



Office de la Propriété
Intellectuelle
du Canada

Un organisme
d'Industrie Canada

Canadian
Intellectual Property
Office

An agency of
Industry Canada

CA 2626768 C 2015/07/07

(11)(21) **2 626 768**

(12) **BREVET CANADIEN
CANADIAN PATENT**

(13) **C**

(86) **Date de dépôt PCT/PCT Filing Date:** 2006/10/17
(87) **Date publication PCT/PCT Publication Date:** 2007/05/03
(45) **Date de délivrance/Issue Date:** 2015/07/07
(85) **Entrée phase nationale/National Entry:** 2008/04/21
(86) **N° demande PCT/PCT Application No.:** US 2006/040423
(87) **N° publication PCT/PCT Publication No.:** 2007/050351
(30) **Priorités/Priorities:** 2005/10/21 (US60/728,833);
2006/09/26 (US11/527,309)

(51) **Cl.Int./Int.Cl. C10M 141/08** (2006.01),
C10M 141/10 (2006.01)
(72) **Inventeurs/Inventors:**
HABEEB, JACOB J., US;
JOHNSON, DOUGLAS E., US
(73) **Propriétaire/Owner:**
EXXONMOBIL RESEARCH AND ENGINEERING
COMPANY, US
(74) **Agent:** BORDEN LADNER GERVAIS LLP

(54) **Titre : COMBINAISONS ADDITIVES ANTIUSURE ET AMELIORANT LA CHARGE DESTINEES A DES HUILES DE
LUBRIFICATION**
(54) **Title: ANTIWEAR INHIBITING AND LOAD ENHANCING ADDITIVE COMBINATIONS FOR LUBRICATING OILS**

(57) **Abrégé/Abstract:**

The anti-wear and load carrying properties of lubricating oils is enhanced by the addition of the combination of thiosalicylic acid and adenine. Phosphate ester anti-wear and load carrying additives may be employed with the combination of thiosalicylic acid and adenine.



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
3 May 2007 (03.05.2007)

PCT

(10) International Publication Number
WO 2007/050351 A1

(51) International Patent Classification:

C10M 141/08 (2006.01) **C10M 141/10** (2006.01)

(21) International Application Number:

PCT/US2006/040423

(22) International Filing Date: 17 October 2006 (17.10.2006)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

60/728,833 21 October 2005 (21.10.2005) US
11/527,309 26 September 2006 (26.09.2006) US

(71) Applicant (for all designated States except US): **EXXON-MOBIL RESEARCH AND ENGINEERING COMPANY** [US/US]; 1545 ROUTE 22 EAST, P.o.box 900, Annandale, NJ 08801-0900 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HABEEB, Jacob, J.** [US/US]; 102 East Dudley Avenue, Westifeld, NJ 07090 (US). **JOHNSON, Douglas, E.** [US/US]; 23 Buxton Road, Cherry Hill, NJ 08003 (US).

(74) Agents: **PURWIN, Paul, E.** et al.; EXXONMOBIL RESEARCH AND ENGINEERING COMPANY, 1545 ROUTE 22 EAST, P.o.box 900, Annandale, NJ 08801-0900 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ANTIWEAR INHIBITING AND LOAD ENHANCING ADDITIVE COMBINATIONS FOR LUBRICATING OILS

(57) Abstract: The anti-wear and load carrying properties of lubricating oils is enhanced by the addition of the combination of thiosalicylic acid and adenine. Phosphate ester anti-wear and load carrying additives may be employed with the combination of thiosalicylic acid and adenine.

WO 2007/050351 A1

- 1 -

ANTIWEAR INHIBITING AND LOAD ENHANCING
ADDITIVE COMBINATIONS FOR LUBRICATING OILS

FIELD OF INVENTION

[001] The present invention relates to antiwear inhibiting and load carrying enhancing additives. More particularly the present invention relates to lubricating oils containing a combination of additives that provide performance enhancements of lubricating oils.

BACKGROUND OF THE INVENTION

[002] The art of lubricating oil formulation has become increasingly complex with ever more stringent industry standards dictated by the increasing complexity of the mechanical equipment requiring lubrication. One important requirement for lubricants is to provide load carrying capability. At the same time the lubricant formulation should provide other important properties. For example, the formulation should provide resistance to oxidation in order to achieve operation life of adequate length. Experience has shown, however, that the incorporation of one type of additive in a lubricant composition can have a negative impact on the function of another type of additive in that composition. Indeed, the presence of antiwear additives in lubricants often reduces the oxidation stability compared to a similar oil where the antiwear additive is absent. The result, of course, is that extensive research is required in developing new lubricant formulations that have enhanced performance.

SUMMARY OF THE INVENTION

[003] It has now been established that the combination of thiosalicylic acid and adenine provide a lubricant base stock with enhanced antiwear and load carrying properties when used in effective amounts. Thus in one embodiment there is provided a lubricating composition comprising:

- (a) a major amount of an oil of lubricating viscosity, and

- 2 -

- (b) an effective amount of an additive combination comprising thiosalicylic acid and adenine.

[004] Other embodiments of the invention will become apparent from the detailed description that follows:

DETAILED DESCRIPTION OF THE INVENTION

[005] A wide range of lubricating base oils is known in the art. Lubricating base oils that are useful in the present invention are natural oils, synthetic oils, and unconventional oils. Natural oil, synthetic oils, and unconventional oils and mixtures thereof can be used unrefined, refined, or rerefined (the latter is also known as reclaimed or reprocessed oil). Unrefined oils are those obtained directly from a natural, synthetic or unconventional source and used without further purification. These include for example shale oil obtained directly from retorting operations, petroleum oil obtained directly from primary distillation, and ester oil obtained directly from an esterification process. Refined oils are similar to the oils discussed for unrefined oils except refined oils are subjected to one or more purification or transformation steps to improve at least one lubricating oil property. One skilled in the art is familiar with many purification or transformation processes. These processes include, for example, solvent extraction, secondary distillation, acid extraction, base extraction, filtration, percolation, hydrogenation, hydrorefining, and hydrofinishing. Rerefined oils are obtained by processes analogous to refined oils, but use an oil that has been previously used.

[006] Groups I, II, III, IV and V are broad categories of base oil stocks developed and defined by the American Petroleum Institute (API Publication 1509; www.API.org) to create guidelines for lubricant base oils. Group I base stocks generally have a viscosity index of between about 80 to 120 and contain greater than about 0.03% sulfur and less than about 90% saturates. Group II base stocks generally have a viscosity index of between about 80 to 120, and

- 3 -

contain less than or equal to about 0.03% sulfur and greater than or equal to about 90% saturates. Group III stock generally has a viscosity index greater than about 120 and contains less than or equal to about 0.03% sulfur and greater than about 90% saturates. Group IV includes polyalphaolefins (PAO). Group V base stocks include base stocks not included in Groups I-IV. Table A summarizes properties of each of these five groups.

