CLAIMS:

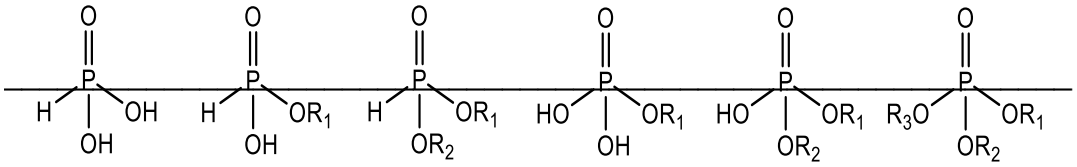
What is claimed is:

1. A transmission fluid composition comprising:

a major amount of a lubricating oil basestock; and

a minor amount of an additive package comprising:

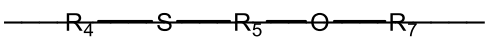
(i) a mixture comprising two or more compounds of structures (I):



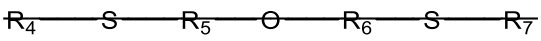
(I);

where groups R_1, R_2 and R_3 are independently alkyl groups having 1 to 18 carbon atoms or alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage, provided that, in the mixture (i), at least some of groups R_1, R_2 and R_3 are alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage;

(ii) one or more compounds of structures (II):



(II)



where groups R_4 and R_7 are independently alkyl groups having 1 to 12 carbon atoms and R_5 and R_6 are independently alkyl linkages having 2 to 12 carbon atoms;

(iii) one or more zinc dihydrocarbyl dithiophosphate compounds; and

(iv) one or more oil-soluble or dispersible molybdenum-containing compounds.

2. A transmission fluid composition according to claim 1, wherein the compounds of component (i) and component (ii) are each present in the composition in an amount from 0.1 to 2.0% by mass, or from 0.1 to 1.2% by mass, or from 0.1 to 0.8% by mass, or from 0.2 to 0.6% by mass, based on the total mass of the composition.

3. A transmission fluid composition according to claim 1 or claim 2, wherein the compounds of component (i) and component (ii) are present in the composition in a mass ratio of from 2:1 to 1:2, or from 3:2 to 2:3, or from 4:3 to 3:4.

4. A transmission fluid composition according to any preceding claim, wherein component (iii) is present in the composition in an amount from 0.4 to 5.0% by mass, or from 0.6 to 3.5% by mass, or from 1.0 to 3.0% by mass, or from 1.2 to 2.5% by mass, based on the total mass of the composition.

5. A transmission fluid composition according to any preceding claim, wherein component (iii) provides the composition with 400 to 4500 parts per million by mass (ppm) of zinc, or from 500 to 2500 ppm of zinc, or from 750 to 2000 ppm of zinc, or from 800 to 1600 ppm of zinc, based on the total mass of the composition.

6. A transmission fluid composition according to any preceding claim, wherein component (iv) is present in the composition in an amount from 0.1 to 2.0% by mass, or from 0.1 to 1.5% by mass, or from 0.2 to 1.2% by mass, or from 0.2% to 0.8% by mass, based on the total mass of the composition.

7. A transmission fluid composition according to any preceding claim, wherein component (iv) provides the composition with from 50 to 1000 parts per million by mass (ppm) of molybdenum, or from 50 to 800 ppm of molybdenum, or from 100 to 650 ppm of molybdenum, or from 100 to 500 ppm of molybdenum, based on the total mass of the composition.

8. A transmission fluid composition according to any preceding claim, wherein component (iv) comprises a molybdenum dithiocarbamate, a molybdenum dialkyldithiophosphate, a molybdenum alkyl xanthate, a molybdenum alkyl thioxanthate, or a combination thereof.

9. A transmission fluid composition according to any preceding claim, wherein component (iv) comprises substantially no molybdenum dialkyldithiophosphate.

10. A transmission fluid composition according to any preceding claim, wherein component (iv) is a di-nuclear or a tri-nuclear molybdenum compound.

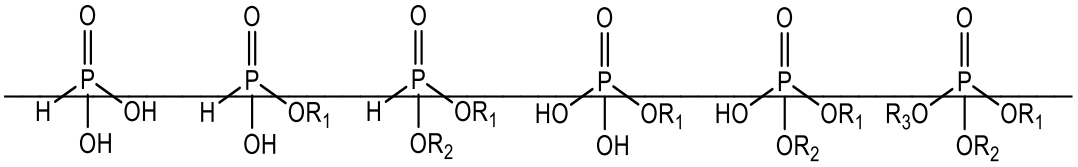
11. A transmission fluid composition according to any preceding claim, further comprising one or more ashless dispersants, a calcium-containing detergent, or a combination thereof.

