

Description

This invention relates to oleaginous liquid compositions useful as automatic transmission fluids of enhanced performance capabilities, and to additive concentrates useful in forming such compositions.

5 Traditionally, oleaginous liquids such as in particular automatic transmission fluids, have contained significant quantities of metal-containing ingredients, typically zinc dihydrocarbyl dithiophosphates and/or alkali or alkaline earth metal-containing detergents. Because of environmental and performance concerns, it is desirable to reduce or eliminate such ingredients. However, to do so requires use of non-metallic additives which contribute the necessary properties to the base oil.

10 Another goal desired in practice is the development of oleaginous liquid compositions based on use of synthetic base oils rather than mineral oils. However the development of such fluids necessitates the discovery of compositions having suitable viscosities at low temperatures and at high temperatures. In addition, it is desirable to provide an oleaginous liquid composition which possesses high shear stability.

This invention provides, *inter alia*, oleaginous liquid compositions useful as automatic transmission 15 fluids which are devoid or essentially devoid of metal-containing components such as additives containing lithium, sodium, potassium, magnesium, calcium, strontium, barium or zinc. By "essentially devoid" is meant that the overall composition contains on a weight basis no more than about 100 parts per million of such metals. The compositions of this invention do contain one or more components containing phosphorus or a combination of boron and phosphorus, which elements of course are not classified as metals.

20 Further, this invention provides oleaginous liquid compositions wherein the base oils are composed predominantly or entirely of particular synthetic lubricants. These oleaginous fluid compositions have good low temperature and high temperature viscosity properties and possess high shear stability.

This invention comprises an additive concentrate for use in preparing an automatic transmission fluid comprising at least the following:

25 A. hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 40 to 120 mm².s⁻¹ at 100 °C;

B. antiwear/extreme pressure agent selected from phosphorus-containing ashless dispersant, and phosphorus- and boron-containing ashless dispersant; and

C. friction modifier,

30 said concentrate being characterized by (i) being devoid or essentially devoid of metal-containing components, (ii) enabling hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm².s⁻¹ at 100 °C to have (a) a kinematic viscosity of at least 5.5 mm².s⁻¹ at 100 °C and a Brookfield viscosity of less than 20,000 mPa.s at -40 °C, or (b) a kinematic viscosity of at least 6.8 mm².s⁻¹ at 100 °C and a Brookfield viscosity of less than 50,000 mPa.s at -40 °C, when said concentrate is blended in such 35 hydrogenated poly- α -olefin oligomer fluid at at least one concentration below 10 percent by weight, and (iii) containing an amount of friction modifier such that an automatic transmission fluid formed therefrom contains 0.05 to 1 percent by weight of the friction modifier. Most preferred are compositions of this type enabling hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm².s⁻¹ at 100 °C to have a kinematic viscosity of at least 6.8 mm².s⁻¹ at 100 °C and a Brookfield viscosity of less 40 than 20,000 mPa.s at -40 °C.

An additional embodiment of this invention is an automatic transmission fluid comprising at least one oil of lubricating viscosity containing up to 10% by weight of a concentrate as defined above. It will be understood and appreciated that, although preferably employed in oleaginous liquids consisting essentially of hydrogenated poly- α -olefin oligomer fluid where the additive-free fluid has a viscosity in the range of 2 to 45 10 mm².s⁻¹ at 100 °C, such additive concentrates can be used in other base oils.

Among the other features of this invention is the fact that preferred compositions of this invention can achieve the foregoing viscosity parameters without use of conventional high molecular weight polymeric viscosity index improvers such as the methacrylates, acrylates, styrene copolymers, ethylene-propylene copolymers, and the like. Thus among the preferred embodiments of this invention are oleaginous liquid 50 compositions of the various types described above which are devoid of such polymeric viscosity index improvers or which contain at most up to but no more than about 10 percent by weight of one or more such polymeric viscosity index improvers.

Another feature of this invention is that it is possible to provide oleaginous liquids which have exceptionally high shear stability. This is accomplished by minimizing the amount, 55 if any, of the high molecular weight polymeric viscosity index improver(s) present in the oleaginous liquid. Thus from the standpoint of shear stability, the lower the concentration of high molecular weight polymeric viscosity index improver, the better, and therefore, compositions that are substantially devoid of such viscosity index improver are preferred, and compositions that are completely devoid of such viscosity index

improver are most preferred.

These and other embodiments and features of this invention will become still further apparent from the ensuing description and appended claims.

5 Base Oils

As noted above, the oleaginous liquids of this invention are compounded from base oils or fluids composed predominantly (i.e., more than 50 percent by volume) or entirely of hydrogenated poly- α -olefin oligomer fluid having a viscosity at 100°C in the range of 2 to 10 mm²·s⁻¹. Such fluids are formed by
10 oligomerization of 1-alkene hydrocarbon having 6 to 20 and preferably 8 to 16 carbon atoms in the molecule and hydrogenation of the resultant oligomer. Hydrogenated oligomers formed from 1-decene are particularly preferred.

Methods for the production of such liquid oligomeric 1-alkene hydrocarbons are known and reported in the literature. See for example U. S. Pat. Nos. 3,763,244; 3,780,128; 4,172,855; 4,218,330; and 4,950,822.
15 Additionally, hydrogenated 1-alkene oligomers of this type are available as articles of commerce, for example, under the trade designations HITEC® 162, HITEC® 164, HITEC® 166, HITEC® 168 and HITEC® 170 poly- α -olefin oils (Ethyl Corporation; Ethyl Petroleum Additives, Inc.; Ethyl Petroleum Additives, Ltd.). Tabulated below are data concerning typical composition and properties of these products. In these tabulations the typical compositions are expressed in terms of normalized area percentages by GC and
20 "n.d." means "not determined".

HITEC 162 poly- α -olefin oil:

Composition - Monomer 0.4, Dimer 90.7, Trimer 8.3, Tetramer 0.6.

25 Properties - Viscosity at 100°C: 1.80 mm²·s⁻¹; Viscosity at 40°C: 5.54 mm²·s⁻¹;
Viscosity at -18°C: n.d.; Viscosity at -40°C: 306 mm²·s⁻¹; Pour point: - 63°C;
Flash point (ASTM D 92): 165°C; NOACK volatility: 99%.

HITEC 164 poly- α -olefin oil:

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Composition - Trimer 82.7, Tetramer 14.6, Pentamer 2.7.

Properties - Viscosity at 100°C: 4.06 mm²·s⁻¹; Viscosity at 40°C: 17.4 mm²·s⁻¹;
Viscosity at -18°C: n.d.; Viscosity at -40°C: 2490 mm²·s⁻¹; Pour point: < -65°C; Flash point (ASTM D
92): 224°C; NOACK volatility: 12.9%.

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HITEC 166 poly- α -olefin oil:

Composition - Trimer 32.0, Tetramer 43.4, Pentamer 21.6, Hexamer 3.0.

40 Properties - Viscosity at 100°C: 5.91 mm²·s⁻¹; Viscosity at 40°C: 31.4 mm²·s⁻¹;
Viscosity at -18°C: n.d.; Viscosity at -40°C: 7877 mm²·s⁻¹; Pour point: - 63°C;
Flash point (ASTM D 92): 235°C; NOACK volatility: 7.5%.

HITEC 168 poly- α -olefin oil:

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Composition - Trimer 4.3, Tetramer 56.3, Pentamer 33.9, Hexamer 5.5.

Properties - Viscosity at 100°C: 7.78 mm²·s⁻¹; Viscosity at 40°C: 46.7 mm²·s⁻¹;
Viscosity at -18°C: n.d.; Viscosity at -40°C: 18305 mm²·s⁻¹; Pour point: - 60°C;
Flash point (ASTM D 92): 254°C; NOACK volatility: 3.5%.

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HITEC 170 poly- α -olefin oil:

Composition - Dimer 0.1, Trimer 1.1, Tetramer 42.5, Pentamer 32.3, Hexamer 11.8, Heptamer 12.2.

55 Properties - Viscosity at 100°C: 9.87 mm²·s⁻¹; Viscosity at 40°C: 64.5 mm²·s⁻¹;
Viscosity at -18°C: 2770.; Viscosity at -40°C: n.d.; Pour point: -54°C; Flash point (ASTM D 92):
268°C; NOACK volatility: 1.7%.

Suitable 1-alkene oligomers are also available from other suppliers. As is well known, hydrogenated oligomers of this type contain little, if any, residual ethylenic unsaturation. Preferred oligomers are formed by use of a Friedel-Crafts catalyst (especially boron trifluoride promoted with water or a C₁₋₂₀ alkanol)

followed by catalytic hydrogenation of the oligomer so formed using procedures such as are described in the foregoing U.S. patents.

Other catalyst systems which can be used to form oligomers of 1-alkene hydrocarbons, which, on hydrogenation, provide suitable oleaginous liquids include Ziegler catalysts such as ethyl aluminum sesquichloride with titanium tetrachloride, aluminum alkyl catalysts, chromium oxide catalysts on silica or alumina supports and a system in which a boron trifluoride catalyst oligomerization is followed by treatment with an organic peroxide.

Mixtures or blends of such 1-alkene oligomers can also be used in the practice of this invention provided the overall blend possesses the requisite viscosity characteristics as specified above. Typical examples of suitable blends of hydrogenated 1-decene oligomers include the following blends in which the typical compositions are expressed in terms of normalized area percentages by GC and wherein "n.d." means "not determined".