TABLE A: Base Stock Properties

	Saturates	Sulfur	Viscosity Index
Group I	< 90% and/or	> 0.03% and	≥ 80 and < 120
Group II	$\geq 90\%$ and	$\leq 0.03\%$ and	≥ 80 and < 120
Group III	$\geq 90\%$ and	$\leq 0.03\%$ and	≥ 120
Group IV	Polyalphaolefins (PAO)		
Group V	All other base oil stocks not included in Groups I, II, III, or IV		

[007] Natural oils include animal oils, vegetable oils (castor oil and lard oil, for example), and mineral oils. Animal and vegetable oils possessing favorable thermal oxidative stability can be used. Of the natural oils, mineral oils are preferred. Mineral oils vary widely as to their crude source, for example, as to whether they are paraffinic, naphthenic, or mixed paraffinic-naphthenic. Oils derived from coal or shale are also useful in the present invention. Natural oils vary also as to the method used for their production and purification, for example, their distillation range and whether they are straight run or cracked, hydrotreated, or solvent extracted.

[008] Synthetic oils include hydrocarbon oils as well as non hydrocarbon oils. Synthetic oils can be derived from processes such as chemical combination (for example, polymerization, oligomerization, condensation, alkylation, acylation, etc.), where materials consisting of smaller, simpler molecular species are built up (i.e., synthesized) into materials consisting of larger, more complex molecular species. Synthetic oils include hydrocarbon oils such as polymerized and inter-

- 4 -

polymerized olefins (polybutylenes, polypropylenes, propylene isobutylene copolymers, ethylene-olefin copolymers, and ethylene-alphaolefin copolymers, for example). Polyalphaolefin (PAO) oil base stock is a commonly used synthetic hydrocarbon oil. By way of example, PAOs derived from C₈, C₁₀, C₁₂, C₁₄ olefins or mixtures thereof may be utilized. See U.S. Patents 4,956,122; 4,827,064; and 4,827,073.

[009] The number average molecular weights of the PAOs, which are known materials and generally available on a major commercial scale from suppliers such as ExxonMobil Chemical Company, Chevron, BP-Amoco, and others, typically vary from about 250 to about 3000, or higher, and PAOs may be made in viscosities up to about 100 cSt (100°C), or higher. In addition, higher viscosity PAOs are commercially available, and may be made in viscosities up to about 3000 cSt (100°C), or higher. The PAOs are typically comprised of relatively low molecular weight hydrogenated polymers or oligomers of alpha-olefins which include, but are not limited to, about C₂ to about C₃₂ alphaolefins with about C₈ to about C₁₆ alphaolefins, such as 1-octene, 1-decene, 1-dodecene and the like, being preferred. The preferred polyalphaolefins are poly-1-octene, poly-1-decene and poly-1-dodecene and mixtures thereof and mixed olefin-derived polyolefins. However, the dimers of higher olefins in the range of about C₁₄ to C₁₈ may be used to provide low viscosity base stocks of acceptably low volatility. Depending on the viscosity grade and the starting oligomer, the PAOs may be predominantly trimers and tetramers of the starting olefins, with minor amounts of the higher oligomers, having a viscosity range of about 1.5 to 12 cSt.

[010] PAO fluids may be conveniently made by the polymerization of an alphaolefin in the presence of a polymerization catalyst such as the Friedel-Crafts catalysts including, for example, aluminum trichloride, boron trifluoride or complexes of boron trifluoride with water, alcohols such as ethanol, propanol

- 5 -

or butanol, carboxylic acids or esters such as ethyl acetate or ethyl propionate. For example the methods disclosed by U. S. Patent 4,149,178 or U.S. Patent 3,382,291 may be conveniently used herein. Other descriptions of PAO synthesis are found in the following U.S. Patents 3,742,082; 3,769,363; 3,876,720; 4,239,930; 4,367,352; 4,413,156; 4,434,408; 4,910,355; 4,956,122; and 5,068,487. The dimers of the C₁₄ to C₁₈ olefins are described in USP 4,218,330.

[011] Other useful synthetic lubricating base stock oils such as silicon-based oil or esters of phosphorus containing acids may also be utilized. For examples of other synthetic lubricating base stocks are the seminal work "Synthetic Lubricants", Gunderson and Hart, Reinhold Publ. Corp., NY 1962.

[012] In alkylated aromatic stocks, the alkyl substituents are typically alkyl groups of about 8 to 25 carbon atoms, usually from about 10 to 18 carbon atoms and up to about three such substituents may be present, as described for the alkyl benzenes in ACS Petroleum Chemistry Preprint 1053-1058, "Poly n-Alkylbenzene Compounds: A Class of Thermally Stable and Wide Liquid Range Fluids", Eapen et al, Philadelphia 1984. Tri-alkyl benzenes may be produced by the cyclodimerization of 1-alkynes of 8 to 12 carbon atoms as described in USP 5,055,626. Other alkylbenzenes are described in European Patent Application 168 534 and USP 4,658,072. Alkylbenzenes are used as lubricant basestocks, especially for low-temperature applications (arctic vehicle service and refrigeration oils) and in papermaking oils. They are commercially available from producers of linear alkylbenzenes (LABs) such as Vista Chem. Co., Huntsman Chemical Co., Chevron Chemical Co., and Nippon Oil Co. Linear alkylbenzenes typically have good low pour points and low temperature viscosities and VI values greater than about 100, together with good solvency for

additives. Other alkylated aromatics which may be used when desirable are described, for example, in "Synthetic Lubricants and High Performance Functional Fluids", Dressler, H., chap 5, (R. L. Shubkin (Ed.)), Marcel Dekker, NY, 1993.

[013] Alkylene oxide polymers and interpolymers and their derivatives containing modified terminal hydroxyl groups obtained by, for example, esterification or etherification are useful synthetic lubricating oils. By way of example, these oils may be obtained by polymerization of ethylene oxide or propylene oxide, the alkyl and aryl ethers of these polyoxyalkylene polymers (methyl-polyisopropylene glycol ether having an average molecular weight of about 1000, diphenyl ether of polyethylene glycol having a molecular weight of about 500-1000, and the diethyl ether of polypropylene glycol having a molecular weight of about 1000 to 1500, for example) or mono- and polycarboxylic esters thereof (the acidic acid esters, mixed C₃₋₈ fatty acid esters, or the C₁₃Oxo acid diester of tetraethylene glycol, for example).