12. A transmission fluid composition according to any preceding claim, wherein the composition consists essentially of:

from 75 to 97%, based on the weight of the composition, of a lubricating oil basestock exhibiting a kinematic viscosity at 100°C (KV100), as measured by ASTM D445, from 2 cSt to 10 cSt; and

from 2.4 to 24%, based on the weight of the composition, of an additive package consisting essentially of:

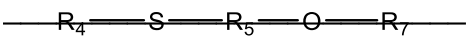
(i) from 0.1 to 2.0% by mass, or from 0.1 to 1.2% by mass, or from 0.1 to 0.8% by mass, or from 0.2 to 0.6% by mass, based on the total mass of the composition, of a mixture comprising two or more compounds of structures (I):



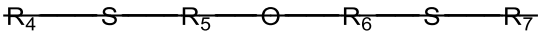
(I);

where groups R_1, R_2 and R_3 are independently alkyl groups having 1 to 18 carbon atoms or alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage, provided that, in the mixture (i), at least some of groups R_1, R_2 and R_3 are alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage;

(ii) from 0.1 to 2.0% by mass, or from 0.1 to 1.2% by mass, or from 0.1 to 0.8% by mass, or from 0.2 to 0.6% by mass, based on the total mass of the composition, of one or more compounds of structures (II):



(II)



where groups R_4 and R_7 are independently alkyl groups having 1 to 12 carbon atoms and R_5 and R_6 are independently alkyl linkages having 2 to 12 carbon atoms;

(iii) from 0.4 to 5.0% by mass, or from 0.6 to 3.5% by mass, or from 1.0 to 3.0% by mass, or from 1.2 to 2.5% by mass, based on the total mass of the composition, of one or more zinc dihydrocarbyl dithiophosphate compounds;

(iv) from 0.1 to 2.0% by mass, or from 0.1 to 1.5% by mass, or from 0.2 to 1.2% by mass, or from 0.2% to 0.8% by mass, based on the total mass of the composition, of one or more oil-soluble or dispersible molybdenum-containing compounds;

(v) optionally an ashless dispersant;

(vi) optionally one or more antioxidants;

(vii) optionally one or more corrosion inhibitors;

(viii) optionally one or more friction modifiers;

(ix) optionally a calcium-containing detergent; and

(x) optionally additional lubricating oil basestock,

wherein one or more of the following are satisfied:

the composition exhibits a zinc content of from 400 to 4500 ppm, or from 500 to 2500 ppm, or from 750 to 2000 ppm, or from 800 to 1600 ppm, based on the total mass of the composition;

the composition exhibits a molybdenum content of from 50 to 1000 ppm, or from 50 to 800 ppm, or from 100 to 650 ppm, or from 100 to 500 ppm, based on the total mass of the composition; and

the composition exhibits a phosphorus content of from 400 to 5000 ppm, or from 600 to 3300 ppm, or from 900 to 2700 ppm, or from 1000 to 2300 ppm, based on the total mass of the composition, and

wherein one or more of the following are satisfied:

in a 4-ball wear test according to ASTM D4172, the composition exhibited an average wear scar after about 1 hour test duration of 0.35 mm or less;

in a 4-ball wear test according to ASTM D4172, the composition exhibited an average wear scar after about 2 hours test duration of less than 0.40 mm; and

in a 4-ball wear test according to ASTM D4172, the composition exhibited an average wear scar after about 1 hour or about 2 hours test duration that was at least 20% smaller than exhibited by the same composition except containing only two or only three of components (i), (ii), (iii), and (iv).

13. A transmission fluid composition according to claim 12, wherein one or more of the following is satisfied:

the lubricating oil basestock is a Group II basestock, a Group III basestock, or a combination thereof;

the additive package comprises from 0.1 to 5% by mass of an ashless dispersant;

the ashless dispersant comprises a polyisobutenyl succinimide formed from polyisobutenyl succinic anhydride and a polyalkylene polyamine, wherein the polyisobutenyl group is derived from polyisobutene and exhibits a number average molecular weight (Mn) from about 750 to about 5000 Daltons;

the additive package comprises an overbased calcium-sulfonate detergent, an overbased calcium salicylate detergent, or a combination thereof, which detergent provides the transmission fluid composition with from 500 to 4500 parts per million by mass of calcium;

the additive package comprises at least two antioxidants, other than any compounds that may function as antioxidants from components (i), (ii), (iii), and (iv);

the additive package comprises one or more friction modifiers;

the additive package comprises lubricating oil basestock, in addition to the lubricating oil basestock that forms a majority of the transmission fluid composition; and

the transmission fluid composition exhibits a boron content from 15 to 180 parts per million by mass, based on the total mass of the composition.