75/25 Blend of HITEC 162 and HITEC 164 poly- α -olefin oils:

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Composition - Monomer 0.3, Dimer 66.8, Trimer 27.3, Tetramer 4.8, Pentamer 0.8.

Properties - Viscosity at 100 °C: 2.19 mm²·s⁻¹; Viscosity at 40 °C: 7.05 mm²·s⁻¹;

Viscosity at -18 °C: 84.4 mm²·s⁻¹; Viscosity at -40 °C: 464 mm²·s⁻¹; Pour point: <-65 °C; Flash point (ASTM D 92): 166 °C; NOACK volatility: 78.2%.

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50/50 Blend of HITEC 162 and HITEC 164 poly- α -olefin oils:

Composition - Monomer 0.2, Dimer 44.7, Trimer 45.9, Tetramer 7.6, Pentamer 1.3, Hexamer 0.3.

Properties - Viscosity at 100 °C: 2.59 mm²·s⁻¹; Viscosity at 40 °C: 9.36 mm²·s⁻¹;

25 Viscosity at -18 °C: 133 mm²·s⁻¹; Viscosity at -40 °C: 792 mm²·s⁻¹; Pour point: <-65 °C; Flash point (ASTM D 92): 168 °C; NOACK volatility: 57.4%.

25/75 Blend of HITEC 162 and HITEC 164 poly- α -olefin oils:

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Composition - Monomer 0.1, Dimer 23.1, Trimer 62.7, Tetramer 11.5, Pentamer 2.1, Hexamer 0.5.

Properties - Viscosity at 100 °C: 3.23 mm²·s⁻¹; Viscosity at 40 °C: 12.6 mm²·s⁻¹;

Viscosity at -18 °C: 214 mm²·s⁻¹; Viscosity at -40 °C: 1410 mm²·s⁻¹; Pour point: <-65 °C; Flash point (ASTM D 92): 190 °C; NOACK volatility: 30.8%.

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95/05 Blend of HITEC 164 and HITEC 166 poly- α -olefin oils:

Composition - Dimer 0.5, Trimer 78.4, Tetramer 15.6, Pentamer 3.7, Hexamer 1.8.

Properties - Viscosity at 100 °C: 4.15 mm²·s⁻¹; Viscosity at 40 °C: 17.9 mm²·s⁻¹;

Viscosity at -18 °C: n.d.; Viscosity at -40 °C: 2760 mm²·s⁻¹; Pour point: <-65 °C;

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Flash point (ASTM D 92): 225 °C; NOACK volatility: 10.5%.

90/10 Blend of HITEC 164 and HITEC 166 poly- α -olefin oils:

Composition - Dimer 0.3, Trimer 76.0, Tetramer 17.0, Pentamer 4.7, Hexamer 2.0.

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Properties - Viscosity at 100 °C: 4.23 mm²·s⁻¹; Viscosity at 40 °C: 18.4 mm²·s⁻¹;

Viscosity at -18 °C: n.d.; Viscosity at -40 °C: 2980 mm²·s⁻¹; Pour point: <-65 °C;

Flash point (ASTM D 92): 228 °C; NOACK volatility: 11.4%.

80/20 Blend of HITEC 164 and HITEC 166 poly- α -olefin oils:

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Composition - Dimer 0.3, Trimer 71.5, Tetramer 19.4, Pentamer 6.5, Hexamer 2.3.

Properties - Viscosity at 100 °C: 4.39 mm²·s⁻¹; Viscosity at 40 °C: 19.9 mm²·s⁻¹;

Viscosity at -18 °C: n.d.; Viscosity at -40 °C: 3240 mm²·s⁻¹; Pour point: <-65 °C;

Flash point (ASTM D 92): 227 °C; NOACK volatility: 9.2%.

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75/25 Blend of HITEC 164 and HITEC 166 poly- α -olefin oils:Composition - Dimer 0.7, Trimer 69.0, Tetramer 21.0, Pentamer 7.3, Hexamer 2.0.Properties - Viscosity at 100 °C: 4.39 mm²·s⁻¹; Viscosity at 40 °C: 20.1 mm²·s⁻¹;5 Viscosity at -18 °C: 436 mm²·s⁻¹; Viscosity at -40 °C: 3380 mm²·s⁻¹; Pour point: <-65 °C; Flash point (ASTM D 92): 226 °C; NOACK volatility: 14.2%.50/50 Blend of HITEC 164 and HITEC 166 poly- α -olefin oils:10 Composition - Dimer 0.4, Trimer 57.3, Tetramer 27.4, Pentamer 11.8, Hexamer 3.1.Properties - Viscosity at 100 °C: 4.82 mm²·s⁻¹; Viscosity at 40 °C: 23.0 mm²·s⁻¹;Viscosity at -18 °C: 544 mm²·s⁻¹; Viscosity at -40 °C: 4490 mm²·s⁻¹; Pour point: <-65 °C; Flash point (ASTM D 92): 226 °C; NOACK volatility: 12.5%.15 25/75 Blend of HITEC 164 and HITEC 166 poly- α -olefin oils:Composition - Dimer 0.3, Trimer 45.3, Tetramer 33.4, Pentamer 16.4, Hexamer 4.6.Properties - Viscosity at 100 °C: 5.38 mm²·s⁻¹; Viscosity at 40 °C: 26.8 mm²·s⁻¹;20 Viscosity at -18 °C: 690 mm²·s⁻¹; Viscosity at -40 °C: 6020 mm²·s⁻¹; Pour point: <-65 °C; Flash point (ASTM D 92): 250 °C; NOACK volatility: 9.2%.75/25 Blend of HITEC 166 and HITEC 168 poly- α -olefin oils:25 Composition - Dimer 0.4, Trimer 28.4, Tetramer 42.0, Pentamer 22.9, Hexamer 6.3.Properties - Viscosity at 100 °C: 6.21 mm²·s⁻¹; Viscosity at 40 °C: 33.7 mm²·s⁻¹;Viscosity at -18 °C: 1070 mm²·s⁻¹; Viscosity at -40 °C: 9570 mm²·s⁻¹; Pour point: <-65 °C; Flash point (ASTM D 92): 242 °C; NOACK volatility: 6.8%.50/50 Blend of HITEC 166 and HITEC 168 poly- α -olefin oils:30 Composition - Trimer 20.4, Tetramer 45.4, Pentamer 26.5, Hexamer 7.7.Properties - Viscosity at 100 °C: 6.79 mm²·s⁻¹; Viscosity at 40 °C: 38.1 mm²·s⁻¹;Viscosity at -18 °C: 1180 mm²·s⁻¹; Viscosity at -40 °C: 12200 mm²·s⁻¹; Pour point: <-65 °C; Flash point (ASTM D 92): 244 °C; NOACK volatility: 6.0%.35 25/75 Blend of HITEC 166 and HITEC 168 poly- α -olefin oils:Composition - Dimer 0.2, Trimer 13.8, Tetramer 48.0, Pentamer 29.2, Hexamer 8.8.Properties - Viscosity at 100 °C: 7.27 mm²·s⁻¹; Viscosity at 40 °C: 42.2 mm²·s⁻¹;40 Viscosity at -18 °C: 1410 mm²·s⁻¹; Viscosity at -40 °C: 15300 mm²·s⁻¹; Pour point: -60 °C; Flash point (ASTM D 92): 248 °C; NOACK volatility: 4.3%.

It is also possible in accordance with this invention to utilize blends of one or more liquid hydrogenated 1-alkene oligomers in combination with other oleaginous materials having suitable viscosities, provided that the resultant blend contains a major proportion of hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm²·s⁻¹ at 100 °C. and possesses the requisite compatibility, stability and performance criteria for the use for which the blend is designed, formulated, and provided.

Illustrative non-oligomeric oils and fluids of lubricating viscosity which can be used include synthetic esters such as mixed C₉ and C₁₁ dialkylphthalates (e.g., ICI Emkarate 911P ester oil), trimethylol propane trioleate, di-(isotridecyl)-adipate (e.g., BASF Glissofluid A13), pentaerythritol tetraheptanoate and the like; 50 and liquid natural fatty oils and esters such as castor oil, olive oil, peanut oil, rapeseed oil, corn oil, sesame oil, cottonseed oil, soybean oil, sunflower oil, safflower oil, hemp oil, linseed oil, tung oil, oiticica oil, jojoba oil, and the like. Such oils may be partially or fully hydrogenated, if desired. The only requirement is that the resultant blend have the requisite properties for the intended use or uses therefor.

It is also possible to include small amounts of mineral oils, commercially available aromatic hydrocarbon mixtures, and/or oleaginous trihydrocarbyl phosphates in blends with one or more linear 1-alkene hydrocarbon oligomers of suitable viscosity, and such blends may in turn contain one or more other base 55 oils (e.g., a synthetic ester, polyalkylene glycol, or natural fatty oil or ester).

Component A

This component is a hydrogenated poly- α -olefin base oil having a viscosity in the range of 40 to 120 $\text{mm}^2\cdot\text{s}^{-1}$ at 100°C. Such "PAO" fluids can be synthesized by the same general methods referred to above in connection with the base oils. PAO fluids derived from 1-decene are most preferred. A number of PAO fluids are available as articles of commerce from various suppliers. Typical materials of this type include:

HITEC 174 poly- α -olefin oil:

Properties - Viscosity at 100°C: 40.0 $\text{mm}^2\cdot\text{s}^{-1}$; Viscosity at 40°C: 403 $\text{mm}^2\cdot\text{s}^{-1}$; Viscosity at -18°C: 40200.; Viscosity at -40°C: Solid; Pour point: -36°C; Flash point (ASTM D 92): 272°C; NOACK volatility: 0.8%.