[014] Esters comprise a useful base stock. Additive solvency and seal compatibility characteristics may be secured by the use of esters such as the esters of dibasic acids with monoalkanols and the polyol esters of monocarboxylic acids. Esters of the former type include, for example, the esters of dicarboxylic acids such as phthalic acid, succinic acid, alkyl succinic acid, alkenyl succinic acid, maleic acid, azelaic acid, suberic acid, sebacic acid, fumaric acid, adipic acid, linoleic acid dimer, malonic acid, alkyl malonic acid, alkenyl malonic acid, etc., with a variety of alcohols such as butyl alcohol, hexyl alcohol, dodecyl alcohol, 2-ethylhexyl alcohol, etc. Specific examples of these types of esters include dibutyl adipate, di(2-ethylhexyl) sebacate, di-n-hexyl fumarate, dioctyl sebacate, diisooctyl azelate, diisodecyl azelate, dioctyl phthalate, didecyl phthalate, dieicosyl sebacate, etc.

- 7 -

[015] Particularly useful synthetic esters are those full or partial esters which are obtained by reacting one or more polyhydric alcohols (preferably the hindered polyols such as the neopentyl polyols, e.g., neopentyl glycol, trimethylol ethane, 2-methyl-2-propyl-1,3-propanediol, trimethylol propane, pentaerythritol and dipentaerythritol) with alkanoic acids containing at least about 4 carbon atoms (preferably C₅ to C₃₀ acids such as saturated straight chain fatty acids including caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, arachic acid, and behenic acid, or the corresponding branched chain fatty acids or unsaturated fatty acids such as oleic acid).

[016] Suitable synthetic ester components include the esters of trimethylol propane, trimethylol butane, trimethylol ethane, pentaerythritol and/or dipentaerythritol with one or more monocarboxylic acids containing from about 5 to about 10 carbon atoms.

[017] Silicon-based oils are another class of useful synthetic lubricating oils. These oils include polyalkyl-, polyaryl-, polyalkoxy-, and polyaryloxy-siloxane oils and silicate oils. Examples of suitable silicon-based oils include tetraethyl silicate, tetraisopropyl silicate, tetra-(2-ethylhexyl)silicate, tetra-(4-methylhexyl)silicate, tetra-(p-tert-butylphenyl)silicate, hexyl-(4-methyl-2-pentoxo)disiloxane, poly(methyl)siloxanes, and poly-(methyl-2-methylphenyl)siloxanes.

[018] Another class of synthetic lubricating oil is esters of phosphorous-containing acids. These include, for example, tricresyl phosphate, trioctyl phosphate, diethyl ester of decanephosphonic acid.

[019] Another class of oils includes polymeric tetrahydrofurans, their derivatives, and the like.

[020] Other useful fluids of lubricating viscosity include non-conventional or unconventional base stocks that have been processed, preferably catalytically, or synthesized to provide high performance lubrication characteristics.

- 8 -

[021] Other useful lubricant fluids include Gas-to-Liquids (GTL) materials, preferably GTL base stocks and base oils. GTL materials are materials that are derived via one or more synthesis, combination, transformation, rearrangement, and/or deconstructive processes from simple gaseous carbon-containing and hydrocarbon-containing compounds and elements as feedstocks. GTL base stocks and base oils are fluids of lubricating viscosity that are generally derived from hydrocarbons, for example waxy synthesized hydrocarbons, that are further derived from simpler gaseous carbon-containing and hydrocarbon-containing compounds and elements as feedstocks. GTL base stocks and base oils include, for example, synthesized wax isomerate base stocks and base oils, comprising for example, hydroisomerized or isodewaxed synthesized waxy stocks, hydroisomerized or isodewaxed Fischer-Tropsch (F-T) hydrocarbons, preferably hydroisomerized or isodewaxed F-T waxy hydrocarbons or hydroisomerized or isodewaxed F-T waxes, hydroisomerized synthesized waxes or mixtures thereof.

[022] Other useful lubricant fluids include Gas-to-Liquids (GTL) materials, preferably GTL base stocks and base oils. GTL materials are materials that are derived via one or more synthesis, combination, transformation, rearrangement, and/or degradation/deconstructive processes from gaseous carbon-containing compounds, hydrogen-containing compounds, and/or elements as feedstocks such as hydrogen, carbon dioxide, carbon monoxide, water, methane, ethane, ethylene, acetylene, propane, propylene, propyne, butane, butylenes, and butynes. GTL base stocks and base oils are GTL materials of lubricating viscosity that are generally derived from hydrocarbons, for example waxy synthesized hydrocarbons, that are themselves derived from simpler gaseous carbon-containing compounds, hydrogen-containing compounds and/or elements as feedstocks. GTL base stocks and base oils include wax isomerates, comprising, for example, hydroisomerized or isodewaxed synthesized waxy hydrocarbons, hydroisomerized or isodewaxed Fischer-Tropsch (F-T) material (i.e.,

- 9 -

hydrocarbons, waxy hydrocarbons, waxes and possible analogous oxygenates), preferably hydroisomerized or isodewaxed F-T waxy hydrocarbons or hydroisomerized or isodewaxed F-T waxes, hydroisomerized or isodewaxed synthesized waxes, or mixtures thereof. The term GTL base stocks and base oil further encompass the aforesaid base stock and base oils in combination with other hydroisomerized or isodewaxed materials comprising for example, hydroisomerized or isodewaxed mineral/petroleum-derived hydrocarbons, hydroisomerized or isodewaxed waxy hydrocarbons, or mixtures thereof, derived from different feed materials including, for example, waxy distillates such as gas oils, waxy hydrocracked hydrocarbons, lubricating oils, high pour point polyalphaolefins, foots oil, normal alpha olefin waxes, slack waxes, deoiled waxes, and microcrystalline waxes.

[023] GTL base stocks and base oils derived from GTL materials, especially, hydroisomerized/isodewaxed F-T material derived base stocks and base oils, and other hydroisomerized/isodewaxed wax derived base stocks and base oils, such as wax isomerates are characterized typically as having kinematic viscosities at 100°C of from about 2 cSt to about 50 cSt, preferably from about 3 cSt to about 30 cSt, more preferably from about 3.5 cSt to about 25 cSt, as exemplified by a GTL base stock derived by the isodewaxing of F-T wax, which has a kinematic viscosity of about 4 cSt at 100°C and a viscosity index of about 130 or greater. Reference herein to Kinematic viscosity refers to a measurement made by ASTM method D445.

[024] GTL base stocks and base oils derived from GTL materials, especially hydroisomerized/isodewaxed F-T material derived base stocks and base oils, and other hydroisomerized/isodewaxed wax-derived base stocks and base oils, such as wax hydroisomerates/isodewaxates, which are components of this invention are further characterized typically as having pour points of about -5°C or lower, preferably about -10°C or lower, more preferably about -15°C or lower, still

- 10 -

more preferably about -20°C or lower, and under some conditions may have advantageous pour points of about -25°C or lower, with useful pour points of about -30°C to about -40°C or lower. If necessary, a separate dewaxing step may be practiced to achieve the desired pour point. References herein to pour point refer to measurement made by ASTM D97 and similar automated versions.

