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(54) **Lubricant compositions including gas to liquid base oils**

(57) A lubricant composition, uses for the lubricant composition, and methods of lubricating devices using the lubricant composition. The lubricant composition includes base oil component having a first base oil derived from a gaseous source, and optionally, a second base oil derived from a liquid petroleum source. The base oil component of the lubricant composition includes from about 5 to about 100 percent by weight of the base oil

derived from a gaseous source. An additive and a solubilizing agent selected from the group consisting of an adipate ester, a polyol ester, an alkylated naphthalene, an alkylated sulfone, a naphthenic base oil, an aromatic base oil, an alkylated benzene, and a combination of two or more of the foregoing agents are also included in the lubricant composition.

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Description**FIELD**

5 **[0001]** The present disclosure relates to lubricant compositions and in particular to lubricants containing gas to liquid base oils as a basestock component.

BACKGROUND AND SUMMARY

10 **[0002]** Liquid petroleum reserves continue to decline as the demand for gasoline and liquid petroleum products continues to increase. Because of ever increasing energy demands, more of such reserves may be used for the production of gasoline and fuel oil products with less of such reserves being directed to the production of lubricant basestocks. For example, methods for converting C₁-C₃ alkanes into liquid petroleum basestocks have been devised.

15 **[0003]** However, a variety of gaseous sources may be used to provide components that may be converted into liquid petroleum products, including but not limited to, land fill gases, off-gases from petroleum drilling operations, methane, natural gas, and the like. In view of such new sources for lubricant basestocks having characteristics that are different from conventional basestocks, there is a need for additive compositions that may be added to the basestocks to provide lubricants suitable for specific applications.

20 **[0004]** With regard to the foregoing, exemplary embodiments of the disclosure provide a lubricant composition, uses for the lubricant composition, and methods of lubricating devices using the lubricant composition. The lubricant composition includes a first base oil component comprising a first base oil derived from a gaseous source. The first base oil has a viscosity index of greater than about 115, contains less than about 0.3 weight percent sulfur, and is characterized as having from about 95 to about 100 percent by weight branched alkanes. A second base oil derived from a liquid petroleum source may optionally be included with the first base oil, wherein the base oil component of the lubricant
25 composition includes from about 5 to about 100 percent by weight of the first base oil. The lubricant composition also includes from about 1 to about 30 percent or more by weight of a solubilizing agent selected from the group consisting of an adipate ester, a polyol ester, an alkylated naphthalene, an alkylated sulfone, a naphthenic base oil, an aromatic base oil, an alkylated benzene, and a combination of two or more of the foregoing agents. An additive component is also provided in the first base oil.

30 **[0005]** Unlike conventional lubricant compositions, the compositions described herein include a primary base oil component that is derived from a gaseous source. Such a base oil enables reallocation of liquid hydrocarbon sources to the production of fuels such as gasoline, fuel oil, jet fuel and the like. Conversion of gaseous sources to liquid lubricant products may also reduce the flaring of by-product and off-gases that cannot be used for fuel applications. Such base oils typically exhibit an extremely high viscosity index, excellent oxidation resistance and good pour points. Other benefits
35 of the lubricant compositions described herein may be evident from the detailed description of exemplary embodiments of the disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

40 **[0006]** As used herein, the term "hydrocarbyl substituent" or "hydrocarbyl group" is used in its ordinary sense, which is well-known to those skilled in the art. Specifically, it refers to a group having a carbon atom directly attached to the remainder of a molecule and having a predominantly hydrocarbon character. Examples of hydrocarbyl groups include:

- 45 (1) hydrocarbon substituents, that is, aliphatic (e.g., alkyl or alkenyl), alicyclic (e.g., cycloalkyl, cycloalkenyl) substituents, and aromatic-, aliphatic-, and alicyclic-substituted aromatic substituents, as well as cyclic substituents wherein the ring is completed through another portion of the molecule (e.g., two substituents together form an alicyclic radical);
- (2) substituted hydrocarbon substituents, that is, substituents containing non-hydrocarbon groups which, in the context of the description herein, do not alter the predominantly hydrocarbon substituent (e.g., halo (especially chloro and fluoro), hydroxy, alkoxy, mercapto, alkylmercapto, nitro, nitroso, and sulfoxy);
- 50 (3) hetero-substituents, that is, substituents which, while having a predominantly hydrocarbon character, in the context of this description, contain other than carbon in a ring or chain otherwise composed of carbon atoms. Hetero-atoms include sulfur, oxygen, nitrogen, and encompass substituents such as pyridyl, furyl, thienyl and imidazolyl. In general, no more than two, usually no more than one, non-hydrocarbon substituent will be present for every ten carbon atoms in the hydrocarbyl group; typically, there will be no non-hydrocarbon substituent in the hydrocarbyl
55 group.

Base Oil Component:

[0007] The base oil component of the lubricant compositions described herein includes a first base oil derived from a gaseous source. Gaseous sources include a wide variety of materials such as natural gas, methane, C₁-C₃ alkanes, landfill gases, and the like. Such gases may be converted to liquid hydrocarbon products suitable for use as lubricant base oils by a gas to liquid (GTL) process, such as the process described in U.S. Patent No. 6,497,812, the disclosure of which is incorporated herein by reference. For the purposes of this disclosure, a "gas" or "gaseous source" means a material that is in the gaseous state at room temperature and atmospheric pressure. A "liquid" means a material that is predominantly in a liquid or fluid state at room temperature and atmospheric pressure.

[0008] The GTL process includes two primary steps, (1) conversion of a material existing in the gaseous state into a synthesis gas consisting primarily of carbon monoxide and hydrogen, and the conversion of the synthesis gas into a synthetic crude in a reaction based on a Fischer-Tropsch reaction. Direct conversion of gaseous hydrocarbon sources using various catalysts and/or catalytic systems may also be used as the GTL process.

[0009] Base oils derived from a gaseous source, hereinafter referred to as "GTL base oils," typically have a viscosity index of greater than about 130, a sulfur content of less than about 0.3 percent by weight, contain greater than about 90 percent by weight saturated hydrocarbons (isoparaffins), typically from about 95 to about 100 wt.% branched aliphatic hydrocarbons, have a pour point of below -15 to -20°C., and have a NOACK volatility of less than about 15 weight percent, and in another embodiment a NOACK volatility of less than about 10 weight percent. Other characteristics of the GTL base oil may be within the range of conventional lubricant base oils. The base oil component of the lubricant composition, as described herein, may include from about 5 to about 100 percent by weight of the GTL base oil with the balance of the base oil component being a conventional base oil. Because of the characteristically high content of branched alkanes in the GTL base oils, finished lubricant formulations made with such GTL base oils include a solubilizing agent that aids in solubilizing additives and degradation products in the finished lubricant formulation. Suitable solubilizing agents are described below.