HITEC 180 poly- α -olefin oil:

Properties - Viscosity at 100°C: 110 $\text{mm}^2\cdot\text{s}^{-1}$; Viscosity at 40°C: 13.90 $\text{mm}^2\cdot\text{s}^{-1}$; Viscosity at -18°C: 203000; Viscosity at -40°C: solid; Pour point: -21°C; Flash point (ASTM D 92): 288°C; NOACK volatility: 0.6%.

These products are available from Ethyl Corporation and/or its affiliates, Ethyl Petroleum Additives, Inc. and Ethyl Petroleum Additives, Ltd. Blends having viscosities between 40 $\text{mm}^2\cdot\text{s}^{-1}$ and 110 $\text{mm}^2\cdot\text{s}^{-1}$ at 100°C can be readily formed by blending HITEC 174 oil and HITEC 180 oil in appropriate proportions.

Component B

The antiwear/extreme pressure agents used in the practice of this invention are ashless dispersants which contain phosphorus or phosphorus and boron. The ashless dispersant can be of various types including succinimides, succinamides, succinic esters, succinic ester-amides, Mannich products, long chain hydrocarbyl amines, and polyol esters. of these, the succinimides are preferred for use in the practice of this invention.

Methods for the production of the foregoing types of ashless dispersants are well known to those skilled in the art and are extensively reported in the patent literature. Likewise methods for introducing phosphorus or a combination of phosphorus and boron into such ashless dispersants are likewise known to those skilled in the art and reported in the patent literature. For example, the synthesis of various ashless dispersants of the foregoing types is described in such patents as U.S. 2,459,112; 2,962,442; 2,984,550; 3,036,003; 3,166,516; 3,172,892; 3,184,474; 3,202,678; 3,215,707; 3,216,936; 3,219,666; 3,254,025; 3,272,746; 3,275,554; 3,311,558; 3,316,177; 3,331,776; 3,340,281; 3,341,542; 3,368,972; 3,381,022; 3,399,141; 3,413,347; 3,415,750; 3,433,744; 3,438,757; 3,442,808; 3,444,170; 3,448,047; 3,448,048; 3,448,049; 3,451,933; 3,454,555; 3,454,607; 3,459,661; 3,461,172; 3,467,668; 3,493,520; 3,501,405; 3,522,179; 3,539,633; 3,541,012; 3,542,680; 3,558,743; 3,565,804; 3,567,637; 3,574,101; 3,576,743; 3,591,598; 3,600,372; 3,630,904; 3,632,510; 3,632,511; 3,634,515; 3,649,229; 3,697,428; 3,725,277; 3,725,441; 3,725,480; 3,726,882; 3,736,357; 3,793,202; 3,798,165; 3,798,247; 3,803,039; 3,804,763; 3,836,471; 3,862,981; 3,936,480; 3,948,800; 3,950,341; 3,957,854; 3,957,855; 3,980,569; 3,991,098; 4,071,548; 4,173,540; and 4,234,435.

The preferred ashless dispersants for use in forming phosphorus-containing ashless dispersants or ashless dispersants containing both phosphorus and boron are one or more alkenyl succinimides of an amine having at least one primary amino group capable of forming an imide group. The alkenyl succinimides may be formed by conventional methods such as by heating an alkenyl succinic anhydride, acid, acid-ester, acid halide, or lower alkyl ester with an amine containing at least one primary amino group. The alkenyl succinic anhydride may be made readily by heating a mixture of olefin and maleic anhydride to 180°-220°C. The olefin is preferably a polymer or copolymer of a lower monoolefin such as ethylene, propylene, isobutene and the like. The more preferred source of alkenyl group is from polyisobutene having a molecular weight up to 10,000 or higher. In a still more preferred embodiment the alkenyl group is a polyisobutene group having a number average molecular weight of 500-5,000, and preferably 900-2,000, especially 900-1,300.

Amines which may be employed in forming the ashless dispersant include any that have at least one primary amino group which can react to form an imide group and at least one additional primary or secondary amino group and/or at least one hydroxyl group. A few representative examples are: N-methyl-propanediamine, N-dodecyl-propanediamine, N-aminopropyl-piperazine, ethanolamine, and N-ethanol-

ethylenediamine.

Preferred amines are the alkylene polyamines such as propylene diamine, dipropylene triamine, di-(1,2-butylene)triamine, and tetra-(1,2-propylene)pentamine.

The most preferred amines are the ethylene polyamines which can be depicted by the formula



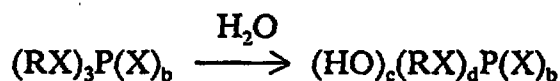
wherein n is an integer from one to ten. These include: ethylene diamine, diethylene triamine, triethylene tetramine, tetraethylene pentamine, pentaethylene hexamine, and the like, including mixtures thereof in which case n is the average value of the mixture. These ethylene polyamines have a primary amine group at each end so can form mono-alkenylsuccinimides and bis-alkenylsuccinimides. Commercially available ethylene polyamine mixtures usually contain minor amounts of branched species and cyclic species such as N-aminoethyl piperazine, N,N'-bis(aminoethyl)piperazine, N,N'-bis(piperazinyl)ethane, and like compounds. The preferred commercial mixtures have approximate overall compositions falling in the range corresponding to diethylene triamine to tetraethylene pentamine, mixtures generally corresponding in overall makeup to tetraethylene pentamine being most preferred.

Thus especially preferred ashless dispersants for use in the present invention are the products of reaction of a polyethylene polyamine, e.g. triethylene tetramine or tetraethylene pentamine, with a hydrocarbon substituted carboxylic acid or anhydride made by reaction of a polyolefin, preferably polyisobutene, having a number average molecular weight of 500 to 5,000, preferably 900 to 2,000 and especially 900 to 1,300, with an unsaturated polycarboxylic acid or anhydride, e.g., maleic anhydride, maleic acid, or fumaric acid including mixtures of two or more such substances.

Methods suitable for introducing phosphorus or a combination of phosphorus and boron into ashless dispersants are likewise known and reported in the patent literature. See for example such patents as U.S. 3,184,411; 3,185,645; 3,235,497; 3,265,618; 3,324,032; 3,403,102; 3,502,677; 3,511,780; 3,513,093; 3,623,985; 3,865,740; 3,950,341; 3,991,056; 4,097,389; 4,338,205; 4,428,849; 4,615,826; 4,634,543; 4,648,980; 4,747,971 and 4,857,214. The procedures described in U.S. 4,857,214 are especially preferred for use in forming component B of the compositions of this invention.

Accordingly, one preferred group of phosphorus-containing or phosphorus and boron-containing ashless dispersants comprises aliphatic hydrocarbyl-substituted succinimide of a mixture of cyclic and acyclic polyethylene polyamines having an approximate average overall composition falling in the range of from diethylene triamine through pentaethylene hexamine, said succinimide being heated with (1) at least one phosphorylating agent to form a phosphorus-containing succinimide ashless dispersant; or (2) either concurrently or in any sequence with at least one phosphorylating agent and at least one boronating agent to form a phosphorus- and boron-containing succinimide ashless dispersant. Particularly preferred ashless dispersants for use as component B are aliphatic hydrocarbyl-substituted succinimides of the type just described which have been heated concurrently or in any sequence with a boron compound such as a boron acid, boron ester, boron oxide, or the like (preferably boric acid) and an inorganic phosphorus acid or anhydride (preferably phosphorous acid, H_3PO_3) or a partial or total sulfur analog thereof to form an oil-soluble product containing both boron and phosphorus.

Combinations of boronated succinimides and phosphorus-containing esters, especially combinations of this type which have been subjected to temperatures of at least about 40°C during blending or formulation operations, are also suitable for use in the practice of this invention. Typical phosphorus-containing esters which may be used in such combinations include trihydrocarbyl phosphates, trihydrocarbyl phosphites, dihydrocarbyl phosphates, dihydrocarbyl phosphonates or dihydrocarbyl phosphites or mixtures thereof, monohydrocarbyl phosphates, monohydrocarbyl phosphites, sulfur-containing analogs of any of the foregoing compounds, and mixtures of any two or more of the foregoing. Dihydrocarbyl and trihydrocarbyl sulfur-containing analogs can be formed in situ by reaction between active sulfur-containing components and dihydrocarbyl phosphites, trihydrocarbyl phosphites, sulfur analogs of such phosphites, or mixtures of any two or more of such phosphites or di- and trithiophosphites. As is well known, O-hydrocarbyl, O,O-dihydrocarbyl, in situ by hydrolyzing O,O,O-trihydrocarbyl, O,O,S-trihydrocarbyl, O,S,S-trihydrocarbyl, and/or S,S,S-trihydrocarbyl phosphates or thiophosphates. Such hydrolytic reactions may be depicted as follows:



where each X is, independently, an oxygen atom or a sulfur atom, b is 0 or 1, and c and d are numbers such that c is less than 3 and the sum of c and d is 3. In the case of mixtures, b or c and d or b, c, and d represent average values, and can be fractional numbers whereby b can be 0 or 1 or any fractional number between 0 and 1 (e.g. as when hydrolyzing a mixture of trihydrocarbyl phosphite and trihydrocarbyl phosphate) and c and d can be fractional or whole numbers totaling 3. Similarly, in situ hydrolysis of O,O-dihydrocarbyl, O,S-dihydrocarbyl, and/or S,S-dihydrocarbyl ester-acids results in formation of O-hydrocarbyl, and/or S-hydrocarbyl ester-acids. Any such phosphorus acid-ester can be present in the form of a salt or adduct with one or more amines -- including the amine moieties in basic nitrogen-containing succinimides, or basic nitrogen-containing boronated succinimides -- and/or other substituted basic nitrogen-containing compounds if present in the system, such as alkanol amines, ether amines, triazines, and the like.