[025] The GTL base stocks and base oils derived from GTL materials, especially hydroisomerized/isodewaxed F-T material derived base stocks and base oils, and other hydroisomerized/isodewaxed wax-derived base stocks and base oils, such as wax isomerate/isodewaxate which are components of this invention are also characterized typically as having viscosity indices of 80 or greater, preferably 100 or greater, and more preferably 120 or greater. Additionally, in certain particular instances, viscosity index of these base stocks may be preferably 130 or greater, more preferably 135 or greater, and even more preferably 140 or greater. For example, GTL base stocks and base oils that derived from GTL materials preferably F-T materials especially F-T wax generally have a viscosity index of 130 or greater. References herein to viscosity index refer to ASTM method D2270.

[026] In addition, the GTL base stocks and base oils are typically highly paraffinic (>90% saturates), and may contain mixtures of monocycloparaffins and multicycloparaffins in combination with non-cyclic isoparaffins. The ratio of the naphthenic (i.e., cycloparaffin) content in such combinations varies with the catalyst and temperature used. Further, GTL base stocks and base oils typically have very low sulfur and nitrogen content, generally containing less than about 10 ppm, and more typically less than about 5 ppm of each of these elements. The sulfur and nitrogen content of GTL base stock and base oil obtained by the hydroisomerization/isodewaxing of F-T material, especially F-T wax is essentially nil.

- 11 -

[027] Useful compositions of GTL base stocks and base oils, hydroisomerized or isodewaxed F-T material derived base stocks and base oils, and wax-derived hydroisomerized/isodewaxed base stocks and base oils, such as wax isomerates/isodewaxes, are recited in U.S. Patents 6,080,301; 6,090,989, and 6,165,949 for example.

[028] Wax isomerate/isodewaxate base stocks and base oils derived from waxy feeds which are also suitable for use in this invention, are paraffinic fluids of lubricating viscosity derived from hydroisomerized or isodewaxed waxy feedstocks of mineral or natural source origin, e.g., feedstocks such as one or more of gas oils, slack wax, waxy fuels hydrocracker bottoms, hydrocarbon raffinates, natural waxes, hydrocrackates, thermal crackates or other suitable mineral or non-mineral oil derived waxy materials, linear or branched hydrocarbyl compounds with carbon number of about 20 or greater, preferably about 30 or greater, and mixtures of such isomerate/isodewaxate base stocks and base oils.

[029] As used herein, the following terms have the indicated meanings:

"paraffinic" material: any saturated hydrocarbons, such as alkanes. Paraffinic materials may include linear alkanes, branched alkanes (iso-paraffins), cycloalkanes (cycloparaffins; mono-ring and/or multi-ring), and branched cycloalkanes;

"hydroprocessing": a refining process in which a feedstock is heated with hydrogen at high temperature and under pressure, commonly in the presence of a catalyst, to remove and/or convert less desirable components and to produce an improved product;

"hydrotreating": a catalytic hydrogenation process that converts sulfur- and/or nitrogen-containing hydrocarbons into hydrocarbon products with reduced sulfur and/or nitrogen content, and which generates hydrogen sulfide and/or ammonia

- 12 -

(respectively) as byproducts; similarly, oxygen containing hydrocarbons can also be reduced to hydrocarbons and water;

"hydrodewaxing" (or catalytic dewaxing): a catalytic process in which normal paraffins (wax) and/or waxy hydrocarbons are converted by cracking/fragmentation into lower molecular weight species, and/or by rearrangement/isomerization into more branched iso-paraffins;

"hydroisomerization" (or isodewaxing): a catalytic process in which normal paraffins (wax) and/or slightly branched iso-paraffins are converted by rearrangement/isomerization into more branched iso-paraffins;

"hydrocracking": a catalytic process in which hydrogenation accompanies the cracking/fragmentation of hydrocarbons, e.g., converting heavier hydrocarbons into lighter hydrocarbons, or converting aromatics and/or cycloparaffins (naphthenes) into non-cyclic branched paraffins.

[030] As previously indicated, wax isomerate base stock and base oils suitable for use as the necessary components in the present invention, can be derived from other waxy feeds such as slack wax.

[031] Slack wax is the wax recovered from petroleum oils by solvent or autorefrigerative dewaxing. Solvent dewaxing employs chilled solvent such as methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), mixtures of MEK/MIBK, mixtures of MEK and toluene, while autorefrigerative dewaxing employs pressurized, liquefied low boiling hydrocarbons such as propane or butane.

[032] Slack waxes, being secured from petroleum oils, may contain sulfur and nitrogen containing compounds. Such heteroatom compounds must be removed by hydrotreating (and not hydrocracking), as for example by hydrodesulfurization (HDS) and hydrodenitrogenation (HDN) so as to avoid subsequent poisoning/deactivation of the hydroisomerization catalyst.

[033] In a preferred embodiment, the GTL material is a F-T material (i.e., hydrocarbons, waxy hydrocarbons, wax). A slurry F-T synthesis process may be beneficially used for synthesizing the feed from CO and hydrogen and particularly one employing a F-T catalyst comprising a catalytic cobalt component to provide a high alpha for producing the more desirable higher molecular weight paraffins. This process is also well known to those skilled in the art.

[034] In a F-T synthesis process, a synthesis gas comprising a mixture of H₂ and CO is catalytically converted into hydrocarbons and preferably liquid hydrocarbons. The mole ratio of the hydrogen to the carbon monoxide may broadly range from about 0.5 to 4, but which is more typically within the range of from about 0.7 to 2.75 and preferably from about 0.7 to 2.5. As is well known, F-T synthesis processes include processes in which the catalyst is in the form of a fixed bed, a fluidized bed or as a slurry of catalyst particles in a hydrocarbon slurry liquid. The stoichiometric mole ratio for a F-T synthesis reaction is 2.0, but there are many reasons for using other than a stoichiometric ratio as those skilled in the art know. In a cobalt slurry hydrocarbon synthesis process the feed mole ratio of the H₂ to CO is typically about 2.1/1. The synthesis gas comprising a mixture of H₂ and CO is bubbled up into the bottom of the slurry and reacts in the presence of the particulate F-T synthesis catalyst in the slurry liquid at conditions effective to form hydrocarbons, a portion of which are liquid at the reaction conditions and which comprise the hydrocarbon slurry liquid. The synthesized hydrocarbon liquid is separated from the catalyst particles as filtrate by means such as filtration, although other separation means such as centrifugation can be used. Some of the synthesized hydrocarbons pass out the top of the hydrocarbon synthesis reactor as vapor, along with unreacted synthesis gas and other gaseous reaction products. Some of these overhead hydrocarbon vapors are typically condensed to liquid and combined with the hydrocarbon liquid filtrate. Thus, the initial boiling point of the filtrate may vary

