequency and entrapped noises from the car at certain speeds. Vibration damping is now a significant problem in keeping with the demand for more comfortable quiter, automotive vehicles. Consequently, focus has been centered not only on improving the joints themselves, but also on improving the grease compositions to be filled therein.

[0007] In view of the fact that the damped vibration of an automobile is correlated to the friction coefficient and hence conducive to saved fuel, a grease composition has been sought which could hold vibration to an absolute minimum.

[0008] Molybdenum disulfide, a sulfur-phosphorus type additive, a lead type additive or the like has heretofore been employed as an additive to be incorporated in a grease composition for use with constant velocity joints. In recent years, however, organomolybdenum compounds have been put to use in the production of a grease exhibiting damped vibration that is a key quality in the art, i.e., a grease with low friction performance.

[0009] Japanese Patent Laid-Open No. 6-184583, for example, discloses a grease for use with constant velocity joints and also a grease composition for such joints wherein a urea grease is formulated with molybdenum dithiophosphate, molybdenum dithiocarbamate and ZDTC.

[0010] Engine oils, however, are usually composed of a wide variety of additives as already discussed. In such oils, the additives tend to interact in some cases with each other and thus fail to impart their respective inherent properties.

[0011] Furthermore, when the prevailing trend toward improved mileage fuel savings are taken into account, it becomes important to bring out the physical performance of a given organomolybdenum compound and retain it. Here, investigation is needed to see which of vrious selected additives would need to be formulated in such a way that the organomolybdenum compound could fully give rise to its performance.

[0012] In the case of the grease of Japanese Patent Laid-Open No. 6-184583 cited above, it has been found that good friction reduction performance is not necessarily attainable.

[0013] EPO 638 582 describes a powdery molybdenum oxysulphide dithiocarbamate composition which exhibits low

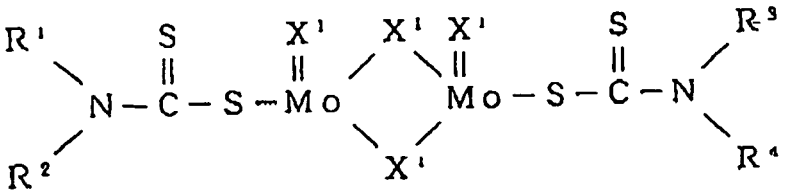
corrosive action and excellent lubricating properties.

[0014] JP 51080825 describes a high pressure additive for lubricants prepared from molybdenum trisulphide, sec.amine and carbon disulphide.

[0015] Accordingly, the present invention seeks to provide a lubricating composition suitable for use as a lubricant oil.

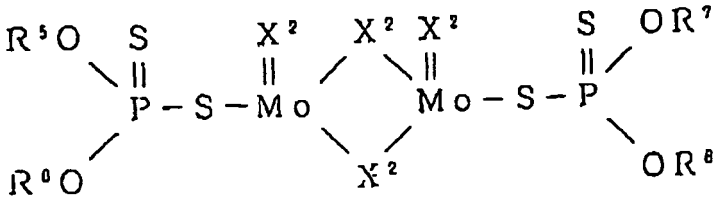
[0016] As a result of extensive research made in an effort to overcome the foregoing deficiencies of the prior art, the present inventors have now found that friction reduction can be enhanced with good friction coefficient by lowering the content of alkali metal, particularly of sodium metal, in a lubricating composition. The present invention is based on such finding.

[0017] The present invention provides a lubricating composition comprising a base oil, one or more organomolybdenum compounds selected from the group consisting of sulfurized oxymolybdenum dithiocarbamates represented by Formula (1)



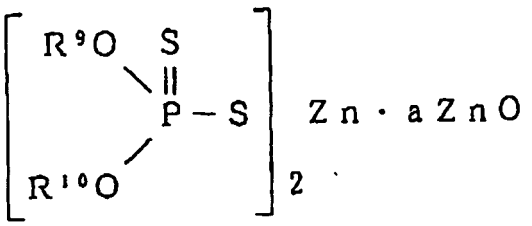
(1)

wherein R^1 to R^4 are each a hydrocarbyl group, X^1 is an oxygen or sulfur atom and the atomic ratio of oxygen to sulfur is from 1:3 to 3:1; and sulfurized oxymolybdenum dithiophosphates represented by Formula (2)