[0010] Conventional base oils that may optionally be combined with the GTL base oil to provide a lubricant composition include natural and synthetic base oils in Groups I-V as specified in the American Petroleum Institute (API) Base Oil Interchangeability Guidelines. Such base oil groups are as follows:

Base Oil Group ¹	Sulfur (wt.%)		Saturates (wt.%)	Viscosity Index
Group I	> 0.03	and/or	< 90	80 to 120
Group II Group II	≤ 0.03	And	≥ 90	80 to 120
	≤ 0.03		And ≥ 90	≥ 120
Group IV	all polyalphaolefins (PAOs)			
Group V	all others not included in Groups I-IV			
¹ Groups I-III are mineral oil base stocks.				

[0011] The detergent/inhibitor (DI) package useful in the exemplary embodiments disclosed herein may contain one or more conventional additives selected from the group consisting of viscosity index improvers, dispersants, friction modifiers, corrosion inhibitors, rust inhibitors, antioxidants, detergents, seal swell agents, extreme pressure additives, anti-wear additives, pour point depressants, deodorizers, defoamers, demulsifiers, dyes, thickening agents, and fluorescent coloring agents. The DI package is typically present in an amount of from 0.5 to 25 weight percent, based on the total weight of the lubricating oil composition.

Solubilizing Agents:

[0012] Solubilizing agents may be used in the disclosed lubricant compositions. Suitable solubilizing agents include, but are not limited to, oil-soluble esters and diesters, alkylated naphthalenes, alkylated sulfones, naphthenic type base oils, aromatic type base oils, and alkylated benzenes. Other solubilizing agents known in the art are also contemplated herein. The esters and diesters that may be used as solubilizing agents include, for example, adipate esters and polyol esters. Exemplary diesters include the adipates, azelates, and sebacates of C₈-C₁₃ alkanols (or mixtures thereof), the phthalates of C₄-C₁₃ alkanols (or mixtures thereof). Mixtures of two or more different types of diesters (e.g., dialkyl adipates and dialkyl azelates, etc.) may also be used. Examples of such materials include the n-octyl, 2-ethylhexyl, isodecyl, and tridecyl diesters of adipic acid, azelaic acid, and sebacic acid, and the n-butyl, isobutyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, and tridecyl diesters of phthalic acid. The amount of solubilizing agent in a

finished lubricant formulation may range, in one embodiment, from about 1 to about 30 percent by weight of the finished lubricant formulation, typically from about 5 to about 15 percent by weight of the finished lubricant formulation.

Viscosity Index Improvers:

[0013] Viscosity index improvers for use in finished lubricant compositions as described herein may be selected from olefin (co)polymer(s), polyalkyl(meth)acrylates, and mixtures thereof. A suitable viscosity index improver may include a mixture of polymers comprising at least one olefin (co)polymer and at least one polyalkyl(meth)acrylate in a ratio of from 20:1 to 1:2 olefin (co)polymer to polyalkyl(meth)acrylate. A fully formulated lubricant composition as described herein may contain 0.1 to 40 wt. % olefin (co)polymer and 0.1 to 20 wt % polyalkyl(meth)acrylate.

[0014] The olefin (co)polymer which may be used is a homopolymer, copolymer, or terpolymer resulting from the polymerization of C₂-C₁₀ olefins having a number average molecular weight of from 1,000 to 10,000, for example, 1,000 to 3,000, as determined by gel permeation chromatography (GPC). The C₂-C₁₀ olefins include ethylene, propylene, 1-butene, isobutylene, 2-butene, isoprene, 1-octene, and 1-decene. Exemplary (co)polymers include polypropylene, polyisobutylene, ethylene/propylene copolymers, styrene/isoprene copolymers, and 1-butene/isobutylene copolymers, and mixtures of the polymers thereof.

[0015] The polyalkyl(meth)acrylates which may be used are prepared by the polymerization of C₁-C₃₀ (meth)acrylates. Preparation of these polymers may further include the use of acrylic monomers having nitrogen-containing functional groups, hydroxy groups and/or alkoxy groups which provide additional properties to the polyalkyl(meth)acrylates such as improved dispersancy. The polyalkyl(meth)-acrylates may have a number average molecular weight of from 10,000 to 250,000, for example, 20,000 to 200,000. The polyalkyl(meth)acrylates may be prepared by conventional methods of free-radical or anionic polymerization.

Dispersants

[0016] The dispersants useful in the lubricant compositions described herein include at least one oil-soluble ashless dispersant having a basic nitrogen and/or at least one hydroxyl group in the molecule. Suitable dispersants include alkenyl succinimides, alkenyl succinic acid esters, alkenyl succinic ester-amides, Mannich bases, hydrocarbyl polyamines, or polymeric polyamines.

[0017] The alkenyl succinimides in which the succinic group contains a hydrocarbyl substituent containing at least 30 carbon atoms are described for example in U.S. Pat. Nos. 3,172,892; 3,202,678; 3,216,936; 3,219,666; 3,254,025; 3,272,746; and 4,234,435. Such alkenyl succinimides may be derived from polyisobutenyl succinic anhydride (PIBSA) having a number average molecular weight ranging from about 200 to about 2100 as determined by gel permeation chromatography. Alkenyl succinic acid esters and diesters of polyhydric alcohols containing 2-20 carbon atoms and 2-6 hydroxyl groups can be used in forming the phosphorus-containing ashless dispersants. Representative examples are described in U.S. Pat. Nos. 3,331,776; 3,381,022; and 3,522,179. The alkenyl succinic portion of these esters corresponds to the alkenyl succinic portion of the succinimides described above.

[0018] Suitable alkenyl succinic ester-amides for forming phosphorylated ashless dispersant are described for example in U.S. Pat. Nos. 3,184,474; 3,576,743; 3,632,511; 3,804,763; 3,836,471; 3,862,981; 3,936,480; 3,948,800; 3,950,341; 3,957,854; 3,957,855; 3,991,098; 4,071,548; and 4,173,540.