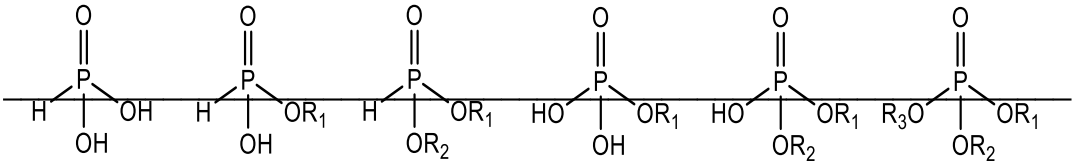
14. A method of controlling or reducing wear in a manual transmission, the method comprising lubricating the transmission with a transmission fluid composition according to any preceding claim.

15. The use of the combination of:

a major amount of a lubricating oil basestock; and

a minor amount of an additive package comprising:

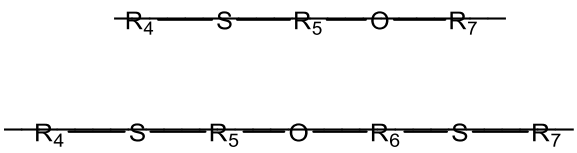
(i) a mixture comprising two or more compounds of structures (I):



(I);

where groups R_1, R_2 and R_3 are independently alkyl groups having 1 to 18 carbon atoms or alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage, provided that, in the mixture (i), at least some of groups R_1, R_2 and R_3 are alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage;

(ii) one or more compounds of structures (II):



(II)

where groups R_4 and R_7 are independently alkyl groups having 1 to 12 carbon atoms and R_5 and R_6 are independently alkyl linkages having 2 to 12 carbon atoms;

(iii) one or more zinc dihydrocarbyl dithiophosphate compounds; and

(iv) one or more oil-soluble or dispersible molybdenum-containing compounds,

in a transmission fluid composition to control or reduce the wear in a transmission lubricated by the composition.

CLAIMS

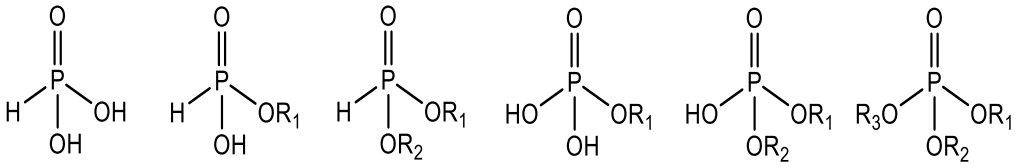
What is claimed is:

1. A transmission fluid composition comprising:

a major amount of a lubricating oil basestock; and

a minor amount of an additive package comprising:

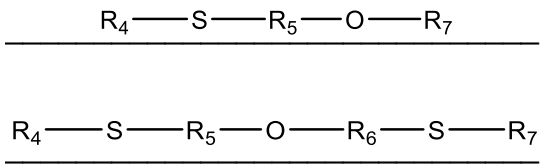
(i) a mixture comprising two or more compounds of structures (I):



(I);

where groups R_1, R_2 and R_3 are independently alkyl groups having 1 to 18 carbon atoms or alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage, provided that, in the mixture (i), at least some of groups R_1, R_2 and R_3 are alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage;

(ii) one or more compounds of structures (II):



(II)

where groups R_4 and R_7 are independently alkyl groups having 1 to 12 carbon atoms and R_5 and R_6 are independently alkyl linkages having 2 to 12 carbon atoms;

(iii) one or more zinc dihydrocarbyl dithiophosphate compounds; and

(iv) one or more oil-soluble or dispersible molybdenum-containing compounds,

wherein the compounds of component (i) and component (ii) are each present in the composition in an amount from 0.1 to 2.0% by mass, based on the total mass of the composition; and wherein component (iii) is present in the composition in an amount from 0.4 to 5.0% by mass, based on the total mass of the composition.