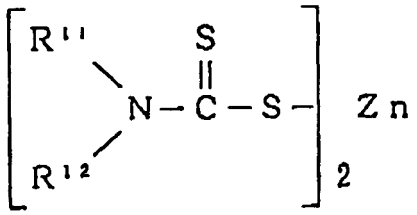
(2)

wherein R^5 to R^8 are each a hydrocarbyl group, and X^2 is an oxygen or sulfur atom and the atomic ratio of oxygen to sulfur is from 1:3 to 3:1; and one or more organozinc compounds selected from the group consisting of zinc dithiophoshates represented by Formula (3)



(3)

wherein a is 0 or 1/3, and R^9 to R^{10} are each a hydrocarbyl group; and zinc dithiocarbamates represented by Formula (4)



(4)

wherein R^{11} and R^{12} are each a hydrocarbly group; and cleaning agents selected from sulfonates, phenates and carboxylates of neutral or highly basic alkaline earth metals;
characterized in that said composition has a total content of alkali metals including a sodium metal of below 100 ppm, and wherein the base oil is a base oil for lubricating oil.

[0018] In a second aspect of the present invention an amount of the organomolybdenum compound added ranges from 0.005 to 0.2 percent by weight in terms of molybdenum based on the weight of the base oil for lubricating oil, and an amount added to the organozinc compound ranges from 0.005 to 2 percent based on the weight of the base oil for lubricating oil.

[0019] The lubricating composition according to the present invention contains said organomolybdenum compound as an essential component. In order to ensure that such compound be able to exhibit its peculiar physical characteristics, the total content of an alkali metal including sodium in the composition should be set below 100 ppm, preferably below 50 ppm. Further, alkali metals mentioned herein are those classed among Group I of the Periodic Table in which lithium, sodium, potassium, rubidium, cesium and francium are included.

[0020] In general, an alkali metal such as sodium becomes introduced into the resultant lubricating composition in cases where such alkali metal has not been completely removed after it was employed as a catalyst or starting material in separating and purifying or synthesizing the desired base lubricating oil. Another such case is found with respect to alkali metals or their salts not being completely eliminated subsequent to their use as a catalyst or starting material in the syntheses of various additives as commonly practiced frequently. Alkali metal compounds for use as starting materials and catalysts are exemplified by basic reagents such as alkali hydroxides, alkali sulfides, alkali hydrosulfides, alkali oxides, alkali alcoholates and the like, and reducing reagents such as alkali metals, alkali metal halides, alkali aluminum halides, alkali boron halides and the like.

[0021] In the case where the lubricating composition of the present invention is applied as a lubricating oil composition, additives such as for example an alkali metal type cleaning agent might often be added. However, the use of such particular additive is not preferable in the practice of the present invention.

[0022] The organomolybdenum compounds that can be used in the present invention include, in addition to MoDTC and MoDTP, reaction products of molybdic acid with amines, oxymolybdenum organophosphates, (sulfurized) oxymolybdenum xanthate, reaction products of molybdenum with basic nitrogens, molybdenum-containing dispersants and the like. MoDTC and MoDTP among these compounds are noticeably affected by the sodium content in the lubricating composition.

[0023] According to the lubricating composition of the present invention, MoDTC is represented by the compounds of Formula (1) indicated above, whereas MoDTP is represented by the compounds of Formula (2) shown above. In both formulae, R^1 to R^4 and R^5 to R^8 are all hydrocarbyl groups that may be by nature saturated, unsaturated, chained, branched-chain or straight-chain. Such hydrocarbyl groups may be of an aliphatic, alicyclic or aromatic nature in which alkyl, alkenyl, alkylaryl, cycloalkyl, cycloalkenyl groups and the like are included.

[0024] Suitable alkyl groups are chosen from among methyl, ethyl, propyl, isopropyl, butyl, isobutyl, tertiary butyl, pentyl, isopentyl, neopentyl, tertiary pentyl, hexyl, heptyl, octyl, 2-ethylhexyl, nonyl, decyl, undecyl, dodecyl, tridecyl, isotridecyl, myristyl, palmityl, stearyl, eicosyl, docosyl, tetracosyl, triacontyl, 2-octyl-dodecyl, 2-dodecylhexadecyl, 2-tetradecyloctadecyl, branched monomethyl-isostearyl groups and the like.