[0019] Hydrocarbyl polyamine dispersants that may be phosphorylated are generally produced by reacting an aliphatic or alicyclic halide (or mixture thereof) containing an average of at least about 40 carbon atoms with one or more amines, typically polyalkylene polyamines. Examples of such hydrocarbyl polyamine dispersants are described in U.S. Pat. Nos. 3,275,554; 3,394,576; 3,438,757; 3,454,555; 3,565,804; 3,671,511; and 3,821,302.

[0020] In general, the hydrocarbyl-substituted polyamines are high molecular weight hydrocarbyl-N-substituted polyamines containing basic nitrogen in the molecule. The hydrocarbyl group typically has a number average molecular weight in the range of about 750-10,000 as determined by GPC, more usually in the range of about 1,000-5,000, and is derived from a suitable polyolefin. Exemplary hydrocarbyl-substituted amines or polyamines are prepared from polyisobutenyl chlorides and polyamines having from 2 to about 12 amine nitrogen atoms and from 2 to about 40 carbon atoms.

[0021] The Mannich base dispersants are usually a reaction product of an alkyl phenol, typically having a long chain alkyl substituent on the ring, with one or more aliphatic aldehydes containing from 1 to about 7 carbon atoms (especially formaldehyde and derivatives thereof), and polyamines (especially polyalkylene polyamines). Examples of Mannich condensation products, and methods for their production are described in U.S. Pat. Nos. 2,459,112; 2,962,442; 2,984,550; 3,036,003; 3,166,516; 3,236,770; 3,368,972; 3,413,347; 3,442,808; 3,448,047; 3,454,497; 3,459,661; 3,493,520; 3,539,633; 3,558,743; 3,586,629; 3,591,598; 3,600,372; 3,634,515; 3,649,229; 3,697,574; 3,703,536; 3,704,308; 3,725,277; 3,725,480; 3,726,882; 3,736,357; 3,751,365; 3,756,953; 3,793,202; 3,798,165; 3,798,247; 3,803,039; 3,872,019; 3,904,595; 3,957,746; 3,980,569; 3,985,802; 4,006,089; 4,011,380; 4,025,451; 4,058,468; 4,083,699;

4,090,854; 4,354,950; and 4,485,023.

[0022] Polymeric polyamine dispersants suitable for use as ashless dispersants are polymers containing basic amine groups and oil solubilizing groups (for example, pendant alkyl groups having at least about 8 carbon atoms). Such materials are illustrated by interpolymers formed from various monomers such as decyl methacrylate, vinyl decyl ether or relatively high molecular weight olefins, with aminoalkyl acrylates and aminoalkyl acrylamides. Examples of polymeric polyamine dispersants are set forth in U.S. Pat. Nos. 3,329,658; 3,449,250; 3,493,520; 3,519,565; 3,666,730; 3,687,849; and 3,702,300.

[0023] The various types of ashless dispersants described above can be phosphorylated by procedures described in U.S. Pat. Nos. 3,184,411; 3,342,735; 3,403,102; 3,502,607; 3,511,780; 3,513,093; 3,513,093; 4,615,826; 4,648,980; 4,857,214 and 5,198,133.

[0024] The dispersants of the present disclosure may be boronated. Methods for boronating (borating) the various types of ashless dispersants described above are described in U.S. Pat. Nos. 3,087,936; 3,254,025; 3,281,428; 3,282,955; 2,284,409; 2,284,410; 3,338,832; 3,344,069; 3,533,945; 3,658,836; 3,703,536; 3,718,663; 4,455,243; and 4,652,387.

[0025] Suitable procedures for phosphorylating and boronating ashless dispersants such as those referred to above are set forth in U.S. Pat. Nos. 4,857,214 and 5,198,133.

[0026] The amount of ashless dispersant on an "active ingredient basis" (i.e., excluding the weight of impurities, diluents and solvents typically associated therewith) is generally within the range of about 0.5 to about 7.5 weight percent (wt %), typically within the range of about 0.5 to 5.0 wt %, notably within the range of about 0.5 to about 3.0 wt %, and usually within the range of about 2.0 to about 3.0 wt %, based on the finished oil.

Friction Modifiers:

[0027] For certain applications it may be desirable to use one or more friction modifiers in preparing the finished lubricating oil formulation. Suitable friction modifiers include such compounds as aliphatic amines or ethoxylated aliphatic amines, aliphatic fatty acid amides, aliphatic carboxylic acids, aliphatic carboxylic esters, aliphatic carboxylic ester-amides, aliphatic phosphonates, aliphatic phosphates, aliphatic thiophosphonates, aliphatic thiophosphates, organic molybdenum compounds, or mixtures thereof. The aliphatic group typically contains at least about eight carbon atoms so as to render the compound suitably oil soluble. Also suitable are aliphatic substituted succinimides formed by reacting one or more aliphatic succinic acids or anhydrides with ammonia.

[0028] One exemplary group of friction modifiers is comprised of the N-aliphatic hydrocarbyl-substituted diethanol amines in which the N-aliphatic hydrocarbyl-substituent is at least one straight chain aliphatic hydrocarbyl group free of acetylenic unsaturation and having in the range of about 14 to about 20 carbon atoms.

[0029] Exemplary friction modifier mixtures include a combination of at least one N-aliphatic hydrocarbyl-substituted diethanol amine and at least one N-aliphatic hydrocarbyl-substituted trimethylene diamine in which the N-aliphatic hydrocarbyl-substituent is at least one straight chain aliphatic hydrocarbyl group free of acetylenic unsaturation and having in the range of about 14 to about 20 carbon atoms. Further details concerning this friction modifier system are set forth in U.S. Pat. Nos. 5,372,735 and 5,441,656.

[0030] Another suitable mixture of friction modifiers is based on the combination of (i) at least one di(hydroxyalkyl) aliphatic tertiary amine in which the hydroxyalkyl groups, being the same or different, each contain from 2 to about 4 carbon atoms, and in which the aliphatic group is an acyclic hydrocarbyl group containing from about 10 to about 25 carbon atoms, and (ii) at least one hydroxyalkyl aliphatic imidazoline in which the hydroxyalkyl group contains from 2 to about 4 carbon atoms, and in which the aliphatic group is an acyclic hydrocarbyl group containing from about 10 to about 25 carbon atoms. For further details concerning this friction modifier system, reference should be had to U.S. Pat. No. 5,344,579.