- 14 -

depending on whether or not some of the condensed hydrocarbon vapors have been combined with it. Slurry hydrocarbon synthesis process conditions vary somewhat depending on the catalyst and desired products. Typical conditions effective to form hydrocarbons comprising mostly C₅₊ paraffins, (e.g., C₅₊-C₂₀₀) and preferably C₁₀₊ paraffins, in a slurry hydrocarbon synthesis process employing a catalyst comprising a supported cobalt component include, for example, temperatures, pressures and hourly gas space velocities in the range of from about 320-850°F, 80-600 psi and 100-40,000 V/hr/V, expressed as standard volumes of the gaseous CO and H₂ mixture (0°C, 1 atm) per hour per volume of catalyst, respectively. It is preferred that the hydrocarbon synthesis reaction be conducted under conditions in which limited or no water gas shift reaction occurs and more preferably with no water gas shift reaction occurring during the hydrocarbon synthesis. It is also preferred to conduct the reaction under conditions to achieve an alpha of at least 0.85, preferably at least 0.9 and more preferably at least 0.92, so as to synthesize more of the more desirable higher molecular weight hydrocarbons. This has been achieved in a slurry process using a catalyst containing a catalytic cobalt component. Those skilled in the art know that by alpha is meant the Schultz-Flory kinetic alpha. While suitable F-T reaction types of catalyst comprise, for example, one or more Group VIII catalytic metals such as Fe, Ni, Co, Ru and Re, it is preferred that the catalyst comprise a cobalt catalytic component. In one embodiment the catalyst comprises catalytically effective amounts of Co and one or more of Re, Ru, Fe, Ni, Th, Zr, Hf, U, Mg and La on a suitable inorganic support material, preferably one which comprises one or more refractory metal oxides. Preferred supports for Co containing catalysts comprise titania, particularly. Useful catalysts and their preparation are known and illustrative, but nonlimiting examples may be found, for example, in U.S. Patents 4,568,663; 4,663,305; 4,542,122; 4,621,072 and 5,545,674.

- 15 -

[035] As set forth above, the waxy feed from which a preferred base stock is derived comprises mineral wax or other natural source wax, especially slack wax, or waxy F-T material, referred to as F-T wax. F-T wax preferably has an initial boiling point in the range of from 650-750°F and preferably continuously boils up to an end point of at least 1050°F. A narrower cut waxy feed may also be used during the hydroisomerization. A portion of the n-paraffin waxy feed is converted to lower boiling isoparaffinic material. Hence, there must be sufficient heavy n-paraffin material to yield an isoparaffin containing isomerate boiling in the lube oil range. If catalytic dewaxing is also practiced, some of the isomerate will also be converted to lower boiling material during the dewaxing. Hence, it is preferred that the end boiling point of the waxy feed be above 1050°F (1050°F+).

[036] The waxy feed preferably comprises the entire 650-750°F+ fraction formed by the hydrocarbon synthesis process, with the initial cut point between 650°F and 750°F being determined by the practitioner and the end point, preferably above 1050°F, determined by the catalyst and process variables employed by the practitioner for the synthesis. Waxy feeds may be processed as the entire fraction or as subsets of the entire fraction prepared by distillation or other separation techniques. The waxy feed also typically comprises more than 90%, generally more than 95% and preferably more than 98 wt% paraffinic hydrocarbons, most of which are normal paraffins. It has negligible amounts of sulfur and nitrogen compounds (e.g., less than 1 wppm of each), with less than 2,000 wppm, preferably less than 1,000 wppm and more preferably less than 500 wppm of oxygen, in the form of oxygenates. Waxy feeds having these properties and useful in the process of the invention have been made using a slurry F-T process with a catalyst having a catalytic cobalt component, as previously indicated.

- 16 -

[037] The process of making the lubricant oil base stocks from waxy stocks, e.g., slack wax or F-T wax, may be characterized as a hydrodewaxing process. If slack waxes are used as the feed, they may need to be subjected to a preliminary hydrotreating step under conditions already well known to those skilled in the art to reduce (to levels that would effectively avoid catalyst poisoning or deactivation) or to remove sulfur- and nitrogen-containing compounds which would otherwise deactivate the hydroisomerization/hydrodewaxing catalyst used in subsequent steps. If F-T waxes are used, such preliminary treatment is not required because, as indicated above, such waxes have only trace amounts (less than about 10 ppm, or more typically less than about 5 ppm to nil) of sulfur or nitrogen compound content. However, some hydrodewaxing catalyst fed F-T waxes may benefit from removal of oxygenates while others may benefit from oxygenates treatment. The hydrodewaxing process may be conducted over a combination of catalysts, or over a single catalyst. Conversion temperatures range from about 150°C to about 500°C at pressures ranging from about 500 to 20,000 kPa. This process may be operated in the presence of hydrogen, and hydrogen partial pressures range from about 600 to 6000 kPa. The ratio of hydrogen to the hydrocarbon feedstock (hydrogen circulation rate) typically range from about 10 to 3500 n.l.l.⁻¹ (56 to 19,660 SCF/bbl) and the space velocity of the feedstock typically ranges from about 0.1 to 20 LHSV, preferably 0.1 to 10 LHSV.

[038] Following any needed hydridenitrogenation or hydrodesulfurization, the hydroprocessing used for the production of base stocks from such waxy feeds may use an amorphous hydrocracking/hydroisomerization catalyst, such as a lube hydrocracking (LHDC) catalysts, for example catalysts containing Co, Mo, Ni, W, Mo, etc., on oxide supports, e.g., alumina, silica, silica/alumina, or a crystalline hydrocracking/hydroisomerization catalyst, preferably a zeolitic catalyst.

- 17 -

[039] Other isomerization catalysts and processes for hydrocracking/hydroisomerized/isodewaxing GTL materials and/or waxy materials to base stock or base oil are described, for example, in U.S. Patents 2,817,693; 4,900,407; 4,937,399; 4,975,177; 4,921,594; 5,059,299; 5,200,382; 5,516,740; 5,182,248; 5,290,426; 5,580,442; 5,976,351; 5,935,417; 5,885,438; 5,965,475; 6,190,532; 6,375,830; 6,332,974; 6,103,099; 6,025,305; 6,080,301; 6,096,940; 6,620,312; 6,676,827; 6,383,366; 6,475,960; 5,059,299; 5,977,425; 5,935,416; 4,923,588; 5,158,671; and 4,897,178; EP 0324528 (B1), EP 0532116 (B1), EP 0532118 (B1), EP 0537815 (B1), EP 0583836 (B2), EP 0666894 (B2), EP 0668342 (B1), EP 0776959 (A3), WO 97/031693 (A1), WO 02/064710 (A2), WO 02/064711 (A1), WO 02/070627 (A2), WO 02/070629 (A1), WO 03/033320 (A1) as well as in British Patents 1,429,494; 1,350,257; 1,440,230; 1,390,359; WO 99/45085 and WO 99/20720. Particularly favorable processes are described in European Patent Applications 464546 and 464547. Processes using F-T wax feeds are described in U.S. Patents 4,594,172; 4,943,672; 6,046,940; 6,475,960; 6,103,099; 6,332,974; and 6,375,830.