[0025] Suitable alkenyl groups are chosen from among vinyl, ally, propenyl, isopropenyl, butenyl, isobutenyl, pentenyl, isopentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, tetradecenyl, oleyl groups and the like.

[0026] Suitable alkylaryl groups are chosen from among phenyl, tolyl, xylyl, cumenyl, mesithyl, benzyl, phenethyl, styryl, cinnamyl, benzhydryl, trityl, ethylpheny, propylphenyl, butylphenyl, pentylphenyl, hexylphenyl, heptylphenyl, octylphenyl, nonylphenyl, alpha-naphthyl, beta-naphthyl groups and the like.

[0027] Suitable cycloalkyl and cycloalkenyl groups are chosen from among cyclopentyl, cyclohexyl, cycloheptyl, methylcyclopentyl, methylcyclohexyl, methylcycloheptyl, cyclopentenyl, cyclohexenyl, cycloheptenyl, methyl-cyclopentenyl, methylcyclohexenyl, methylcycloheptenyl groups and the like.

[0028] The substituent groups, R^1 to R^8, may be the same or different; that is, R^1 to R^4 may be identical to, or different from R^5 to R^8. Where the base oil is a base oil for lubricating oil, i.e., where the lubricating composition is a lubricating oil composition, an alkyl group of 8 to 13 carbon atoms is preferred as R^1 to R^4 that are in MoDTC and an alkyl group of 6 to 13 carbon atoms as R^5 to R^8 that are in MoDTP. The case where R^1 to R^4 are different from each other, is preferable when the resultant lubricating oil composition is to have long drain or long service life..

[0029] Each of the X^1 in Formula (1) and X^2 in Formula (2) is an oxygen or sulfur atom and may be identical or different. Too small a number of oxygen atoms invites insufficient lubricity, and too large a number of sulfur atoms makes the finished lubricating composition highly corrosive. The atomic ratio of oxygen to sulfur is from 1:3 to 3:1.

[0030] In the lubricating composition according to the present invention, the organomolybdenum compounds specified above can be used singly or in combination. Though not particularly restricted, the amount of such compound added is of itself limited to gain adequate lubricity and to prevent adverse sludge. For example, when the lubricating composition is a lubricating oil composition, the organomolybdenum compound may be used in an amount of 0.005 to 0.2 percent by weight in terms of molybdenum, preferably of 0.01 to 0.1 percent by weight, based on a selected base oil.

[0031] MoDTC and MoDTP tend to contain a greater content of alkali metals, particularly of sodium metals since they are synthesized usually with the use of an alkali metal compound, especially of sodium hydrosulfide. Thus, it is preferred that MoDTC and MoDTP for use in the lubricating composition of the present invention be derived for example by the

production methods stated below.

[0032] MoDTC can preferably be produced by the method disclosed for instance in Japanese Patent Laid-Open No. 56-12638. In this known method, molybdenum trioxide or molybdate salt is reacted with an alkali sulfide or alkali hydrosulfide, followed by addition of carbon disulfide and a secondary amine, and the reaction is continued at an appropriate temperature.

[0033] MoDTP can preferably be produced by the methods taught for instance in Japanese Patent Laid-Open Nos. 61-87690 and 61-106587. Both methods are contrived to react an alkali sulfide or alkali hydrosulfide, followed by addition of P_2S_5 and a secondary amine, and the reaction is continued at an appropriate temperature.

[0034] The lubricating composition of the present invention incorporates either one or both of ZDTP and ZDTC as organozinc compounds. ZDTP is represented by the compounds of Formula (3) as previously shown, and R^9 and R^{10} in that formula are each hydrocarbyl groups similar to R^1 to R^8. ZDTC is represented by the compounds of Formula (4) also indicated above, and R^{11} and R^{12} are each hydrocarbyl groups similar to R^1 to R^8.