Thus, in one of its embodiments, this invention provides compositions which contain a phosphorus-containing succinimide and/or a phosphorus- and boron-containing succinimide, together with at least one phosphorus-containing substance selected from (1) one or more inorganic acids of phosphorus; or (2) one or more inorganic thioacids of phosphorus; or (3) one or more monohydrocarbyl esters of one or more inorganic acids of phosphorus; or (4) one or more monohydrocarbyl esters of one or more inorganic thioacids of phosphorus; or (5) any combination of any two, or any three or all four of (1), (2), (3), and (4); or at least one oil-soluble amine salt or complex or adduct of any of (1), (2), (3), (4), and (5), said amine optionally being in whole or in part an amine moiety in (i) a basic nitrogen-containing succinimide or (ii) a phosphorus- and basic nitrogen-containing succinimide or (iii) a phosphorus-, boron- and basic nitrogen-containing succinimide.

Friction Modifier

The compositions of this invention contain friction modifiers such 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 or aliphatic thiophosphates, wherein the aliphatic group usually contains above about 8 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.

Other Components

In accordance with conventional practice, various other known components can be employed in the foregoing compositions in order to partake of the properties engendered by use of such known additives. It is contemplated that any known additive can be included so long as (a) it is compatible with and soluble in the finished oleaginous liquid composition, (b) it does not contribute to the presence of more than 100 ppm of metal in the finished oleaginous liquid composition, and (c) it does not cause the finished oleaginous liquid composition to have viscosity characteristics other than (i) a kinematic viscosity of at least 5.5 mm²·s⁻¹ at 100 °C and a Brookfield viscosity of less than 20,000 mPa·s at -40 °C; or (ii) a kinematic viscosity of at least 6.8 mm²·s⁻¹ at 100 °C and a Brookfield viscosity of less than 50,000 mPa·s at -40 °C.

Described below are illustrative examples of the types of conventional additives that may be employed in the compositions of this invention.

In accordance with known practice, additives may be introduced into the compositions of this invention in order to improve the seal performance (elastomer compatibility) of the compositions. Known materials of this type include dialkyl diesters such as dioctyl sebacate, aromatic hydrocarbons of suitable viscosity such as Panasol AN-3N, products such as Lubrizol 730, polyol esters such as Emery 2935, 2936, and 2939 esters from the Emery Group of Henkel Corporation and Hatcol 2352, 2962, 2925, 2938, 2939, 2970, 3178, and 4322 polyol esters from Hatco Corporation. 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) can 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 additive compositions and oleaginous liquid compositions of this invention can also contain antioxidant, e.g., one or more phenolic antioxidants, aromatic amine antioxidants, sulphurised phenolic antioxidants, and organic phosphites, among others. Examples 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-butyl-

phenol), 2,2'-methylenebis(4-methyl-6-tert-butylphenol), mixed methylene-bridged polyalkyl phenols, 4,4'-thiobis(2-methyl-6-tert-butylphenol), N,N'-di-sec-butyl-p-phenylenediamine, 4-isopropylaminodiphenyl amine, phenyl- α -naphthyl amine, and phenyl- β -naphthyl amine.

Corrosion inhibitors comprise another type of optional additive for use in this invention. Thus use can be made of dimer and trimer acids, such as are produced from tall oil fatty acids, oleic acid, linoleic acid, or the like. Products of this type are currently available from various commercial sources, such as, for example, the dimer and trimer acids sold under the HYSTRENE trademark by the Humco Chemical Division of Witco Chemical Corporation and under the EMPOL trademark by Emery Chemicals. Another useful type of corrosion inhibitor for use in the practice of this invention are 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 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 well known to those skilled in the art and a number of such materials are available as articles of commerce.

Foam inhibitors are likewise suitable for use as optional components in the compositions of this invention. These include silicones, polyacrylates, surfactants, and the like.

Copper corrosion inhibitors constitute another class of additives suitable for inclusion in the compositions of this invention. 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. The preferred compounds are the 1,3,4-thiadiazoles, a number of which are available as articles of commerce. Such compounds 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.

Metal-containing detergents such as calcium phenates, magnesium phenates, calcium sulfonates or magnesium sulfonates can also be used. However, as noted above, if an oil-soluble phenate or sulfonate is used it should be proportioned such that the finished fluid contains no more than about 100 ppm of metal.

Still other components useful in the compositions of this invention are lubricity agents such as sulfurized fats, sulfurized isobutylene, dialkyl polysulfides, and sulfur-bridged phenols such as nonylphenol polysulfide. Dyes, pour point depressants, viscosity index improvers, air release agents, and the like can also be included in the compositions of this invention.

In selecting any of the foregoing optional additives, it is of course important to ensure that the selected component(s) are soluble in the oleaginous liquid, are compatible with the other components of the composition, and do not interfere significantly with the viscosity and/or shear stability properties desired in the overall finished oleaginous composition.

Concentrations and Proportions

In general, the components of the additive compositions of this invention are employed in the oleaginous liquids in minor amounts sufficient to improve the performance characteristics and properties of the base fluid. The amounts will thus vary in accordance with such factors as the viscosity characteristics of the base fluid employed, the viscosity characteristics desired in the finished fluid, the service conditions for which the finished fluid is intended, and the performance characteristics desired in the finished fluid. However, generally speaking, the following concentrations (weight percent) of the components (active ingredients) in the base fluids are illustrative:

	General Range	Preferred Range	More Preferred Range	Particularly Preferred Range
Component A)	1 - 30	1 - 15	1 - 10	5 - 10
Component B)	1 - 15	1 - 10	1 - 6	2 - 5
Friction modifier	0.05-1	0.05-0.5	-	-

The concentrations (weight percent) of typical optional ingredients in the oleaginous liquid compositions of this invention are generally as follows:

	Typical Range	Preferred Range
Seal performance improver	0 - 30	2 - 20
Antioxidant	0 - 1	0.25 - 1
Corrosion inhibitor	0 - 0.5	0.01 - 0.1
Foam inhibitor	0 - 0.01	0.0001 - 0.005
Copper corrosion inhibitor	0 - 0.5	0.01 - 0.05
Lubricity agent	0 - 1.5	0.5 - 1
Viscosity index improver	0 - 10	0 - 4
Dye	0 - 0.05	0.015 - 0.035

It will be appreciated that the individual components A and B, and also any and all auxiliary components employed, can be separately blended into the base fluid or can be blended therein in various subcombinations, if desired. Ordinarily, the particular sequence of such blending steps is not critical. Moreover, such components can be blended in the form of separate solutions in a diluent. It is preferable, however, to blend the components used in the form of an additive concentrate of this invention, as this simplifies the blending operations, reduces the likelihood of blending errors, and takes advantage of the compatibility and solubility characteristics afforded by the overall concentrate.

The additive concentrates of this invention will contain components A and B) in amounts proportioned to yield finished fluid blends consistent with the concentrations tabulated above. In most cases, the additive concentrate will contain one or more diluents such as light mineral oils, to facilitate handling and blending of the concentrate. Thus concentrates containing up to 50% by weight of one or more diluents or solvents can be used.

The oleaginous liquids provided by this invention are particularly suitable for use as automatic transmission fluids.

The practice and advantages of this invention are illustrated by the following illustrative examples in which all percentages are by weight unless otherwise specified.

EXAMPLE 1

An automatic transmission fluid is formed by blending together the following components:

- 40.00% 6 mm²·s⁻¹ poly- α -olefin fluid (HITEC® 166 fluid);
- 28.50% 8 mm²·s⁻¹ poly- α -olefin fluid (HITEC® 168 fluid);
- 5.90% 110 mm²·s⁻¹ poly- α -olefin fluid (HITEC® 180 fluid);
- 20.00% Diisononyl adipate;
- 5.58% ATF additive concentrate;
- 0.02% Dye.

The ATF additive concentrate is composed of the following components:

- 67.56% Phosphorus- and boron-containing ashless dispersant¹;
- 2.69% Ethoxylated amines²;
- 0.72% Tolyltriazole (Cobrattec TT-100);
- 1.06% Silicone antifoam agent (4% solution in hydrocarbon);
- 4.66% Bis-(p-nonylphenyl)amine (Naugalube 438L);
- 0.90% Calcium phenate³;
- 0.90% Octanoic acid;
- 8.60% Sulfurized fat⁴

¹ Prepared as in Example 1A of U.S. 4,857,214, and this component contains approximately 25% mineral oil diluent.

² A combination of 2.24% Ethomeen T-12 (Akzo Chemical, Inc.) and 0.45% Tomah PA-14 (Exxon Chemical Company).

³ OLOA 216C (Chevron Chemical Company).

⁴ Sulperm 10S (Keil Products Division of Ferro Corporation).

12.91% Mineral oil diluent.

EXAMPLE 2

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An automatic transmission fluid is formed by blending together the following components:

- 40.00% 6 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
- 28.50% 8 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
- 5.90% 110 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
- 10 20.00% Diisononyl adipate;
- 5.58% ATF additive concentrate;
- 0.02% Dye.