[040] Hydrocarbon conversion catalysts useful in the conversion of the n-paraffin waxy feedstocks disclosed herein to form the isoparaffinic hydrocarbon base oil are zeolite catalysts, such as ZSM-5, ZSM-11, ZSM-23, ZSM-35, ZSM-12, ZSM-38, ZSM-48, offretite, ferrierite, zeolite beta, zeolite theta, zeolite alpha, as disclosed in USP 4,906,350. These catalysts are used in combination with Group VIII metals, in particular palladium or platinum. The Group VIII metals may be incorporated into the zeolite catalysts by conventional techniques, such as ion exchange.

[041] In one embodiment, conversion of the waxy feedstock may be conducted over a combination of Pt/zeolite beta and Pt/ZSM-23 catalysts in the presence of hydrogen. In another embodiment, the process of producing the

- 18 -

lubricant oil base stocks comprises hydroisomerization and dewaxing over a single catalyst, such as Pt/ZSM-35. In yet another embodiment, the way feed can be fed over Group VIII metal loaded ZSM-48, preferably Group VIII noble metal loaded ZSM-48, more preferably Pt/ZSM-48 in either one stage or two stages. In any case, useful hydrocarbon base oil products may be obtained. Catalyst ZSM-48 is described in USP 5,075,269. The use of the Group VIII metal loaded ZSM-48 family of catalysts in the isodewaxing of the waxy feedstock eliminates the need for any subsequent, separate dewaxing step, and is preferred.

[042] A dewaxing step, when needed, may be accomplished using either well known solvent or catalytic dewaxing processes and either the entire hydroisomerate or the 650-750°F+ fraction may be dewaxed, depending on the intended use of the 650-750°F- material present, if it has not been separated from the higher boiling material prior to the dewaxing. In solvent dewaxing, the hydroisomerate may be contacted with chilled solvents such as acetone, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), mixtures of MEK/MIBK, or mixtures of MEK/toluene and the like, and further chilled to precipitate out the higher pour point material as a waxy solid which is then separated from the solvent-containing lube oil fraction which is the raffinate. The raffinate is typically further chilled in scraped surface chillers to remove more wax solids. Low molecular weight hydrocarbons, such as propane, are also used for dewaxing, in which the hydroisomerate is mixed with liquid propane, a least a portion of which is flashed off to chill down the hydroisomerate to precipitate out the wax. The wax is separated from the raffinate by filtration, membrane separation or centrifugation. The solvent is then stripped out of the raffinate, which is then fractionated to produce the preferred base stocks useful in the present invention. Also well known is catalytic dewaxing, in which the hydroisomerate is reacted with hydrogen in the presence of a suitable dewaxing catalyst at conditions effective to lower the pour point of the hydroisomerate. Catalytic dewaxing also

- 19 -

converts a portion of the hydroisomerate to lower boiling materials, in the boiling range, for example, 650-750°F-, which are separated from the heavier 650-750°F+ base stock fraction and the base stock fraction fractionated into two or more base stocks. Separation of the lower boiling material may be accomplished either prior to or during fraction of the 650-750°F+ material into the desired base stocks.

[043] Any dewaxing catalyst which will reduce the pour point of the hydroisomerate and preferably those which provide a large yield of lube oil base stock from the hydroisomerate may be used. These include shape selective molecular sieves which, when combined with at least one catalytic metal component, have been demonstrated as useful for dewaxing petroleum oil fractions and include, for example, ferrierite, mordenite, ZSM-5, ZSM-11, ZSM-23, ZSM-35, ZSM-22 also known as theta one or TON, and the silicoaluminophosphates known as SAPO's. A dewaxing catalyst which has been found to be unexpectedly particularly effective comprises a noble metal, preferably Pt, composited with H-mordenite. The dewaxing may be accomplished with the catalyst in a fixed, fluid or slurry bed. Typical dewaxing conditions include a temperature in the range of from about 400-600°F, a pressure of 500-900 psig, H₂ treat rate of 1500-3500 SCF/B for flow-through reactors and LHSV of 0.1-10, preferably 0.2-2.0. The dewaxing is typically conducted to convert no more than 40 wt% and preferably no more than 30 wt% of the hydroisomerate having an initial boiling point in the range of 650-750°F to material boiling below its initial boiling point.

[044] GTL base stocks and base oils, hydroisomerized or isodewaxed wax-derived base stocks and base oils, have a beneficial kinematic viscosity advantage over conventional Group II and Group III base stocks and base oils, and so may be very advantageously used with the instant invention. Such GTL base stocks and base oils can have significantly higher kinematic viscosities, up

- 20 -

to about 20-50 cSt at 100°C, whereas by comparison commercial Group II base oils can have kinematic viscosities, up to about 15 cSt at 100°C, and commercial Group III base oils can have kinematic viscosities, up to about 10 cSt at 100°C. The higher kinematic viscosity range of GTL base stocks and base oils, compared to the more limited kinematic viscosity range of Group II and Group III base stocks and base oils, in combination with the instant invention can provide additional beneficial advantages in formulating lubricant compositions.

[045] In the present invention the hydroisomerate isodewaxate oil can constitute all or part of the base stock oil.

[046] One or more of these wax isomerate/isodewaxate base stocks and base oils can be used as such or in combination with the aforesaid GTL base stocks and base oils.

[047] One or more of these waxy feed derived base stocks and base oils, derived from GTL materials and/or other waxy feed materials can similarly be used as such or further in combination with other base stock and base oils of mineral oil origin, natural oils and/or with other synthetic base oils.

[048] The preferred base stocks or base oils derived from GTL materials and/or from waxy feeds are characterized as having predominantly paraffinic compositions and are further characterized as having high saturates levels, low-to-nil sulfur, low-to-nil nitrogen, low-to-nil aromatics, and are essentially water-white in color.

[049] Useful compositions of GTL base oils, hydroisomerized or isodewaxed Fischer-Tropsch wax derived base oils, and wax-derived hydroisomerized base oils are recited in U.S. Patents 6,080,301; 6,090,989, and 6,165,949 for example.