[0035] In the ZDTP of Formula (3), R^9 and R^{10} are each hydrocarbyl groups and may be the same or different. Both of the substituent groups may be selected, like R^1 to R^8, from alkyl, alkenyl, alkylaryl groups and the like, among which an alkyl group of 3 to 14 carbon atoms is particularly preferred.

[0036] In addition, among the R^9 and R^{10} of one or more ZDTP compounds to be used more than 60% are preferably occupied by a primary alkyl group. The remaining quantity of less than 40% may be a secondary alkyl and/or a tertiary alkyl group.

[0037] In Formula (3), a is 0 or 1/3, and the resulting compound is termed a "neutral ZnDTP" when a is zero and a "basic ZnDTP" when a is 1/3.

[0038] ZDTP to be used in the present invention can be obtained by the method disclosed for instance in Japanese Patent Laid-Open No. 48-37251. That is, P_2S_5 is reacted with a given alcohol to form an alkyl-substituted dithio-phosphoric acid which is then neutralized or basified with zinc oxide, whereby a zinc salt is prepared.

[0039] In the ZDTC of Formula (4), R^{11} and R^{12} are each hydrocarbyl groups and may be the same or different. The two substituent groups are selected, like R^1 to R^8, from alkyl, alkenyl, alkylaryl groups and the like, among which an alkyl group of 3 to 14 carbon atoms is particularly preferred.

[0040] One or more members of the above organozinc compounds are used in the lubricating composition of the present invention. When this composition is applied as a lubricating oil composition, no particular restriction is placed on the amount of the organozinc compound to be added. Too small an amount of such compound, however, results in an insufficient level of extreme pressure performance. Conversely, too large an amount of the compound is responsible for impaired properties of extreme pressure performance and oxidation resistance. In regards to ZDTP, as it contains phosphorus it tends to contaminate catalysts employed inexhaust gas-treating systems. The organozinc compound is therefore added in an amount of 0.005 to 2% by weight, preferably of 0.01 to 1% by weight, based on the weight of the base lubricating oil selected. The organozinc compound contributes to improvements in extreme pressure performance and oxidation resistance of the lubricant composition.

[0041] The lubricating composition of the present invention is comprised of a base oil, one or more organomolybdenum compounds as specified above and, one or more organozinc compounds as previously stated. Here, the base oil is a base oil for lubricating oil.

[0042] The base oil for lubricating oil that can be used as the base oil may be mineral or synthetic oils. By the term mineral oil is meant such derived from cracking of crude oil and from subsequent distillation and refining. Included in the term mineral oil is paraffinic oils, naphthenic oils and oils made available from hydrogenation and solvent refining thereof. The term synthetic oil denotes a chemically synthesized lubricating oil and includes poly-alpha-olefins, polyisobutylene (polybutenes), diesters, polyol esters, phosphate esters, silicate esters, polyalkylene glycols, polyphenylethers, silicones, fluorine compounds, alkyl benzenes and the like.

[0043] When the lubricating composition of the present invention is used as an engine oil composition, it is preferred to select as the base, a mineral oil such as hydrogenated oils and hydrogenation refined oils, synthetic oils such as poly-alpha-olefins, diesters, polyol esters and the like.

[0044] If the lubricating composition of the present invention is used as a lubricating oil composition, numerous known additives may be incorporated which are chosen from friction relaxants such as higher fatty acids, higher alcohols, amines, esters and the like, extreme pressure agents such as of a sulfur, chlorine, phosphorus or organometallic type or the like, antioxidants such as phenols, amines and the like,
dispersants such as imide succinates, benzyl-amines and the like, viscosity index improvers such as high-molecular poly(meth)acrylates, polyisobutylenes, polystyrenes, ethylene-propylene copolymers, styrene-isobutylene copolymers and the like, defoamers such as esters, silicones and the like, rust preventives, pour point depressants and molybdic acid amines. The amount of each of such additive to be added is within the range commonly accepted in the art.

[0045] Advantageously, the lubricating oil composition having the formulation as stated above, can be used as a lubricant for internal combustion engines such as engines for vehicles inclusive of automobiles, 2-cycle engines, aircraft engines, marine engines, locomotive engines (irrespective of whether the combustion system is gasoline, diesel, gas

or turbine), as an automatic transmission fluid, as a trans axle lubricant, as a gear lubricant and as a metal working lubricant.