[0031] The use of friction modifiers is optional. However, in applications where friction modifiers are used, finished lubricant formulations may contain up to about 1.25 wt %, and usually from about 0.05 to about 1 wt % of one or more friction modifiers.

Inhibitors:

[0032] Finished lubricant compositions as described herein typically will contain some inhibitors. The inhibitor components serve different functions including rust inhibition, corrosion inhibition and foam inhibition. The inhibitors may be introduced in a pre-formed additive package that may contain in addition one or more other components used in the finished lubricant compositions. Alternatively these inhibitor components may be introduced individually or in various sub-combinations. While amounts of inhibitors used may be varied within reasonable limits, the finished lubricant compositions of this disclosure will typically have a total inhibitor content in the range of about 0 to about 15 wt %, on an "active ingredient basis", i.e., excluding the weight of inert materials such as solvents or diluents normally associated

therewith.

[0033] Foam inhibitors form one type of inhibitor suitable for use as an inhibitor component in the finished lubricant compositions. Useful foam inhibitors include silicones, polyacrylates, surfactants, and the like.

[0034] Copper corrosion inhibitors constitute another class of additives suitable for inclusion in the finished lubricant compositions. Such compounds include thiazoles, triazoles and thiadiazoles. Examples of such compounds include benzotriazole, tolyltriazole, octyltriazole, decyltriazole, dodecyltriazole, 2-mercapto benzothiazole, 2,5-dimercapto-1,3,4-thiadiazole, 2-mercapto-5-hydrocarbylthio-1,3,4-thiadiazoles, 2-mercapto-5-hydrocarbyldithio-1,3,4-thiadiazoles, 2,5-bis(hydrocarbylthio)-1,3,4-thiadiazoles, and 2,5-bis(hydrocarbyldithio)-1,3,4-thiadiazoles. In one embodiment the compounds are the 1,3,4-thiadiazoles, a number of which are available as articles of commerce, and also combinations of triazoles such as tolyltriazole with a 1,3,5-thiadiazole such as a 2,5-bis(alkyldithio)-1,3,4-thiadiazole. The 1,3,4-thiadiazoles are generally synthesized from hydrazine and carbon disulfide by known procedures. See, for example, U.S. Pat. Nos. 2,765,289; 2,749,311; 2,760,933; 2,850,453; 2,910,439; 3,663,561; 3,862,798; and 3,840,549.

[0035] Rust or corrosion inhibitors comprise another type of inhibitor additive for use in finished lubricant compositions. Such materials include monocarboxylic acids and polycarboxylic acids. Examples of suitable monocarboxylic acids are octanoic acid, decanoic acid and dodecanoic acid. Suitable polycarboxylic acids include dimer and trimer acids such as are produced from such acids as tall oil fatty acids, oleic acid, linoleic acid, or the like.

[0036] Another useful type of rust inhibitor for use in the disclosed lubricant compositions is comprised of the alkenyl succinic acid and alkenyl succinic anhydride corrosion inhibitors such as, for example, tetrapropenylsuccinic acid, tetrapropenylsuccinic anhydride, tetradecenylsuccinic acid, tetradecenylsuccinic anhydride, hexadecenylsuccinic acid, hexadecenylsuccinic anhydride, and the like. Also useful are the half esters of alkenyl succinic acids having 8 to 24 carbon atoms in the alkenyl group with alcohols such as the polyglycols. Other suitable rust or corrosion inhibitors include ether amines; acid phosphates; amines; polyethoxylated compounds such as ethoxylated amines, ethoxylated phenols, and ethoxylated alcohols; imidazolines; aminosuccinic acids or derivatives thereof, and the like. Materials of these types are available as articles of commerce. Mixtures of such rust or corrosion inhibitors can be used.

Antioxidants:

[0037] Antioxidants may also be present in the finished lubricant formulations of the disclosure. Suitable antioxidants include phenolic antioxidants, aromatic amine antioxidants, sulfurized phenolic antioxidants, and organic phosphites, among others. Examples of phenolic antioxidants include 2,6-di-tert-butylphenol, liquid mixtures of tertiary butylated phenols, 2,6-di-tert-butyl-4-methylphenol, 4,4'-methylenebis(2,6-di-tert-butylphenol), 2,2'-methylenebis(4-methyl-6-tert-butylphenol), mixed methylene-bridged polyalkyl phenols, and 4,4'-thiobis(2-methyl-6-tert-butylphenol). N,N'-di-sec-butyl-p-phenylenediamine, 4-isopropylaminodiphenyl amine, phenyl-naphthyl amine, phenyl-naphthyl amine, and ring-alkylated diphenylamines serve as examples of aromatic amine antioxidants. In one embodiment, the antioxidants are the sterically hindered tertiary butylated phenols, the ring alkylated diphenylamines, and combinations thereof.

[0038] The amounts of the inhibitor components and antioxidants used to provide the finished lubricant compositions will depend to some extent upon the composition of the component and its effectiveness when used in the finished lubricant. However, generally speaking, the finished lubricant composition will typically contain the following concentrations in weight percent of the inhibitor components and antioxidants on an active ingredient basis:

Inhibitor	Typical Range	Usual Range
Foam inhibitor	0 to 0.1	0.01 to 0.08
Copper corrosion inhibitor	0 to 1.5	0.01 to 1.0
Rust inhibitor	0 to 0.5	0.01 to 0.3
Antioxidant	0 to 1.0	0.1 to 0.6

Detergents:

[0039] Metal-containing or ash-forming detergents function both as detergents to reduce or remove deposits and as acid neutralizers or rust inhibitors, thereby reducing wear and corrosion and extending engine life for lubricant formulations used in crankcase applications. Detergents generally comprise a polar head with a long hydrophobic tail where the polar head comprises a metal salt of an acidic organic compound. The salts may contain a substantially stoichiometric amount of the metal, in which case they are usually described as normal or neutral salts, and would typically have a total base number or TBN (as measured by ASTM D2896) of from 0 to less than 150. Large amounts of a metal base may be included by reacting an excess of a metal compound such as an oxide or hydroxide with an acidic gas such as carbon dioxide. The resulting overbased detergent comprises micelles of neutralized detergent surrounding a core of inorganic

metal base (e.g., hydrated carbonates). Such overbased detergents may have a TBN of 150 or greater, and typically ranging from 250 to 450 or more.