The ATF additive concentrate is composed of the following components:

- 67.56% Phosphorus- and boron-containing ashless dispersant¹;
- 15 2.95% Ethoxylated amine²;
- 0.72% 2,5-dimethylthio-1,3,4-thiadiazole;
- 1.06% Silicone antifoam agent (4% solution in hydrocarbon);
- 4.66% Bis-(p-nonylphenyl)amine (Naugalube 438L);
- 1.80% Surfactant³;
- 20 0.90% Calcium phenate⁴;
- 0.90% Octanoic acid;
- 19.45% Mineral oil diluent.

EXAMPLE 3

25

An automatic transmission fluid is formed by blending together the following components:

- 40.00% 6 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
- 28.50% 8 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
- 5.90% 110 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
- 30 20.00% Diisononyl adipate;
- 5.58% ATF additive concentrate;
- 0.02% Dye.

The ATF additive concentrate is composed of the following components:

- 67.56% Phosphorus- and boron-containing ashless dispersant¹;
- 35 2.69% Ethoxylated amine²;
- 0.72% Benzotriazole (Cobratec 99);
- 1.06% Silicone antifoam agent (4% solution in hydrocarbon);
- 4.66% Bis-(p-nonylphenyl)amine (Naugalube 438L);
- 1.62% Surfactants³;

40

1 Prepared as in Example 1A of U.S. 4,857,214, and this component contains approximately 25% mineral oil diluent.

45 2 Ethomeen T-12.

3 Pluronic L-81.

50 4 OLOA 225.

1 Prepared as in Example 1A of U.S. 4,857,214, and this component contains approximately 25% mineral oil diluent.

55

2 Tomah PA-14.

3 A combination of 1.14% PC 1244 and 0.48% Pluronic L-81.

1.05% Octanoic acid;
4.45% Sulfurized fat⁴;
16.19% Mineral oil diluent.

5 EXAMPLE 4

An automatic transmission fluid is formed by blending together the following components:

40.00% 6 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
28.50% 8 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
10 5.90% 110 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
20.00% Diisononyl adipate;
5.58% ATF additive concentrate;
0.02% Dye.

The ATF additive concentrate is composed of the following components:

15 67.56% Phosphorus- and boron-containing ashless dispersant¹;
3.44% Ethoxylated amines²;
0.72% 2,5-dimethylthio-1,3,4-thiadiazole;
1.06% Silicone antifoam agent (4% solution in hydrocarbon);
4.66% Ethyl antioxidant 728 (Ethyl Corporation);
20 1.48% Surfactant³;
0.90% Calcium phenate⁴;
0.90% Octanoic acid;
2.75% Sulfurized isobutylene;
16.53% Mineral oil diluent.

25 EXAMPLE 5

An automatic transmission fluid is formed by blending together the following components:

40.00% 6 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
30 28.50% 8 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
5.90% 110 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
20.00% Diisononyl adipate;
5.58% ATF additive concentrate;
0.02% Dye.

35 The ATF additive concentrate is composed of the following components:

67.56% Phosphorus- and boron-containing ashless dispersant¹;
2.69% Ethoxylated amines²;
0.72% 2,5-dimethylthio-1,3,4-thiadiazole;
1.06% Silicone antifoam agent (4% solution in hydrocarbon);
40

4. Sulperm 10S.

45 1 Prepared as in Example 1A of U.S. 4,857,214, and this component contains approximately 25% mineral oil diluent.

2 A combination of 1.88% Ethomeen T-12 and 1.56% Tomah PA-14.

50 3 Mazawet 77.

4 OLOA 218A.

55 1 Prepared as in Example 1A of U.S. 4,857,214, and this component contains approximately 25% mineral oil diluent.

2 A combination of 1.79% Ethomeen T-12 and 0.90% Tomah PA-1.

4.66% Bis-(p-nonylphenyl)amine (Naugalube 438L);
 1.62% Surfactants³;
 0.90% Calcium phenate⁴;
 0.90% Octanoic acid;
 5 8.60% Sulfurized fat⁵;
 11.29% Mineral oil diluent.

EXAMPLE 6

10 An automatic transmission fluid is formed by blending together the following components:
 40.00% 6 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
 28.50% 8 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
 5.90% 110 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
 20.00% Diisononyl adipate;
 15 5.58% ATF additive concentrate;
 0.02% Dye.

The ATF additive concentrate is composed of the following components:
 67.56% Phosphorus- and boron-containing ashless dispersant¹;
 2.95% Ethoxylated amines²;
 20 0.72% 2,5-dimethylthio-1,3,4-thiadiazole;
 1.06% Silicone antifoam agent (4% solution in hydrocarbon);
 4.66% Bis-(p-nonylphenyl)amine (Naugalube 438L);
 1.85% Surfactant³;
 0.90% Calcium phenate⁴;
 25 0.90% Octanoic acid;
 7.42% Sulfurized fat⁵;
 11.98% Mineral oil diluent.

EXAMPLE 7

30 An automatic transmission fluid is formed by blending together the following components:
 40.00% 6 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
 28.50% 8 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
 5.90% 110 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
 35 20.00% Diisononyl adipate;
 5.58% ATF additive concentrate;
 0.02% Dye.

40 3 A combination of 0.54% PC 1244, 0.90% Mazawet 77, and 0.18% Pluronic L-81.

4 OLOA 216C.

45 5. Sulperm 10S.

1 Prepared as in Example 1A of U.S. 4,857,214, and this component contains approximately 25% mineral oil diluent.

50 2 A combination of 1.79% Ethomeen T-12 and 0.90% Tomah PA-14.

3 PC 1244.

55 4 OLOA 218A.

5. Sulperm 60-93 (Kell Products Division of Ferro Corporation).

The ATF additive concentrate is composed of the following components:

- 67.56% Phosphorus- and boron-containing ashless dispersant¹;
- 2.35% Ethoxylated amines²;
- 0.70% Tolyltriazole;
- 5 1.06% Silicone antifoam agent (4% solution in hydrocarbon);
- 8.65% Ethyl antioxidant 728 OM50 (Ethyl Corporation);
- 1.58% Surfactants³;
- 0.90% Calcium phenate⁴;
- 0.90% Octanoic acid;
- 10 4.42% Sulfurized fat⁵;
- 11.88% Mineral oil diluent.

EXAMPLE 8

- 15 Examples 1-7 are repeated using the following components:
- 38.92% 6 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
- 27.74% 8 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
- 5.74% 110 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
- 20.00% Di(tridecyl) adipate;
- 20 2.00% Aromatic hydrocarbon (Panasol AN-3N);
- 5.58% ATF additive concentrates of Examples 1-7, respectively;
- 0.02% Dye.

EXAMPLE 9

- 25 Example 8 is repeated substituting in each case dibutyl phthalate for the aromatic hydrocarbon (Panasol AN-3N).

EXAMPLE 10

- 30 Examples 1-7 are repeated using the following components:
- 45.38% 6 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
- 32.33% 8 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
- 6.69% 110 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
- 35 10.00% Synthetic ester (Hatcol 2923; Hatco Corporation);
- 5.58% ATF additive concentrates of Examples 1-7, respectively;
- 0.02% Dye.

EXAMPLE 11

- 40 Examples 1-7 are repeated using the following components:
- 40.00% 6 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
- 28.50% 8 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
- 5.90% 110 mm²·s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
- 45 20.00% Synthetic ester (Hatcol 2920);

1 Prepared as in Example 1A of U.S. 4,857,214, and this component contains approximately 25% mineral oil diluent.

50 2 A combination of 1.40% Ethomeen T-12 and 0.95% Tomah PA-14.

3 A combination of 0.95% PC 1244 and 0.63% Mazawet 77.

55 4 OLOA 216C.

5. Sulperm 60-93.

5.58% ATF additive concentrates of Examples 1-7, respectively;
0.02% Dye.

EXAMPLE 12

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Examples 1-7 are repeated using the following components:

45.38% 6 mm²·s⁻¹ poly- α -olefin fluid (HITEC® 166 fluid);

32.33% 8 mm²·s⁻¹ poly- α -olefin fluid (HITEC® 168 fluid);

6.69% 110 mm²·s⁻¹ poly- α -olefin fluid (HITEC® 180 fluid);

10 10.00% Synthetic ester (Hatcol 2920);

5.58% ATF additive concentrates of Examples 1-7, respectively;

0.02% Dye.

EXAMPLE 13

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The procedure of Example 12 is repeated substituting Hatcol 2915 for the Hatcol 2920.

EXAMPLE 14

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The procedure of Example 12 is repeated substituting Hatcol 2970 for the Hatcol 2920.

EXAMPLE 15

25 The procedure of Example 8 is repeated except that dioctyl sebacate is used in lieu of the di(tridecyl) adipate.

EXAMPLE 16

30 The procedure of Example 15 is repeated except that dibutyl phthalate is used in place of the aromatic hydrocarbon (Panasol AN-3N).

EXAMPLE 17

35 The procedure of Example 16 is repeated except that tricresyl phosphate is used in place of the dibutyl phthalate.

EXAMPLE 18

40 The procedure of Example 15 is repeated except that the dioctyl sebacate is replaced by di(tridecyl) phthalate.

EXAMPLE 19

45 The procedure of Example 18 is repeated except that the dibutyl phthalate replaces the aromatic hydrocarbons (Panasol AN-3N).

EXAMPLE 20

50 The procedure of Example 19 is repeated except that tricresyl phosphate replaces the dibutyl phthalate.

EXAMPLE 21

The procedure of Example 20 is repeated except that Vistone A-30 replaces the di(tridecyl) phthalate.