[0046] In accordance with the invention, a novel lubricating oil composition is provided which exhibits good performance of friction reduction.

EXAMPLES

[0047] The present invention is further described hereunder with reference to the following examples.

[0048] The details of the components used in the inventive and comparative lubricating compositions are given below.

Base Oils

[0049] Base oil for lubricating oil:

A high VI oil of a mineral class derived by subjecting a crude oil-induced mineral oil to a hydrocracking process; kinematic viscosity: 4.1 cSt at 100 □C; VI: 126; sodium content: below 10 ppm.

Organomolybdenum Compounds

[0050]

Mo compound 1:

MoDTC of R^1 to R^4 = 2-ethylhexyl group, X^1 = S/O = 2.2 in Formula (1); sodium content: below 10 ppm.

Mo compound 2:

MoDTC of R^1 to R^4 = 2-ethylhexyl group : isotridecyl group = 1:1, X^1 = S/O = 2.2 in Formula (1); sodium content: below 10 ppm.

Mo compound 3:

MoDTP of R^5 to R^8 = 2-ethylhexyl group, X^2 = S/O = 2.2 in Formula (2); sodium content: below 10 ppm.

Mo compound 4:

MoDTC of R^1 to R^4 = n-butyl group, X^1 = S/O = 2.2 in Formula (1); sodium content: below 10 ppm.

Cleaning agent 1:

Calcium sulfonate; sodium content: below 10 ppm.

Cleaning agent 2:

Magnesium sulfonate; sodium content: below 10 ppm.

Cleaning agent 3:

Calcium salicylate; sodium content: below 10 ppm.

Cleaning agent 4:

Sodium phenate; sodium content: 10.5 percent by weight.

Organozinc Compounds

[0051]

ZDTP:

R^9 to R^{10} = 2-ethylhexyl group (primary alkyl group), neutral salt : basic salt = 55 : 45 (in molar ratio) in Formula (3); sodium content: below 10 ppm.

ZDTC:

R^{11} to R^{12} = 2-ethylhexyl group in Formula (4); sodium content: below 10 ppm.

Na Compound:

Sodium sulfite (rust preventive) (sodium content: 36.5%)

[0052] The sodium content of each of the above components was measured by an ICP process after incineration. No alkali metals other than a sodium metal were detected in the base oil for lubricating oil, Mo compounds 1 to 4, ZDTP, ZDTC or cleaning agents 1 to 3.

Example 1

[0053] The above prepared components were formulated in the proportions shown in Tables 1 and 2 below, whereby inventive and comparative lubricant compositions were provided. In these tables, the numerical figures related to the Mo compounds are expressed by percent by weight in terms of molybdenum, and other figures are expressed by percent by weight.

[0054] The resulting lubricant compositions were examined for their coefficients of friction.

[0055] Friction Coefficient Measurement Test:

Friction coefficient measurements were carried out with an SRV measuring apparatus and under the set of conditions indicated below.

[0056] Measurement Conditions:

Line Contact:

[0057] Testing was done in accordance with a cylinder-on-plate line contact test. Namely, an upper cylinder (□15 x 22 mm) was set to vertically positioned in the reciprocating direction on a plate (□24 x 6.85 mm) and then allowed to reciprocally vibrate. After a lapse of 7 minutes, measurement was made of the friction coefficient. Both the cylinder and the plate were made of SUJ-2.

loading: 200 N
temperature: 80□C
measuring time: 15 minutes
vibrational amplitude: 1 mm
cycle: 50 Hz

[0058] The test results are shown in Tables 1 and 2.