5 [0040] Detergents that may be used include oil-soluble neutral and overbased sulfonates, phenates, sulfurized phenates, and salicylates of a metal, particularly the alkali or alkaline earth metals, e.g., sodium, potassium, lithium, calcium, and magnesium. The most commonly used metals are calcium and magnesium, which may both be present. Mixtures of calcium and/or magnesium with sodium are also useful. Particularly convenient metal detergents are neutral and overbased calcium or magnesium sulfonates having a TBN of from 20 to 450 TBN, neutral and overbased calcium or magnesium phenates and sulfurized phenates having a TBN of from 50 to 450, and neutral or overbased calcium or magnesium salicylates having a TBN of from 130 to 350. Mixtures of such salts may also be used. When used, the presence of at least one overbased detergent is desirable.

10 [0041] Sulfonates may be prepared from sulfonic acids which are typically obtained by the sulfonation of alkyl substituted aromatic hydrocarbons such as those obtained from the fractionation of petroleum or by the alkylation of aromatic hydrocarbons. Examples include those obtained by alkylating benzene, toluene, xylene, naphthalene, diphenyl or their halogen derivatives such as chlorobenzene, chlorotoluene and chloronaphthalene. The alkylation may be carried out in the presence of a catalyst with alkylating agents having from 3 to more than 70 carbon atoms. The alkaryl sulfonates usually contain from 9 to 80 or more carbon atoms, typically from 16 to 60 carbon atoms per alkyl substituted aromatic moiety.

15 [0042] The oil-soluble sulfonates or alkaryl sulfonic acids may be neutralized with oxides, hydroxides, alkoxides, carbonates, carboxylate, sulphides, hydrosulfides, nitrates, borates and ethers of the alkali metal. The amount of metal compound is chosen having regard to the desired TBN of the final product but typically ranges from 100 to 220 wt % (desirably at least 125 wt %) of that stoichiometrically required.

20 [0043] Metal salts of alkyl phenols and sulfurized alkyl phenols are prepared by reaction with an appropriate metal compound such as an oxide, hydroxide or alkoxide, and overbased products may be obtained by methods well known in the art. Sulfurized alkyl phenols may be prepared by reacting an alkyl phenol with sulphur or a sulphur-containing compound such as hydrogen sulphide, sulphur monohalide or sulphur dihalide, to form products which are generally mixtures of compounds in which 2 or more phenols are bridged by sulphur-containing bridges. The starting alkyl phenol may contain one or more alkyl substituents. These may be branched or unbranched, and depending on the number of substituents may have from 1 to 30 carbon atoms (provided the resulting alkyl phenol is oil-soluble), with from 9 to 18 carbon atoms being particularly suitable. Mixtures of alkyl phenols with different alkyl substituents may be used.

25 [0044] Metal salts of carboxylic acids (including salicylic acids) may be prepared in a number of ways: for example, by adding a basic metal compound to a reaction mixture comprising the carboxylic acid (which may be part of a mixture with another organic acid such as a sulfonic acid) or its metal salt and promoter, and removing free water from the reaction mixture to form an metal salt, then adding more basic metal compound to the reaction mixture and removing free water from the reaction mixture. The carboxylate is then overbased by introducing the acidic material such as carbon dioxide to the reaction mixture while removing water. This can be repeated until a product of the desired TBN is obtained.

30 [0045] The overbasing process is well known in the art and typically comprises reacting acidic material with a reaction mixture comprising the organic acid or its metal salt, a metal compound. That acidic material may be a gas such as carbon dioxide or sulphur dioxide, or it may be boric acid. Processes for the preparation of overbased alkali metal sulfonates and phenates are described in U.S. Pat. No. 4,839,094. A process suitable for overbased sodium sulfonates is described in EP-A-235929. A process for making overbased salicylates is described in U.S. Pat. No. 5,451,331.

35 [0046] The overbased metal detergents may also be borated. The boron may be introduced by using boric acid as the acidic material used in the overbasing step. However, a desirable alternative is to borate the overbased product after formation by reacting a boron compound with the overbased metal salt. Boron compounds include boron oxide, boron oxide hydrate, boron trioxide, boron trifluoride, boron tribromide, boron trichloride, boron acid such as boronic acid, boric acid, tetraboric acid and metaboric acid, boron hydrides, boron amides and various esters of boron acids. Generally, the overbased metal salt may be reacted with a boron compound at from 50° C. to 250° C., in the presence of a solvent such as mineral oil or xylene. The borated, overbased alkali metal salt comprises at least 0.5%, and typically from 1% to 5%, by weight boron.

40 [0047] The amount of detergent in a finished lubricant composition according to the disclosed embodiments may range from about 0.1 to about 1.5 percent by weight based on the total weight of the finished lubricant composition.

Antiwear and Extreme Pressure Agents:

45 [0048] Various types of sulfur-containing antiwear and/or extreme pressure agents may be used in the finished lubricant formulations described herein. Examples include dihydrocarbyl polysulfides; sulfurized olefins; sulfurized fatty acid esters of both natural and synthetic origins; trithiones; sulfurized thienyl derivatives; sulfurized terpenes; sulfurized oligomers of C₂-C₈ monoolefins; and sulfurized Diels-Alder adducts such as those disclosed in U.S. Pat. No. Re 27,331. Specific examples include sulfurized polyisobutene, sulfurized isobutylene, sulfurized diisobutylene, sulfurized triisobutylene,

dicyclohexyl polysulfide, diphenyl polysulfide, dibenzyl polysulfide, dinonyl polysulfide, and mixtures of di-tert-butyl polysulfide such as mixtures of di-tert-butyl trisulfide, di-tert-butyl tetrasulfide and di-tert-butyl pentasulfide, among others. Combinations of such categories of sulfur-containing antiwear and/or extreme pressure agents may also be used, such as a combination of sulfurized isobutylene and di-tert-butyl trisulfide, a combination of sulfurized isobutylene and dinonyl trisulfide, a combination of sulfurized tall oil and dibenzyl polysulfide.

[0049] Use may also be made of a wide variety of phosphorus-containing oil-soluble antiwear and/or extreme pressure additives such as the oil-soluble organic phosphates, organic phosphites, organic phosphonates, organic phosphonites, etc., and their sulfur analogs. Also useful as the phosphorus-containing antiwear and/or extreme pressure additives in the disclosed lubricant compositions include those compounds that contain both phosphorus and nitrogen. Phosphorus-containing oil-soluble antiwear and/or extreme pressure additives useful in the disclosed embodiments include those compounds taught in U.S. Pat. Nos. 5,464,549; 5,500,140; and 5,573,696, the disclosures of which are hereby incorporated by reference.