55 EXAMPLE 22

The procedure of Example 21 is repeated except that Lubrizol 730 additive replaces the tricresyl phosphate.

EXAMPLE 23

The procedures of Examples 1-7 are repeated using the following components:
 65.42% 6 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
 5 4.00% 110 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
 25.00% Polyol ester (Emery 2935; Emery Group of Henkel Corporation);
 5.58% ATF additive concentrates of Examples 1-7, respectively.

EXAMPLE 24

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The procedure of Example 23 is repeated except that the polyol ester is Emery 2939.

EXAMPLE 25

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The procedures of Examples 1-7 are repeated using the following components:
 84.42% 6 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
 4.00% 110 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
 6.00% Dibutyl phthalate;
 5.58% ATF additive concentrates of Examples 1-7, respectively.

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EXAMPLE 26

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The procedures of Examples 1-7 are repeated using the following components:
 83.12% 6 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
 5.90% 110 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
 5.40% Dibutyl phthalate;
 5.58% ATF additive concentrates of Examples 1-7, respectively.

EXAMPLE 27

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The procedures of Examples 1-7 are repeated using the following components:
 64.42% 6 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 166 fluid);
 10.00% 8 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 168 fluid);
 6.00% 110 mm²•s⁻¹ poly- α -olefin fluid (HiTEC® 180 fluid);
 35 14.00% Polyol ester (Hatcol 2915);
 5.58% ATF additive concentrates of Examples 1-7, respectively.

EXAMPLE 28

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The procedures of Examples 1 through 27 are repeated except that the phosphorus- and boron-containing ashless dispersant used in the ATF additive concentrates is prepared as in Example 2 of U.S. 4,857,214.

EXAMPLE 29

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The procedures of Examples 1 through 27 are repeated except that the phosphorus- and boron-containing ashless dispersant used in the ATF additive concentrates is prepared as in Example 3 of U.S. 4,857,214.

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EXAMPLE 30

The procedures of Examples 1 through 27 are repeated except that the phosphorus- and boron-containing ashless dispersant used in the ATF additive concentrates is replaced by a phosphorus-containing ashless dispersant prepared as in Example 5 of U.S. 4,857,214.

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EXAMPLE 31

5 The procedures of Examples 1 through 27 are repeated except that the phosphorus- and boron-containing ashless dispersant used in the ATF additive concentrates is replaced by a phosphorus-containing ashless dispersant prepared as in Example 6 of U.S. 4,857,214.

EXAMPLE 32

10 The procedures of Examples 1 through 27 are repeated except that the phosphorus- and boron-containing ashless dispersant used in the ATF additive concentrates is replaced by a phosphorus-containing ashless dispersant prepared as in Example 7 of U.S. 4,857,214.

EXAMPLE 33

15 The procedures of Examples 1 through 27 are repeated except that the phosphorus- and boron-containing ashless dispersant used in the ATF additive concentrates is replaced by a phosphorus-containing ashless dispersant prepared as in Example 8 of U.S. 4,857,214.

EXAMPLE 34

20 The procedures of Examples 1 through 27 are repeated except that the phosphorus- and boron-containing ashless dispersant used in the ATF additive concentrates is replaced by a phosphorus-containing ashless dispersant prepared as in Example 9 of U.S. 4,857,214.

EXAMPLE 35

25 The procedures of Examples 1 through 27 are repeated except that the phosphorus- and boron-containing ashless dispersant used in the ATF additive concentrates is replaced by a phosphorus-containing ashless dispersant prepared as in Example 10 of U.S. 4,857,214.

EXAMPLE 36

30 The procedures of Examples 1 through 27 are repeated except that the ATF additive concentrate used is a commercially available ATF additive package (Paranox 445 additive; Exxon Chemical Company).

EXAMPLE 37

35 The procedures of Examples 8 through 35 are repeated except that the ATF additive concentrate used is the additive concentrate of Example 1 modified so that it contains 6.68% of a 50% solution of methylene-bridged alkyl phenols in mineral oil (ETHYL antioxidant 728 OM50; Ethyl Corporation), and so that the amount of mineral oil diluent is reduced from 12.91% to 10.89%.

EXAMPLE 38

45 The procedures of Examples 8 through 35 are repeated except that the ATF additive concentrate used is the additive concentrate of Example 2 modified so that it contains 7.05% of a 60% solution of mixed tertiary butylphenols in mineral oil, and so that the amount of mineral oil diluent is reduced from 19.45% to 17.06%.

EXAMPLE 39

50 The procedures of Examples 8 through 35 are repeated except that the ATF additive concentrate used is the additive concentrate of Example 3 modified so that it contains 7.36% of a 50% solution of methylene-bridged alkyl phenols in mineral oil (ETHYL antioxidant 728 OM50; Ethyl Corporation), and so that the amount of mineral oil diluent is reduced from 16.19% to 13.49%.

EXAMPLE 40

The procedures of Examples 8 through 35 are repeated except that the ATF additive concentrate used is the additive concentrate of Example 5 modified so that it contains 7.17% of a 50% solution of methylene-bridged alkyl phenols in mineral oil (ETHYL antioxidant 728 OM50; Ethyl Corporation), and so that the amount of mineral oil diluent is reduced from 11.29% to 4.12%.

EXAMPLE 41

The procedures of Examples 8 through 35 are repeated except that the ATF additive concentrate used is the additive concentrate of Example 6 modified so that it contains 6.95% of a 50% solution of 4,4'-methylene-bis(2,6-di-tert-butylphenol) in mineral oil, and so that the amount of mineral oil diluent is reduced from 11.98% to 9.69%.

EXAMPLE 42

The ATF additive concentrate of Example 37 is blended at a concentration of 5.58% in an automatic transmission fluid formulation composed of 16.05% HiTEC® 164 fluid; 64.25% HiTEC® 166 fluid; 8.70% HiTEC® 180 fluid; 5.40% dibutyl phthalate; and 0.02% dye.

EXAMPLE 43

The ATF additive concentrate of Example 38 is blended at a concentration of 5.58% in an automatic transmission fluid formulation composed of 16.05% HiTEC® 164 fluid; 64.25% HiTEC® 166 fluid; 8.70% HiTEC® 180 fluid; 5.40% dibutyl phthalate; and 0.02% dye.

EXAMPLE 44

The ATE additive concentrate of Example 39 is blended at a concentration of 5.58% in an automatic transmission fluid formulation composed of 16.05% HiTEC® 164 fluid; 64.25% HiTEC® 166 fluid; 8.70% HiTEC® 180 fluid; 5.40% dibutyl phthalate; and 0.02% dye.

EXAMPLE 45

The ATE additive concentrate of Example 40 is blended at a concentration of 5.58% in an automatic transmission fluid formulation composed of 16.05% HiTEC® 164 fluid; 64.25% HiTEC® 166 fluid; 8.70% HiTEC® 180 fluid; 5.40% dibutyl phthalate; and 0.02% dye.

EXAMPLE 46

The ATE additive concentrate of Example 41 is blended at a concentration of 5.58% in an automatic transmission fluid formulation composed of 16.05% HiTEC® 164 fluid; 64.25% HiTEC® 166 fluid; 8.70% HiTEC® 180 fluid; 5.40% dibutyl phthalate; and 0.02% dye.

All experimental results obtained to date indicate that the compositions of the foregoing examples possess either (i) a kinematic viscosity of at least $5.5 \text{ mm}^2 \cdot \text{s}^{-1}$ at 100°C and a Brookfield viscosity of less than $20,000 \text{ mPa} \cdot \text{s}$ at -40°C ; or (ii) a kinematic viscosity of at least $6.8 \text{ mm}^2 \cdot \text{s}^{-1}$ at 100°C and a Brookfield viscosity of less than $50,000 \text{ mPa} \cdot \text{s}$ at -40°C . Indeed, the available experimental evidence indicates that a number of such compositions have a kinematic viscosity of at least $6.8 \text{ mm}^2 \cdot \text{s}^{-1}$ at 100°C and a Brookfield viscosity of less than $20,000 \text{ mPa} \cdot \text{s}$ at -40°C .

Besides possessing desirable viscosity characteristics, the compositions of this invention which are devoid of high molecular weight polymeric viscosity index improvers possess excellent shear stability. The results in the following table are typical. These results were obtained using the standard Turbo Hydra-matic Cycling Test procedure as described in the Dexron-II specifications.