Table 1

Inventive Product	1	2	3	4	5	6	7	8	9	10	11	12
Mo compound 1	0.07	0.07	0.07			0.02		0.07	0.01			0.07
Mo compound 2				0.07			0.15			0.1	0.06	
Mo compound 3					0.07							

(continued)

Inventive Product	1	2	3	4	5	6	7	8	9	10	11	12
Cleaning agent 1	1.0					1.0	1.0	1.0			1.0	1.0
Cleaning agent 2		1.0							1.0			
Cleaning agent 3			1.0	1.0	1.0					1.0		
ZDTP								1.0	1.0	1.2	0.2	
ZDTC												1.0
Na content (ppm)	1.6	2.8	2.2	3.0	1.8	1.5	1.6	2.7	2.2	3.2	2.0	2.3
Friction coefficient	0.07	0.09	0.075	0.07	0.075	0.10	0.065	0.076	0.09	0.06	0.06	0.09

Table 2

Comparative Product	1	2	3	4	5	6
Mo compound 1	0.07					0.07
Mo compound 2		0.07			0.15	
Mo compound 3			0.07			
Cleaning agent 4	1.0	1.0	1.0	1.0	1.0	1.0
ZDTP						1.0
Na content (ppm)	1,000	1,010	1,010	1,010	1,010	1,010
Friction coefficient	0.12	0.12	0.12	0.15	0.13	0.12

Example 2, useful for understanding the invention and not an embodiment of the invention.

[0059] The foregoing components were formulated in the proportions enumerated in Tables 3 and 4 below, whereby inventive and comparative grease compositions were obtained. In these tables, all the numerical figures are expressed by percent by weight relative to the weight of a given base grease.

[0060] The resulting grease compositions were tested in respect of their frictional properties under the set of conditions indicated below.

Friction Test:

[0061]

Point Contact:

Testing was done in accordance with cylinder-on-plate point contact test.
Namely, an upper ball (□ 10 mm) was disposed on a plate (0 24 x 7.85 mm) and then allowed to reciprocally vibrate. After a lapse of 2 hours, measurement was made of the friction coefficient. Both the ball and the plate were made of SUJ-2.

loading: 200 N
temperature: 50□C
measuring time: 2 hours
vibrational amplitude: 1 mm

cycle: 50 Hz

Wear Resistance Test:

[0062] The coefficient of friction and the diameter of wear scar were measured with a high-speed four-ball testing apparatus under the set of conditions indicated below.

revolution: 1,800 rpm
loading: 40 kg
temperature: 40□C
time: 60 minutes

[0063] The compositons of tested grease and test results are shown in Tables 3 and 4 wherein all the numerical figures are expressed by percent by weight.

Table 3

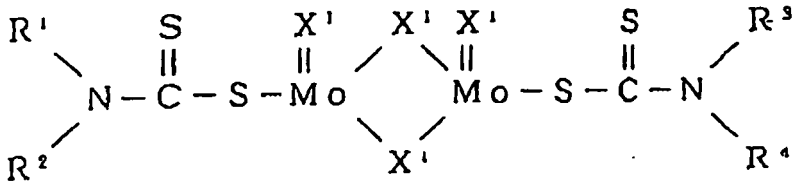
Inventive Product	13	14	15	16	17	18	19	20	21	22
Base grease No.	1	1	1	1	1	1	1	1	1	1
Mo compound 4	3.0				3.0	1.0	5.0	0.5	3.0	3.0
Mo compound 1		3.0								
Mo compound 2			3.0							
Mo compound 3				3.0						
ZDTP	3.0	3.0	3.0	3.0		3.0	3.0		0.5	
ZDTC					3.0			3.0		0.5
Na content (ppm)	10	11	9	9	12	10	15	18	10	13
SRV/friction coefficient	0.32	0.045	0.047	0.035	0.035	0.048	0.034	0.049	0.046	0.046
High-speed four-ball test wear scar dia (mm)	0.53	0.52	0.55	0.50	0.45	0.55	0.45	0.57	0.55	0.55

Table 4

Comparative Product	7	8	9	10	11	12	13
Base grease No.	1	1	1	1	1	2	2
Mo compound 4	3.0				3.0	3.0	3.0
Mo compound 1		3.0					
Mo compound 2			3.0				
Mo compound 3				3.0			
ZDTP	3.0	3.0	3.0	3.0		3.0	3.0
ZDTC					3.0		
Na compound	1.0	1.0	1.0	1.0	1.0	1.0	
Na content (ppm)	3,500	3,600	3,500	3,700	3,700	21,000	17,000
SRV/friction coefficient	0.06	0.070	0.064	0.07	0.064	0.07	0.07
High-speed four-ball test wear scar dia (mm)	0.63	0.75	0.65	0.73	0.65	0.74	0.75