[0050] The phosphorus-containing antiwear agents may include an organic ester of phosphoric acid, phosphorous acid, or an amine salt thereof. For example, phosphorus-containing antiwear agent may include one or more of a dihydrocarbyl phosphite, a trihydrocarbyl phosphite, a dihydrocarbyl phosphate, a trihydrocarbyl phosphate, any sulfur analogs thereof, and any amine salts thereof.

[0051] The phosphorus-containing antiwear agent may be present in an amount sufficient to provide about 10 to about 500 parts per million by weight of phosphorus in the finished lubricant composition. As a further example, the phosphorus-containing antiwear agent may be present in an amount sufficient to provide about 150 to about 300 parts per million by weight of phosphorus in the finished lubricant composition.

[0052] One such type of phosphorus- and nitrogen-containing antiwear and/or extreme pressure additives which may be used are the phosphorus- and nitrogen-containing compositions of the type described in G.B. 1,009,913; U.S. Pat. No. 3,197,405 and/or U.S. Pat. No. 3,197,496. In general, these compositions are formed by forming an acidic intermediate by the reaction of a hydroxy-substituted triester of a phosphorothioic acid with an inorganic phosphorus acid, phosphorus oxide or phosphorus halide, and neutralizing a substantial portion of said acidic intermediate with an amine or hydroxy-substituted amine. Other types of phosphorus- and nitrogen-containing antiwear and/or extreme pressure additive that may be used in the lubricant compositions described herein include the amine salts of hydroxy-substituted phosphetanes or the amine salts of hydroxy-substituted thiophosphetanes and the amine salts of partial esters of phosphoric and thiophosphoric acids.

Pour point depressants:

[0053] The detergent/inhibitor package may also contain one or more pour point depressants. Pour point depressants may be used in compositions described herein to improve low temperature properties of the compositions. Examples of useful pour point depressants are polymethacrylates; polyacrylates; polyacrylamides; condensation products of haloparaffin waxes and aromatic compounds; vinyl carboxylate polymers; and terpolymers of dialkylfumarates, vinyl esters of fatty acids and alkyl vinyl ethers. Pour point depressants useful for the purposes of this disclosure and techniques for their preparation are described in U.S. Pat. Nos. 2,387,501; 2,015,748; 2,655,479; 1,815,022; 2,191,498; 2,666,746; 2,721,877; 2,721,878; and 3,250,715 which are herein incorporated by reference for their relevant disclosures.

[0054] In one embodiment, the pour point depressant is represented by the general structural formula: Ar (R)--(Ar¹R¹)-Ar², wherein the Ar, Ar¹ and Ar² are aromatic groups of up to about 12 carbon atoms, (R) and (R¹) are independently an alkylene group containing 1 to 100 carbon atoms with the proviso that at least one of (R) or (R¹) is CH₂, and n is 0 to about 1000 with the proviso that if n is 0, then (R) is CH₂ and at least one aromatic moiety has at least one substituent, the substituents being selected from the group consisting of a substituent derived from an olefin containing about 8 to about 30 carbon atoms, and a substituent derived from a chlorinated hydrocarbon usually containing about 8 to about 50 carbon atoms and about 2.5 chlorine atoms for each 24 carbon atoms.

Seal swell agents:

[0055] Seal swell agents may be included in the finished lubricant compositions of the disclosed embodiments particularly when the lubricant compositions are used as power transmission fluids. Suitable seal swell agents may be selected from oil-soluble diesters, oil-soluble sulfones, silicon containing organic compounds, and mixtures thereof. Generally speaking the most suitable diesters include the adipates, azelates, and sebacates of C₈-C₁₃ alkanols (or mixtures thereof), and the phthalates of C₄-C₁₃ alkanols (or mixtures thereof). Mixtures of two or more different types of diesters (e.g., dialkyl adipates and dialkyl azelates, etc.) may also be used. Examples of such materials include the n-octyl, 2-ethylhexyl, isodecyl, and tridecyl diesters of adipic acid, azelaic acid, and sebacic acid, and the n-butyl, isobutyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, and tridecyl diesters of phthalic acid. Other esters which may give generally equivalent performance are polyol esters.

[0056] Suitable sulfone seal swell agents are described in U.S. Pat. Nos. 3,974,081 and 4,029,587. Typically these products are employed at levels in the range of about 0.25 to about 1 wt % in the finished transmission fluid.

[0057] In one embodiment, the seal swell agents are the oil-soluble dialkyl esters of (i) adipic acid, (ii) sebacic acid, or (iii) phthalic acid. The adipates and sebacates should be used in amounts in the range of from about 4 to about 15 wt % in the finished fluid. In the case of the phthalates, the levels in the transmission fluid should fall in the range of from about 1.5 to about 10 wt %. Generally speaking, the higher the molecular weight of the adipate, sebacate or phthalate, the higher should be the treat rate within the foregoing ranges.

Thickening agents:

[0058] A wide variety of thickening agents may be used for providing lubricants and greases containing the base oil component. Included among the thickening agents are alkali and alkaline earth metal soaps of fatty acids and fatty materials having from about 12 to about 30 carbon atoms per molecule. The metal cations of the metal soaps are typified by sodium, lithium, calcium, magnesium, and barium. Fatty materials are illustrated by stearic acid, hydroxystearic acid, stearin, cottonseed oil acids, oleic acid, palmitic acid, myristic acid and hydrogenated fish oils.

[0059] Other thickening agents include salt and salt-soap complexes such as calcium stearate-acetate (U.S. Pat. No. 2,197,263), barium stearate acetate (U.S. Pat. No. 2,564,561), calcium stearate-caprylate-acetate complexes (U.S. Pat. No. 2,999,065), calcium-caprylate-acetate (U.S. Pat. No. 2,999,066), and calcium salts and soaps of low-, intermediate- and high-molecular weight acids and of nut oil acids.

[0060] Another group of thickening agents comprises substituted ureas, phthalocyanines, indanthrene, pigments, such as perylimides, pyromellitdiimides, ammeline, and hydrophobic clays. Some of the additive components described above may be supplied in the form of solutions of active ingredient(s) in an inert diluent or solvent, such as a diluent oil. Unless expressly stated to the contrary, the amounts and concentrations of each additive component are expressed in terms of active additive, i.e., the amount of solvent or diluent that may be associated with such component as received is excluded.