TABLE

Shear Stability Per the Turbo Hydra-matic Cycling Test			
Test Cycles	Automatic Transmission Fluid		
	This Invention	Commercial A	Commercial B
Fresh	7.18	7.70	6.95
0	7.07	7.40	6.78
5,000	7.05	6.24	6.08
10,000	7.07	5.78	5.64
15,000	7.08	5.60	5.55
17,500	7.08	5.62	5.53
20,000	7.09	5.55	5.51

Claims

1. An additive concentrate for use in preparing an automatic transmission fluid comprising at least the following:
 - A. hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 40 to 120 mm².s⁻¹ at 100 °C;
 - B. antiwear/extreme pressure agent selected from phosphorus-containing ashless dispersant, and phosphorus- and boron-containing ashless dispersant; and
 - C. friction modifier,
 said concentrate being characterized by (i) being devoid or essentially devoid of metal-containing components, (ii) enabling hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm².s⁻¹ at 100 °C to have (a) a kinematic viscosity of at least 5.5 mm².s⁻¹ at 100 °C and a Brookfield viscosity of less than 20,000 mPa.s at -40 °C, or (b) a kinematic viscosity of at least 6.8 mm².s⁻¹ at 100 °C and a Brookfield viscosity of less than 50,000 mPa.s at -40 °C, when said concentrate is blended in such hydrogenated poly- α -olefin oligomer fluid at at least one concentration below 10 percent by weight, and (iii) containing an amount of friction modifier such that an automatic transmission fluid formed therefrom contains 0.05 to 1 percent by weight of the friction modifier.
2. An additive concentrate according to claim 1 further characterized by enabling hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm².s⁻¹ at 100 °C to have (a) a kinematic viscosity of at least 6.8 mm².s⁻¹ at 100 °C and a Brookfield viscosity of less than 20,000 mPa.s at -40 °C.
3. An automatic transmission fluid composition comprising at least one oil of lubricating viscosity containing up to 10% by weight of a concentrate as claimed in claim 1 or 2.
4. A composition according to claim 3 comprising a hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm².s⁻¹ at 100 °C, said composition being devoid or essentially devoid of metal-containing components and having:
 - (i) a kinematic viscosity of at least 5.5 mm².s⁻¹ at 100 °C and a Brookfield viscosity of less than 20,000 mPa.s at -40 °C; or
 - (ii) a kinematic viscosity of at least 6.8 mm².s⁻¹ at 100 °C and a Brookfield viscosity of less than 50,000 mPa.s at -40 °C.
5. A composition as claimed in claim 4 wherein the antiwear/extreme pressure agent consists essentially of:
 - (1) at least one phosphorus-containing succinimide ashless dispersant, or
 - (2) at least one phosphorus- and boron-containing succinimide ashless dispersant, or
 - (3) a combination of (1) and (2).
6. A composition as claimed in claim 5 wherein said antiwear/extreme pressure agent comprises aliphatic hydrocarbyl-substituted succinimide of a mixture of cyclic and acyclic polyethylene polyamines having



TABLE

Shear Stability Per the Turbo Hydra-matic Cycling Test			
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Fresh	7.18	7.70	6.95
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10,000	7.07	5.78	5.64
15,000	7.08	5.60	5.55
17,500	7.08	5.62	5.53
20,000	7.09	5.55	5.51

Claims

1. An additive concentrate for use in preparing an automatic transmission fluid comprising at least the following:
 - A. hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 40 to 120 mm².s⁻¹ at 100°C;
 - B. antiwear/extreme pressure agent selected from phosphorus-containing ashless dispersant, and phosphorus- and boron-containing ashless dispersant; and
 - C. friction modifier,
 said concentrate being characterized by (i) being devoid or essentially devoid of metal-containing components, (ii) enabling hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm².s⁻¹ at 100°C to have (a) a kinematic viscosity of at least 5.5 mm².s⁻¹ at 100°C and a Brookfield viscosity of less than 20,000 mPa.s at -40°C, or (b) a kinematic viscosity of at least 6.8 mm².s⁻¹ at 100°C and a Brookfield viscosity of less than 50,000 mPa.s at -40°C, when said concentrate is blended in such hydrogenated poly- α -olefin oligomer fluid at at least one concentration below 10 percent by weight, and (iii) containing an amount of friction modifier such that an automatic transmission fluid formed therefrom contains 0.05 to 1 percent by weight of the friction modifier.
2. An additive concentrate according to claim 1 further characterized by enabling hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm².s⁻¹ at 100°C to have (a) a kinematic viscosity of at least 6.8 mm².s⁻¹ at 100°C and a Brookfield viscosity of less than 20,000 mPa.s at -40°C.
3. An automatic transmission fluid composition comprising at least one oil of lubricating viscosity containing up to 10% by weight of a concentrate as claimed in claim 1 or 2.
4. A composition according to claim 3 comprising a hydrogenated poly- α -olefin oligomer fluid having a viscosity in the range of 2 to 10 mm².s⁻¹ at 100°C, said composition being devoid or essentially devoid of metal-containing components and having:
 - (i) a kinematic viscosity of at least 5.5 mm².s⁻¹ at 100°C and a Brookfield viscosity of less than 20,000 mPa.s at -40°C; or
 - (ii) a kinematic viscosity of at least 6.8 mm².s⁻¹ at 100°C and a Brookfield viscosity of less than 50,000 mPa.s at -40°C.
5. A composition as claimed in claim 4 wherein the antiwear/extreme pressure agent consists essentially of:
 - (1) at least one phosphorus-containing succinimide ashless dispersant, or
 - (2) at least one phosphorus- and boron-containing succinimide ashless dispersant, or
 - (3) a combination of (1) and (2).
6. A composition as claimed in claim 5 wherein said antiwear/extreme pressure agent comprises aliphatic hydrocarbyl-substituted succinimide of a mixture of cyclic and acyclic polyethylene polyamines having



- an approximate average overall composition falling in the range of from diethylene triamine through pentaethylene hexamine; said succinimide being heated with (1) at least one phosphorylating agent to form a phosphorus-containing succinimide ashless dispersant; or (2) either concurrently or in any sequence with at least one phosphorylating agent and at least one boronating agent to form a phosphorus- and boron-containing succinimide ashless dispersant.
7. A composition as claimed in claim 6 further comprising at least one phosphorus-containing substance selected from (1) one or more inorganic acids of phosphorus; or (2) one or more inorganic thioacids of phosphorus; or (3) one or more monohydrocarbyl esters of one or more inorganic acids of phosphorus; or (4) one or more monohydrocarbyl esters of one or more inorganic thioacids of phosphorus; or (5) any combination of any two, or any three or all four of (1), (2), (3), and (4); or at least one oil-soluble amine salt or complex or adduct of any of (1), (2), (3), (4), and (5), said amine optionally being in whole or in part an amine moiety in (i) a basic nitrogen-containing succinimide or (ii) a boron- and basic nitrogen-containing succinimide, or (iii) a phosphorus- and basic nitrogen-containing succinimide or (iv) a phosphorus-, boron- and basic nitrogen-containing succinimide.
8. A composition as claimed in any of claims 4-7 further characterized by having a kinematic viscosity of at least $6.8 \text{ mm}^2 \cdot \text{s}^{-1}$ at -100°C and a Brookfield viscosity of less than $20,000 \text{ mPa} \cdot \text{s}$ at -40°C .
9. A composition as claimed in any of claims 4-8 further characterized by being devoid of high molecular weight polymeric viscosity index improver.
10. A composition as claimed in any of claims 4 to 9 wherein the proportion of the friction modifier is in the range of 0.05 to 0.5 per cent by weight.

Patentansprüche

1. Additivkonzentrat zur Verwendung bei der Herstellung einer Flüssigkeit für Automatikgetriebe, das zumindest folgende Substanzen umfaßt:
- A) eine Flüssigkeit aus einem hydrierten Poly- α -olefinoligomer mit einer Viskosität im Bereich von 40 bis $120 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C ;
- B) ein Mittel gegen Verschleiß und für extremen Druck ausgewählt aus einem phosphorhaltigem aschefreien Dispergiermittel und einem phosphor- und borhaltigen aschefreien Dispergiermittel sowie
- C) ein Reibungsmodifikationsmittel,
- wobei das Konzentrat dadurch gekennzeichnet ist, daß es (i) keine oder nahezu keine metallhaltigen Komponenten aufweist, (ii) einer Flüssigkeit aus hydriertem Poly- α -olefinoligomer mit einer Viskosität im Bereich von 2 bis $10 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C
- (a) eine kinematische Viskosität von mindestens $5,5 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C und eine Brookfield-Viskosität von weniger als $20.000 \text{ mPa} \cdot \text{s}$ bei -40°C oder
- (b) eine kinematische Viskosität von mindestens $6,8 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C und eine Brookfield-Viskosität von weniger als $50.000 \text{ mPa} \cdot \text{s}$ bei -40°C verleiht, wenn dieses Konzentrat in eine solche Flüssigkeit aus hydriertem Poly- α -olefinoligomer bei mindestens einer Konzentration von unter 10 Gew.-% eingemischt wird, und (iii) eine solche Menge an Reibungsmodifikationsmittel enthält, daß eine daraus hergestellte Flüssigkeit für Automatikgetriebe $0,05$ bis 1 Gew.-% des Reibungsmodifikationsmittels enthält.
2. Additivkonzentrat nach Anspruch 1, das außerdem dadurch gekennzeichnet ist, daß es einer Flüssigkeit aus einem hydrierten Poly- α -olefinoligomer mit einer Viskosität im Bereich von 2 bis $10 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C (a) eine kinematische Viskosität von mindestens $6,8 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C und eine Brookfield-Viskosität von weniger als $20.000 \text{ mPa} \cdot \text{s}$ bei -40°C verleiht.
3. Flüssigkeitszusammensetzung für ein Automatikgetriebe, die mindestens ein Öl von Schmierviskosität mit bis zu 10 Gew.-% eines Konzentrats nach Anspruch 1 oder 2 enthält.
4. Zusammensetzung nach Anspruch 3, umfassend eine Flüssigkeit aus einem hydrierten Poly- α -olefinoligomer mit einer Viskosität im Bereich von 2 bis $10 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C , wobei die Zusammensetzung frei oder im wesentlichen frei von metallhaltigen Komponenten ist und



- (i) eine kinematische Viskosität von mindestens $5,5 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C und eine Brookfield-Viskosität von weniger als $20.000 \text{ mPa} \cdot \text{s}$ bei -40°C oder
- (ii) eine kinematische Viskosität von mindestens $6,8 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C und eine Brookfield-Viskosität von weniger als $50.000 \text{ mPa} \cdot \text{s}$ bei -40°C aufweist.