[050] Alkylene oxide polymers and interpolymers and their derivatives containing modified terminal hydroxyl groups obtained by, for example,

- 21 -

esterification or etherification are useful synthetic lubricating oils. By way of example, these oils may be obtained by polymerization of ethylene oxide or propylene oxide, the alkyl and aryl ethers of these polyoxyalkylene polymers (methyl-polyisopropylene glycol ether having an average molecular weight of about 1000, diphenyl ether of polyethylene glycol having a molecular weight of about 500-1000, and the diethyl ether of polypropylene glycol having a molecular weight of about 1000 to 1500, for example) or mono- and polycarboxylic esters thereof (the acidic acid esters, mixed C₃₋₈ fatty acid esters, or the C₁₃Oxo acid diester of tetraethylene glycol, for example).

[051] Esters comprise a useful base stock. Additive solvency and seal compatibility characteristics may be secured by the use of esters such as the esters of dibasic acids with monoalkanols and the polyol esters of monocarboxylic acids. Esters of the former type include, for example, the esters of dicarboxylic acids such as phthalic acid, succinic acid, alkyl succinic acid, alkenyl succinic acid, maleic acid, azelaic acid, suberic acid, sebacic acid, fumaric acid, adipic acid, linoleic acid dimer, malonic acid, alkyl malonic acid, alkenyl malonic acid, etc., with a variety of alcohols such as butyl alcohol, hexyl alcohol, dodecyl alcohol, 2-ethylhexyl alcohol, etc. Specific examples of these types of esters include dibutyl adipate, di(2-ethylhexyl) sebacate, di-n-hexyl fumarate, dioctyl sebacate, diisooctyl azelate, diisodecyl azelate, dioctyl phthalate, didecyl phthalate, dieicosyl sebacate, etc.

[052] Particularly useful synthetic esters are those which are obtained by reacting one or more polyhydric alcohols (preferably the hindered polyols such as the neopentyl polyols e.g. neopentyl glycol, trimethylol ethane, 2-methyl-2-propyl-1,3-propanediol, trimethylol propane, pentaerythritol and dipentaerythritol) with alkanoic acids containing at least about 4 carbon atoms (preferably C₅ to C₃₀ acids such as saturated straight chain fatty acids including caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, arachic

- 22 -

acid, and behenic acid, or the corresponding branched chain fatty acids or unsaturated fatty acids such as oleic acid).

[053] Suitable synthetic ester components include the esters of trimethylol propane, trimethylol butane, trimethylol ethane, pentaerythritol and/or dipentaerythritol with one or more monocarboxylic acids containing from about 5 to about 10 carbon atoms.

[054] Silicon-based oils are another class of useful synthetic lubricating oils. These oils include polyalkyl-, polyaryl-, polyalkoxy-, and polyaryloxy-siloxane oils and silicate oils. Examples of suitable silicon-based oils include tetraethyl silicate, tetraisopropyl silicate, tetra-(2-ethylhexyl)silicate, tetra-(4-methylhexyl)silicate, tetra-(p-tert-butylphenyl)silicate, hexyl-(4-methyl-2-pentoxo)disiloxane, poly(methyl)siloxanes, and poly-(methyl-2-methylphenyl)siloxanes.

[055] Another class of synthetic lubricating oil is esters of phosphorous-containing acids. These include, for example, tricresyl phosphate, trioctyl phosphate, diethyl ester of decanephosphonic acid.

[056] Another class of oils includes polymeric tetrahydrofurans, their derivatives, and the like.

[057] Other useful fluids of lubricating viscosity include non-conventional or unconventional base stocks that have been processed, preferably catalytically, or synthesized to provide high performance lubrication characteristics.

[058] In many cases it will be advantageous to employ only a GTL base stock such as one derived from waxy Fischer-Tropsch hydrocarbons for a particular wear resistant lubricant, while in other cases one or more additional base stocks may be mixed with, added to or blended with one or more of the GTL base stocks, e.g., Fischer-Tropsch derived base stocks. Such additional base stocks may be selected from the group consisting of (i) natural base stock, (ii) synthetic base stock, (iii) unconventional base stock and mixtures thereof.

- 23 -

[059] If a base stock blend is used it should contain at least 20 wt%, preferably at least 40 wt%, more preferably at least 60 wt%, most preferably at least 80 wt% of the GTL base stock or base oil, or slack wax or Fischer-Tropsch derived base stock, preferably Fischer-Tropsch derived base stock. As is readily apparent, any formulated oil utilizing such a blend while exhibiting performance superior to that secured when such other base stock is used exclusively will be inferior in performance to that achieved when GTL base stocks, Fischer-Tropsch derived base stock or mixture thereof is the only base stock employed.

[060] In the lubricating composition of the present invention the foregoing base stocks comprise a major amount of the lubricating composition.

[061] The lubricating composition of the present invention also includes an antiwear and load carrying additive combination comprising thiosalicylic acid and adenine. The weight ratio of thiosalicylic acid to adenine used in the additive typically is in the range of about 50:1 to 5:1, and preferably from 15:1 to 25:1. Preferably the additive combination may also include a phosphate ester or tricresyl phosphate load carrying additive. The weight ratio of the combined thiosalicylic acid and adenine to phosphate ester typically is in the range of about 1:1 to 1:50 and preferably 1:10 to 1:30. In another preferred embodiment, the antiwear and load carrying phosphate ester additive is a phosphate oligomer.

[062] The thiosalicylic acid and adenine combined additive is present in the lubricant in an effective amount. Typically they will comprise about 0.01 to about 1.0 wt%, and preferably from about 0.05 wt% to about 0.5 wt%, based on the total weight of the composition.

[063] When a phosphate ester load carrying additive such as tricresyl phosphate is employed the thiosalicylic acid, adenine and phosphate ester

- 24 -

additive will comprise about 0.01 wt% to about 5.0 wt% and preferably 0.5 wt% to 3.0 wt% of the lubricating composition.

[064] Other conventional additives which can be used in the lubricants of the invention include oxidation inhibitors, antifoam agents, viscosity index improvers, pour point depressants and the like. These include hindered phenols, alkylated diphenyl amines, benzotriazole derivatives, silicone oils and the like. In general these other additive will be used in total amounts ranging from about 0.5 wt% to about 15.0 wt%, based on the total weight of the lubricating composition.

EXAMPLES AND COMPARATIVE EXAMPLES

[065] Examples 1 to 5 and comparative examples 2 to 4 which follow illustrate a few specific compositions in greater detail. These consist of fully formulated lubricant AA, having a phosphate ester base stock and TCP except where noted in Table 1. Also, in Table 1 "TSA" refers to thiosalicylic acid and DVP 560 is an aromatic oligomer reaction product of Bisphenol A and phenol sold by Great Lakes Chemicals, West Lafayette, IN, antiwear and load carrying additive; lubricant BB, which had the same base stock and additives of lubricant AA except it did not contain tricresyl phosphate.