[0061] Additives used in formulating the compositions described herein may be blended into the base oil component individually or in various sub-combinations. However, it is preferable to blend all of the components concurrently using an additive concentrate (i.e., additives plus a diluent, such as a hydrocarbon solvent). The use of an additive concentrate takes advantage of the mutual compatibility afforded by the combination of ingredients when in the form of an additive concentrate. Also, the use of a concentrate reduces blending time and lessens the possibility of blending errors.

[0062] Exemplary embodiments of the disclosure include use of finished lubricant compositions as described herein in a wide variety of applications, including but not limited to, metal-working fluids, quench fluids, greases, crankcase lubricants, power transmission fluids, vehicle axle applications, hydraulic systems, heavy duty gear oils, and rotating machinery such as stationary engines, pumps, gas turbines, compressors, wind turbines, and the like, and for a wide variety of applications associated with the automotive, tractor, airline, and railroad industries including engines, transmissions, and the like. Stationary engines include fuel and gas powered engines that are not associated with the automotive, tractor, airline, and railroad industries.

[0063] In one embodiment, the finished lubricating oil composition is an automatic transmission fluid (ATF). An ATF composition uses components proportioned such that the kinematic viscosity of the composition at 100° C. is in the range of from about 4 to about 10 cSt, usually at least 15.9 cSt. An exemplary ATF composition contains the base oil component, a solubilizing agent, from about 0.5 to about 1.5 wt. % viscosity index improver, from about 1.5 to about 2.5 wt.% ashless dispersant, from about 0.05 to about 1 wt.% friction modifier, from about 0.01 to about 0.5 wt.% corrosion inhibitor, from about 0.1 to about 0.4 wt.% antiwear additive, from about 0.005 to about 5 wt.% metal deactivator, from about 0.1 to about 15 wt.% metallic detergent, from about 0.25 to about 1 wt. % seal swell agent, and from about 0.01 to about 0.5 wt.% pour point depressant.

[0064] In one embodiment, the finished lubricating oil composition is a manual transmission oil. An exemplary manual transmission lubricating oil formulation contains the base oil component (which includes at least one GTL base oil), a solubilizing agent, a viscosity index improver, and a DI package comprising an ashless dispersant, at least one antioxidant and at least one inhibitor. Typically, the DI package provides 0.2-5 wt % ashless dispersant(s) to the finished lubricant composition, 0-1.0 wt %, typically from about 0.2-1.0 wt %, antioxidant(s) to the finished lubricant composition, and 0.01-2 wt % inhibitor(s) selected from the group consisting of copper corrosion inhibitors, rust inhibitors and mixtures thereof, to the lubricant composition. The manual transmission lubricating oil formulation usually contains from 0-5 wt. % sulfur and from 30 to 5000 ppm phosphorus, based on the total finished lubricant composition.

[0065] In another embodiment of the disclosure, the finished lubricating oil composition is an axle lubricating oil. An exemplary axle lubricating oil formulation contains the GTL base oil component, a solubilizing agent, a viscosity index improver, a DI package comprising a sulfur containing extreme pressure agent, at least one phosphorus containing anti-wear agent, at least one ashless dispersant and at least one inhibitor. Usually, the DI package provides 3-15 wt % sulfur containing extreme pressure agent(s), 2-10 wt % phosphorus containing anti-wear agent(s), 0.2-5 wt % ashless

dispersant(s) and 0.01-2 wt % inhibitor(s) selected from the group consisting of copper corrosion inhibitors, rust inhibitors and mixtures thereof, to the finished lubricant composition. The axle lubricating oil formulation may contain from 0.5-5 wt % sulfur and from 200 to 5000 ppm phosphorus, based on the finished lubricant composition.

[0066] The power transmission fluids disclosed herein may include fluids suitable for any power transmitting application, such as a step automatic transmission or a manual transmission used for automotive, truck, or tractor applications. Further, the power transmission fluids of the disclosed embodiments may be used in transmissions with a slipping torque converter, a lock-up torque converter, a starting clutch, and/or one or more shifting clutches. Such transmissions include four-, five-, six-, and seven-speed transmissions, and continuously variable transmissions (chain, belt, or disk type). They may also be used in manual transmissions, including automated manual and dual-clutch transmissions.

[0067] A crankcase lubricant composition in accordance with another embodiment of the disclosure may include the GTL base oil component, a solubilizing agent, a viscosity index improver, and a DI package including a detergent, a dispersant, an anti-wear agent, a friction modifier, an antioxidant, a corrosion inhibitor, a pour point depressant, and an anti-foam agent. Such DI package includes from about 1.3 to about 3.0 wt.% dispersant, from about 0.1 to about 15 wt.% detergent, from about 0 to about 5 wt.% corrosion inhibitor, from about 0 to about 5 wt.% antioxidant, from about 0 to about 5 wt.% anti-foam agent, from about 0 to about 5 wt.% friction modifier, from about 0.01 to about 6 wt.% viscosity index improver, from about 0.1 to about 6 wt.% antiwear agent, and from about 0.01 to about 5 wt.% pour point depressant.

[0068] Oil compositions described herein may also be used in quench fluid applications to provide a slower rate of cooling for hardening metals such as steel. Quench fluid performance may be modified by introducing one or more of the foregoing additives and/or compositions to improve wettability, cooling rates, oil stability life, and to reduce deposit forming tendencies of the quench fluids. At numerous places throughout this specification, reference has been made to a number of U.S. Patents. All such cited documents are expressly incorporated in full into this disclosure as if fully set forth herein.

[0069] Other embodiments of the disclosure will be apparent to those skilled in the art from consideration of the specification and practice of the embodiments disclosed herein. As used throughout the specification, "a" and/or "an" may refer to one or more than one. Unless otherwise indicated, all numbers expressing quantities of ingredients, properties such as molecular weight, percent, ratio, reaction conditions, and so forth used in the specification are to be understood as being modified in all instances by the term "about." Accordingly, unless indicated to the contrary, the numerical parameters set forth in the specification are approximations that may vary depending upon the desired properties sought to be obtained by the disclosed embodiments. At the very least, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claims, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the exemplary embodiments are approximations, the numerical values set forth in the specific examples are reported as precisely as possible. Any numerical value, however, inherently contains certain errors necessarily resulting from the standard deviation found in their respective testing measurements. It is intended that the specification and examples be considered as exemplary only, with a true scope of the invention being indicated by the following claims.