5. Zusammensetzung nach Anspruch 4, in der das Mittel gegen Verschleiß und für extremen Druck im wesentlichen aus
 - (1) mindestens einem phosphorhaltigen aschefreien Succinimiddispersiermittel oder
 - (2) mindestens einem phosphor- und borhaltigen aschefreien Succinimiddispersiermittel oder (3) einer Kombination aus (1) und (2) besteht.
6. Zusammensetzung nach Anspruch 5, bei der das Mittel gegen Verschleiß und für extremen Druck aliphatisches, Hydrocarbyl-substituiertes Succinimid aus einer Mischung aus cyclischen und acyclischen Polyethylenpolyaminen mit einer ungefähren durchschnittlichen Gesamtzusammensetzung im Bereich von Diethylentriamin bis einschließlich Pentaethylenhexamin umfaßt, wobei das Succinimid erhitzt wird mit (1) mindestens einem Phosphorylierungsmittel, um ein phosphorhaltiges aschefreies Succinimiddispersiermittel herzustellen, oder (2) entweder gleichzeitig oder in beliebiger Reihenfolge mit mindestens einem Phosphorylierungsmittel und mindestens einem Borierungsmittel, um ein phosphor- und borhaltiges aschefreies Succinimiddispersiermittel herzustellen.
7. Zusammensetzung nach Anspruch 6, die außerdem mindestens eine phosphorhaltige Substanz, ausgewählt aus (1) einer oder mehreren anorganischen Phosphorsäuren oder (2) einer oder mehreren anorganischen Thiosäuren von Phosphor oder (3) einem oder mehreren Monohydrocarbylestern von einer oder mehreren anorganischen Phosphorsäuren oder (4) einem oder mehreren Monohydrocarbylestern von einer oder mehreren anorganischen Thiosäuren von Phosphor oder (5) einer beliebigen Kombination aus je zwei oder beliebigen drei oder allen vier von (1), (2), (3) und (4); oder mindestens ein öllösliches Aminsalt, Komplex oder Addukt aus (1), (2), (3), (4) oder (5) umfaßt, wobei das Amin wahlweise im ganzen oder teilweise eine Aminkomponente in (i) einem basischen Stickstoff enthaltenden Succinimid oder (ii) einem Bor und basischen Stickstoff enthaltenden Succinimid oder (iii) in einem Phosphor und basischen Stickstoff enthaltenden Succinimid oder (iv) in einem Phosphor, Bor und basischen Stickstoff enthaltenden Succinimid ist.
8. Zusammensetzung nach einem der Ansprüche 4 bis 7, die außerdem dadurch gekennzeichnet ist, daß sie eine kinematische Viskosität von mindestens $6,8 \text{ mm}^2 \cdot \text{s}^{-1}$ bei 100°C und eine Brookfield-Viskosität von weniger als $20.000 \text{ mPa} \cdot \text{s}$ bei -40°C aufweist.
9. Zusammensetzung nach einem der Ansprüche 4 - 8, die außerdem dadurch gekennzeichnet ist, daß sie frei von Mitteln mit hohem Molekulargewicht ist, die den polymeren Viskositätsindex verbessern.
10. Zusammensetzung nach einem der Ansprüche 4 bis 9, in der der Anteil des Reibungsmodifikationsmittels im Bereich von 0,05 bis 0,5 Gew.-% liegt.

Revendications

1. Concentré d'additifs destiné à être utilisé dans la préparation d'un fluide de transmission automatique, comprenant au moins les ingrédients suivants :
 - A. un fluide oligomère poly- α -oléfinique hydrogéné ayant une viscosité comprise dans la plage de 40 à $120 \text{ mm}^2 \cdot \text{s}^{-1}$ à 100°C ;
 - B. un agent anti-usure/d'extrême-pressure choisi dans le groupe comprenant un dispersant sans cendres contenant du phosphore et un dispersant sans cendres contenant du phosphore et du bore ; et
 - C. un modificateur de friction,
 ledit concentré étant caractérisé (i) en ce qu'il est dépourvu ou essentiellement dépourvu de composants contenant des métaux, (ii) en ce qu'il permet à un fluide oligomère poly- α -oléfinique hydrogéné ayant une viscosité comprise dans la plage de 2 à $10 \text{ mm}^2 \cdot \text{s}^{-1}$ à 100°C d'avoir (a) une viscosité cinématique à 100°C d'au moins $5,5 \text{ mm}^2 \cdot \text{s}^{-1}$ et une viscosité Brookfield inférieure à $20\,000 \text{ mPa} \cdot \text{s}$ à -40°C , ou (b) une viscosité cinématique d'au moins $6,8 \text{ mm}^2 \cdot \text{s}^{-1}$ à 100°C et une viscosité Brookfield



inférieure à 50 000 mPa.s à -40 °C, lorsque ce concentré est incorporé à un tel fluide oligomère poly- α -oléfinique hydrogéné à au moins une concentration inférieure à 10 % en poids, et (iii) en ce qu'il contient une quantité de modificateur de friction telle qu'un fluide de transmission automatique formé à partir de ce concentré contienne 0,05 à 1 % en poids du modificateur de friction.

- 5
2. Concentré d'additifs suivant la revendication 1, caractérisé en outre en ce qu'il permet à un fluide oligomère poly- α -oléfinique hydrogéné ayant une viscosité comprise dans la plage de 2 à 10 mm².s⁻¹ à 100 °C d'avoir (a) une viscosité cinématique d'au moins 6,8 mm².s⁻¹ à 100 °C et une viscosité Brookfield inférieure à 20 000 mPa.s à -40 °C.
- 10
3. Composition de fluide de transmission automatique, comprenant au moins une huile de viscosité propre à la lubrification, contenant jusqu'à 10 % en poids d'un concentré suivant la revendication 1 ou 2.
- 15
4. Composition suivant la revendication 3, comprenant un fluide oligomère poly- α -oléfinique hydrogéné ayant une viscosité comprise dans la plage de 2 à 10 mm².s⁻¹ à 100 °C, cette composition étant dépourvue ou essentiellement dépourvue de composants contenant des métaux, et ayant :
- 20
- (i) une viscosité cinématique d'au moins 5,5 mm².s⁻¹ à 100 °C et une viscosité Brookfield inférieure à 20 000 mPa.s à -40 °C ; ou
- (ii) une viscosité cinématique d'au moins 6,8 mm².s⁻¹ à 100 °C et une viscosité Brookfield inférieure à 50 000 mPa.s à -40 °C.
- 25
5. Composition suivant la revendication 4, dans laquelle l'agent anti-usure/d'extrême-pression est essentiellement constitué :
- (1) d'au moins un dispersant sans cendres formé d'un succinimide contenant du phosphore, ou
- (2) d'au moins un dispersant sans cendres formé d'un succinimide contenant du phosphore et du bore, ou
- (3) d'une association entre (1) et (2).
- 30
6. Composition suivant la revendication 5, dans laquelle l'agent anti-usure/d'extrême-pression comprend un succinimide substitué par un groupe hydrocarbyle aliphatique d'un mélange de polyéthylène-polyamines cycliques et acycliques ayant une composition globale moyenne approximative rentrant dans la plage allant de la diéthylène-triamine à la pentaéthylène-hexamine, ce succinimide étant chauffé avec (1) au moins un agent de phosphorylation pour former un dispersant sans cendres du type d'un succinimide contenant du phosphore ; ou bien (2) en même temps ou successivement, avec
- 35
- au moins un agent de phosphorylation et au moins un agent introduisant du bore pour former un dispersant sans cendres du type d'un succinimide contenant du phosphore et du bore.
- 40
7. Composition suivant la revendication 6, comprenant en outre au moins une substance contenant du phosphore choisie entre (1) un ou plusieurs acides inorganiques contenant du phosphore ; ou (2) un ou plusieurs thioacides inorganiques contenant du phosphore ; ou (3) un ou plusieurs esters monohydrocarbyliques d'un ou plusieurs acides inorganiques contenant du phosphore ; ou (4) un ou plusieurs esters monohydrocarbyliques d'un ou plusieurs thioacides inorganiques contenant du phosphore ; ou
- 45
- (5) toute association de deux quelconques ou de trois quelconques ou de la totalité des quatre substances (1), (2), (3) et (4) ; ou bien un sel d'amine ou un complexe ou un produit d'addition soluble dans l'huile de l'un quelconque de (1), (2), (3), (4) et (5), cette amine étant facultativement en totalité ou en partie un groupement amine présent dans (i) un succinimide contenant de l'azote basique ou (ii) un succinimide contenant du bore et de l'azote basique, ou (iii) un succinimide contenant du phosphore et de l'azote basique ou (iv) un succinimide contenant du phosphore, du bore et de l'azote basique.
- 50
8. Composition suivant l'une quelconque des revendications 4 à 7, caractérisée en outre en ce qu'elle a une viscosité cinématique d'au moins 6,8 mm².s⁻¹ à -100 °C et une viscosité Brookfield inférieure à 20 000 mPa.s à -40 °C.
- 55
9. Composition suivant l'une quelconque des revendications 4 à 8, caractérisée en outre en ce qu'elle est dépourvue d'agent polymérique de haut poids moléculaire améliorant l'indice de viscosité.
10. Composition suivant l'une quelconque des revendications 4 à 9, dans laquelle la proportion de modificateur de friction se situe dans la plage de 0,05 à 0,5 % en poids.