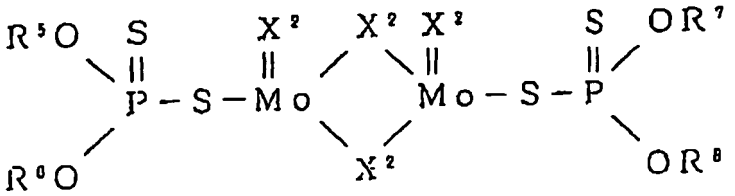
Claims

1. A lubricating composition comprising a base oil, one or more organomolybdenum compounds selected from the group consisting of sulfurized oxymolybdenum dithiocarbamates represented by Formula (1)



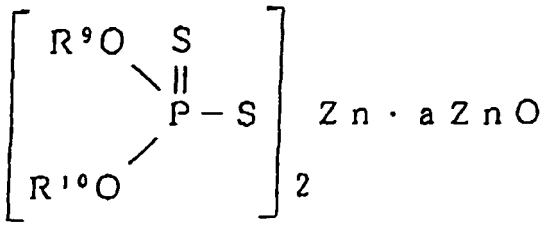
(1)

wherein R^1 to R^4 are each a hydrocarbyl group, X^1 is an oxygen or sulfur atom and the atomic ratio of oxygen to sulfur is from 1:3 to 3:1; and sulfurized oxymolybdenum dithiophosphates represented by Formula (2)



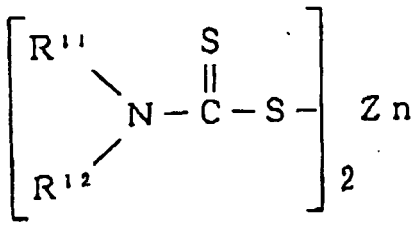
(2)

wherein R^5 to R^8 are each a hydrocarbyl group, and X^2 is an oxygen or sulfur atom and the atomic ratio of oxygen to sulfur is from 1:3 to 3:1; and one or more organozinc compounds selected from the group consisting of zinc dithiophoshates represented by Formula (3)



(3)

wherein a is 0 or 1/3, and R^9 to R^{10} are each a hydrocarbyl group; and zinc dithiocarbamates represented by Formula (4)



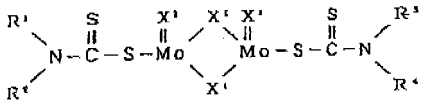
(4)

wherein R^{11} and R^{12} are each a hydrocarbly group; and cleaning agents selected from sulfonates, phenates and carboxylates of neutral or highly basic alkaline earth metals;
characterized in that said composition has a total content of alkali metals including a sodium metal of below 100 ppm, and wherein the base oil is a base oil for lubricating oil.

2. The lubricating composition according to claim 1, wherein an amount of the organomolybdenum compound added ranges from 0.005 to 0.2 percent by weight in terms of molybdenum based on the weight of the base oil for lubricating oil, and an amount added to the organozinc compound ranges from 0.005 to 2 percent based on the weight of the base oil for lubricating oil.

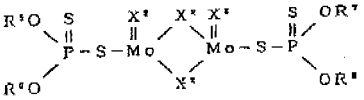
Patentansprüche

1. Schmiermittelzusammensetzung umfassend ein Basisöl, eine oder mehrere Organomolybdänverbindungen ausgewählt aus der Gruppe bestehend aus sulfurierten Oxymolybdändithiocarbamaten, die durch die Formel (I)



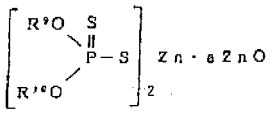
(1)

dargestellt sind, wobei R^1 bis R^4 jeweils eine Hydrocarbylgruppe sind, X^1 ein Sauerstoff - oder Schwefelatom ist und das Atomverhältnis von Sauerstoff zu Schwefel 1:3 bis 3:1 beträgt; und sulfurierten Oxymolybdändithiophosphaten, die durch die Formel (2)