Claims

1. A lubricant composition, including:

a first base oil component including a first base oil derived from a gaseous source, said first base oil having a viscosity index of greater than 115, and containing less than 0.3 weight percent sulfur, and from 95 to 100 percent by weight branched alkanes, and optionally, a second base oil derived from a liquid petroleum source, wherein the base oil component contains from 5 to 100 percent by weight of the first base oil; from 1 to 30 percent or more by weight, based on the total weight of the lubricant composition, of a solubilizing agent selected from an adipate ester, a polyol ester, an alkylated naphthalene, an alkylated sulfone, a naphthenic base oil, an aromatic base oil, an alkylated benzene, and a combination of two or more of the solubilizing agents; and an additive component.

2. The lubricant composition of claim 1, wherein the additive component includes from 0.5 to 25 weight percent, based on the total weight of the lubricant composition, of a detergent/inhibitor package.

3. The lubricant composition of any one of claims 1-2, wherein the additive component is selected viscosity index improvers, dispersants, friction modifiers, corrosion inhibitors, rust inhibitors, antioxidants, detergents, seal swell agents, extreme pressure additives, anti-wear additives, pour point depressants, deodorizers, defoamers, demul-

sifiers, dyes, thickening agents, fluorescent coloring agents, and combinations of two or more of these additive components.

- 5 4. The lubricant composition of any one of claims 1-3, wherein lubricant composition includes from 5 to 1.5 percent by weight of the solubilizing agent.
- 10 5. The lubricant composition of any one of claims 1-4, wherein the additive component includes from 0.1 to 40 weight percent, based on the total weight of the lubricant composition, of at least one polymer selected from olefin (co) polymer(s), polyalkyl (meth)acrylate(s) and mixtures thereof.
- 15 6. The lubricant composition of claim 5, wherein the polymer includes polyisobutylene having a weight average molecular weight ranging from 700 to 2,500.
- 20 7. The lubricant composition of claim 1, wherein the additive component includes a detergent/inhibitor package.
- 25 8. The lubricant composition of any one of claims 1-7, wherein the additive component includes a friction modifier selected from aliphatic fatty amines, ether amines, alkoxyated aliphatic fatty amines, alkoxyated ether amines, oil-soluble aliphatic carboxylic acids, polyol esters, fatty acid amides, imidazolines, tertiary amines, hydrocarbyl succinimides reacted with ammonia or a primary amine, and organic molybdenum compounds.
- 30 9. The lubricant composition of any one of claims 1-8, wherein the additive component includes an antioxidant selected from bis-alkylated diphenyl amines, phenyl alpha or beta naphthyl amines, sterically hindered phenols, bisphenols, cinnamic acid derivatives, and sulfurized olefins.
- 35 10. The lubricant composition of any one of claims 1-9, wherein the additive component includes an antiwear agent selected from phosphate esters and salts thereof, phosphite esters and salts thereof, dialkyldithiophosphoric acid esters and salts thereof, and dithiocarbamic acid esters and salts thereof.
- 40 11. The lubricant composition of any one of claims 1-10, wherein the additive component includes an antifoam agent selected from silicones and polyacrylates.
- 45 12. The lubricant composition of any one of claims 1-11, wherein the additive component includes a seal swell agent selected from an acrylate, an alkylated sulfone, and a silicon containing compound.
- 50 13. The lubricant composition of any one of claims 1-12, wherein the additive component includes a detergent selected from neutral and overbased sodium sulfonates, sodium carboxylates, sodium salicylates, sodium phenates, sulfurized sodium phenates, lithium sulfonates, lithium carboxylates, lithium salicylates, lithium phenates, sulfurized lithium phenates, magnesium sulfonates, magnesium carboxylates, magnesium salicylates, magnesium phenates, sulfurized magnesium phenates, potassium sulfonates, potassium carboxylates, potassium salicylates, potassium phenates, sulfurized potassium phenates, zinc sulfonates, zinc carboxylates, zinc salicylates, zinc phenates, and sulfurized zinc phenates.
- 55 14. The lubricant composition of any one of claims 1-13, wherein the additive component includes a dispersant derived from a hydrocarbyl succinic acid or anhydride having a number average molecular weight ranging from 200 to 2100, as determined by gel permeation chromatography, and ammonia or a primary amine.
15. The lubricant composition of claim 14, wherein the dispersant is derived from polyisobutenyl succinic anhydride and a polyalkylene polyamine in a ratio of polyisobutenyl succinic anhydride to amine ranging from 1:1 to 3:1.
16. The lubricant composition of claim 15, wherein the dispersant includes a post-treated succinimide dispersant.
17. The lubricant composition of claim 16, wherein the post-treated succinimide dispersant is post-treated with a compound or composition selected from phosphorus-based acids, boron-based acids, carboxylic acids, alkylphenol/aldehyde mixtures, and mixtures of two or more of these compounds or compositions.
18. The lubricant composition of any one of claims 1-17, wherein the second base oil includes a liquid base oil selected from a natural oil, a mixture of natural oils, a synthetic oil, a mixture of synthetic oils, and a mixture of natural and synthetic oils.

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19. A finished lubricant including the lubricant composition of any one of claims 1-18.

20. The finished lubricant of claim 19, wherein the additive component includes a pour point depressant, a viscosity index improver, a foam inhibitor, and, optionally, a thickening agent.

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21. A quench fluid including the finished lubricant of any one of claims 19-20.

22. An automatic transmission fluid including the finished lubricant composition of any one of claims 19-20.

10 23. The automatic transmission fluid of claim 22, wherein the additive component includes a viscosity index improver, an antiwear additive, a metal deactivator, and a seal swell agent.

24. A gear oil composition including the finished lubricant composition of any one of claims 19-20.

15 25. An engine selected from stationary engines, passenger vehicle engines, truck engines, and heavy duty engines including the lubricant composition of any one of claims 1-18.

26. A power transmission selected from automatic transmissions, manual transmissions, continuously variable transmissions including the lubricant composition of any one of claims 1-18.

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27. A method of lubricating a power transmission, the method including the step of introducing into a power transmission a lubricant composition as claimed in any one of claims 1-4 and 6-18, and wherein the additive component includes from 0.1 to 40 weight percent, based on the total weight of the lubricant composition, of at least one polymer selected from olefin (co) polymer(s), polyalkyl (meth) acrylate(s) and mixtures thereof.

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