[066] The load carrying properties of these compositions were evaluated in the extreme pressure Four-Ball wear test according to the ASTM D 2783-88 procedure. In this test the last non-seizure load (LNSL) was measured to establish difference between the formulations. The formulations and results are given in Table 1.

- 25 -

TABLE 1

	Formulation	Additive	Amount of Additive, wt%	LNSL, kg
Comp. 1	AA	TCP	3.0	40
Comp. 2	BB	None	0.0	45
Example 1	BB	TSA & Adenine	0.1	85
Example 2	BB	TSA & Adenine (0.11%), TCP (0.9%)	1.0	90
Example 3	BB	TSA, Adenine (0.1%), TCP 1.9%)	2.0	100
Example 4	BB	TSA, Adenine (0.1%), TCP (2.9%)	3.0	105
Comp. 3	BB	DVP 506	0.5	45
Comp. 4	BB	DVP 506	3.0	50
Example 5	BB	TSA & Adenine (0.1%) and DVP 506 (0.4%)	0.5	110

[067] The TSA adenine system was further evaluated in the oxidation and corrosion test ASTM D 4636-86 at 425°C. The results are given in Table 2.

- 26 -

TABLE 2

Formulation	Example 2	Example 3	Example 4	Comp. 1
KV @ 40°C (cSt)				
Initial	26.78	26.78	25.72	25.85
Final	40.89	41.28	41.47	47.31
% Increase	52.69	54.14	61.24	83.02
Total Acid No. (mgKOH)				
Initial	0.29	0.28	0.30	0.13
Final	2.73	3.73	3.89	8.98
% Increase	2.44	3.45	3.59	8.85
Deposits				
Vapor	Light	Medium	Light	Light
Interface	Light	Light	Light	Nil
Liquid	Nil	Nil	Nil	Nil
Silver				
Initial Wt, g/cm ²	1.9236	1.8440	1.7924	2.0184
Final Weight	1.9232	1.8435	1.7920	2.0180
Weight Change	-0.00008	-0.0001	-0.00008	-0.00008
Aluminum				
Initial Weight	0.4997	0.4847	0.5092	0.5123
Final Weight	0.4996	0.4846	0.5091	0.5121
Weight Change	-0.00002	-0.00002	-0.00002	-0.00004
Steel				
Initial Weight	1.4183	1.4135	1.4212	1.3968
Final Weight	1.4184	1.4134	1.4213	1.3968
Weight Change	0.00002	-0.00002	0.00002	0.0000
Titanium				
Initial Weight	1.4760	1.4455	1.4809	1.4324
Final Weight	1.4758	1.4453	1.4807	1.4323
Weight Change	-0.00004	-0.00004	-0.00004	-0.00002
Entire Tube				
Initial Weight	929.60	896.60	918.10	926.45
Final Weight	917.60	886.00	906.95	913.90
Weight Change	-12.00	-10.60	-11.15	-12.55
MIL-23699F				
Ag	Pass	Pass	Pass	Pass
Al	Pass	Pass	Pass	Pass
Fe	Pass	Pass	Pass	Pass
Ti	Pass	Pass	Pass	Pass
Sludge	Pass	Pass	Pass	Pass

[068] Examples 6 to 8 and comparative examples 5 and 6 further illustrate the advantages of the present invention. In these instances formulation CC refers to a fully formulated lubricant comprising a gas to liquid base oil and including the additive TCP (comparative examples) or the TCP and additive combination of TSA and adenine (the examples) in the amounts shown in Table 3. The load carrying properties of these compositions were evaluated in the extreme pressure Four-Ball Wear test according to the ASTM D 2783-88 procedure. In this test the last non-seizure load (LNSL) was measured to establish the differences between the formulations. The formulations and results are given in Table 3.

TABLE 3

	<u>Formulation</u>	<u>Additive</u>	<u>Additive wt%</u>	<u>LNSL, Kg</u>
Comp 5	CC	TCP	0.5	60
Comp 6	CC	TCP	3.0	60
Example 6	CC	TCP	0.5	
		TSA	0.05	
		Adenine	---	126
Example 7	CC	TCP	0.5	
		TSA	0.1	
		Adenine	---	126
Example 8	CC	TCP	0.5	
		TSA	0.5	
		Adenine	---	160

- 28 -

CLAIMS:

1. A lubricating composition having enhanced load carrying properties comprising:
 - (a) a major amount of an oil of lubricating viscosity selected from the group consisting of phosphate ester base oils and gas to liquid base oils, and
 - (b) an amount of additives comprising a combination of thiosalicylic acid and adenine wherein the weight ratio of thiosalicylic acid to adenine is in the range of 5:1 to 50:1; and wherein the combined thiosalicylic acid and adenine comprises 0.01 wt% to 1.0 wt% based on the total weight of the composition.
2. The composition of claim 1 wherein the additives further comprise a phosphate ester antiwear and load carrying additive.
3. The composition of claim 2 wherein the antiwear and load carrying phosphate ester additive is tricresyl phosphate.
4. The composition of claim 2 wherein the antiwear and load carrying phosphate ester additive is a phosphate oligomer.
5. The composition of claim 2 wherein the combination further comprising said phosphate ester antiwear and load carrying additive comprises from 0.1 to 5.0 wt% of the total lubricating composition.
6. The composition of claim 3 wherein the weight ratio of the combined thiosalicylic acid and adenine to tricresyl phosphate is in the range of about 1:1 to about 1:50.
7. The composition of any one of claims 1 to 3 wherein the oil of lubricating viscosity is a gas to liquid base oil.

- 29 -

8. The composition of claim 1 or 4 wherein the oil of lubricating viscosity is a phosphate ester base oil.

9. A lubricating oil additive for enhancing the antiwear and load carrying properties of a base oil, the additive comprising thiosalicylic acid and adenine in the weight ratio of 50:1 to 5:1.

10. The additive of claim 9 comprising an antiwear and load carrying phosphate ester additive wherein the weight ratio of the combined thiosalicylic acid and adenine to phosphate ester additive is in the range of 1:1 to 1:50.

11. The additive of claim 10 wherein the phosphate ester is tricresyl phosphate.

12. The additive of claim 10 wherein the phosphate ester is a phosphate oligomer.

13. A method for enhancing the antiwear and load carrying performance of a lubricating oil comprising adding from 0.5 to 15 wt% of the additive defined in any one of claims 10 to 12 to an oil of lubricating viscosity selected from the group consisting of phosphate ester base oils and gas to liquid base oils.