2. A transmission fluid composition according to claim 1, wherein the compounds of component (i) and component (ii) are each present in the composition in an amount from 0.1 to 1.2% by mass, or from 0.1 to 0.8% by mass, or from 0.2 to 0.6% by mass, based on the total mass of the composition.

3. A transmission fluid composition according to claim 1 or claim 2, wherein the compounds of component (i) and component (ii) are present in the composition in a mass ratio of from 2:1 to 1:2, or from 3:2 to 2:3, or from 4:3 to 3:4.

4. A transmission fluid composition according to any preceding claim, wherein component (iii) is present in the composition in an amount from 0.6 to 3.5% by mass, or from 1.0 to 3.0% by mass, or from 1.2 to 2.5% by mass, based on the total mass of the composition.

5. A transmission fluid composition according to any preceding claim, wherein component (iii) provides the composition with 400 to 4500 parts per million by mass (ppm) of zinc, or from 500 to 2500 ppm of zinc, or from 750 to 2000 ppm of zinc, or from 800 to 1600 ppm of zinc, based on the total mass of the composition.

6. A transmission fluid composition according to any preceding claim, wherein component (iv) is present in the composition in an amount from 0.1 to 2.0% by mass, or from 0.1 to 1.5% by mass, or from 0.2 to 1.2% by mass, or from 0.2% to 0.8% by mass, based on the total mass of the composition.

7. A transmission fluid composition according to any preceding claim, wherein component (iv) provides the composition with from 50 to 1000 parts per million by mass (ppm) of molybdenum, or from 50 to 800 ppm of molybdenum, or from 100 to 650 ppm of molybdenum, or from 100 to 500 ppm of molybdenum, based on the total mass of the composition.

8. A transmission fluid composition according to any preceding claim, wherein component (iv) comprises a molybdenum dithiocarbamate, a molybdenum dialkyldithiophosphate, a molybdenum alkyl xanthate, a molybdenum alkyl thioxanthate, or a combination thereof.

9. A transmission fluid composition according to any preceding claim, wherein component (iv) comprises substantially no molybdenum dialkyldithiophosphate.

10. A transmission fluid composition according to any preceding claim, wherein component (iv) is a di-nuclear or a tri-nuclear molybdenum compound.

11. A transmission fluid composition according to any preceding claim, further comprising one or more ashless dispersants, a calcium-containing detergent, or a combination thereof.

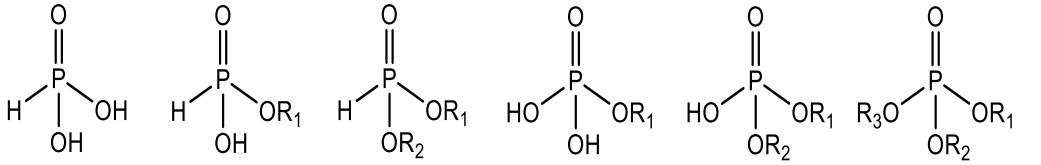
12. A method of controlling or reducing wear in a manual transmission, the method comprising lubricating the transmission with a transmission fluid composition according to any preceding claim.

13. The use of the combination of:

a major amount of a lubricating oil basestock; and

a minor amount of an additive package comprising:

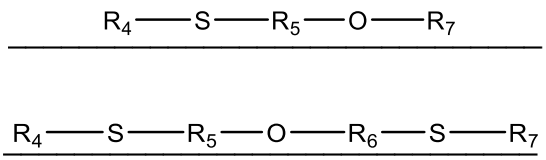
(i) a mixture comprising two or more compounds of structures (I):



(I);

where groups R_1, R_2 and R_3 are independently alkyl groups having 1 to 18 carbon atoms or alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage, provided that, in the mixture (i), at least some of groups R_1, R_2 and R_3 are alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage;

(ii) one or more compounds of structures (II):



(II)

where groups R_4 and R_7 are independently alkyl groups having 1 to 12 carbon atoms and R_5 and R_6 are independently alkyl linkages having 2 to 12 carbon atoms;

(iii) one or more zinc dihydrocarbyl dithiophosphate compounds; and

(iv) one or more oil-soluble or dispersible molybdenum-containing compounds,

in a transmission fluid composition to control or reduce the wear in a transmission lubricated by the composition,

wherein the compounds of component (i) and component (ii) are each present in the composition in an amount from 0.1 to 2.0% by mass, based on the total mass of the composition; and wherein component (iii) is present in the composition in an amount from 0.4 to 5.0% by mass, based on the total mass of the composition.