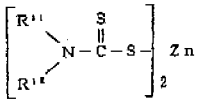
(2)

dargestellt sind, wobei R^5 bis R^8 jeweils eine Hydrocarbylgruppe sind und X^2 ein Sauerstoff- oder Schwefelatom ist und das Atomverhältnis von Sauerstoff zu Schwefel 1:3 bis 3:1 beträgt; und eine oder mehrere Organozinkverbindungen ausgewählt aus der Gruppe bestehend aus Zinkdithiophosphaten, die durch die Formel (3)



(3)

dargestellt sind, wobei a 0 oder 1/3 beträgt und R^9 bis R^{10} jeweils eine Hydrocarbylgruppe sind; und Zinkdithiophosphaten, die durch die Formel (4)



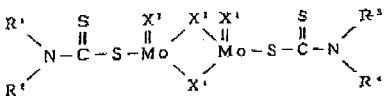
(4)

dargestellt sind, wobei R^{11} bis R^{12} jeweils eine Hydrocarbylgruppe sind; und Reinigungsmittel ausgewählt unter Sulfonaten, Phenaten und Carboxylaten von neutralen oder stark basischen Erdalkalimetallen;
dadurch gekennzeichnet, dass die Zusammensetzung einen Gesamtgehalt an Alkalimetallen, einschließlich eines Natriummetalls, von weniger als 100 ppm aufweist, und wobei das Basisöl ein Basisöl für Schmieröl ist.

2. Schmiermittelzusammensetzung nach Anspruch 1, wobei eine Menge der hinzugegebenen Organomolybdänverbindung im Bereich von 0,005 bis 0,2 Gewichtsprozent, als Molybdän ausgedrückt, auf das Gewicht des Basisöl für Schmieröl bezogen, liegt und eine zu der Organozinnverbindung hinzugegebene Menge im Bereich von 0,005 bis 2 Prozent, auf das Gewicht des Basisöls für Schmieröl bezogen, liegt.

Revendications

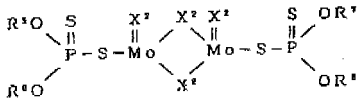
1. Composition lubrifiante comprenant une huile de base, un ou plusieurs composés d'organomolybdène choisis dans le groupe constitué de dithiocarbamates d'oxymolybdène sulfurés représentés par la Formule (1):



(1)

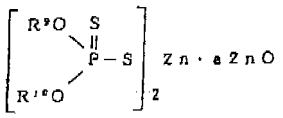
dans laquelle R^1 à R^4 sont chacun un groupe hydrocarbyl, X^1 est un atome d'oxygène ou de soufre et le rapport

atomique d'oxygène sur soufre est de 1:3 à 3:1; et de dithiophosphates d'oxymolybdène sulfurés représentés par la Formule (2):



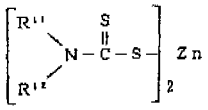
(2)

dans laquelle R^5 à R^8 sont chacun un groupe hydrocarbyle, et X^2 est un atome d'oxygène ou de soufre et le rapport atomique d'oxygène sur soufre est de 1:3 à 3:1; et un ou plusieurs composés d'organozinc choisis dans le groupe constitué de dithiophosphates de zinc représentés par la Formule (3):



(3)

dans laquelle a est 0 ou 1/3, et R^9 à R^{10} sont chacun un groupe hydrocarbyle; et de dithiocarbamates de zinc représentés par la Formule (4):



(4)

dans laquelle R^{11} et R^{12} sont chacun un groupe hydrocarbyle; et des agents nettoyants choisis parmi des sulfonates, des phénates et des carboxylates de métaux alcalino-terreux neutres ou forcement basiques;
caractérisé en ce que ladite composition possède une teneur totale de métaux alcalins incluant un métal de sodium en dessous de 100 ppm et dans laquelle l'huile de base est une huile de base pour une huile lubrifiante.

2. Composition lubrifiante selon la revendication 1, dans laquelle la quantité du composé d'organomolybdène ajoutée varie de 0,005 à 2 pour-cent en poids en termes de molybdène sur la base du poids de l'huile de base pour une huile lubrifiante et la quantité ajoutée pour le composé d'organozinc varie de 0,005 à 2 pour-cent sur la base du poids de l'huile de base pour une huile lubrifiante.

REFERENCES CITED IN THE DESCRIPTION

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