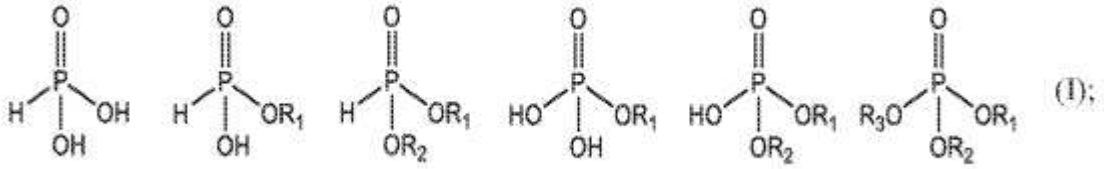
CLAIMS

~~What is claimed is:~~

1. ~~A~~A suspension-stable transmission fluid booster additive package composition comprising:

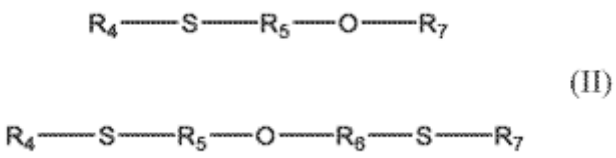
(a) anti-wear compounds consisting of a mixture comprising:

(i) 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 component (i), at least ~~some of groups R_1, R_2 and R_3~~ one incarnation represented by at least one moiety from the mixture comprising structure (I) as functionalized in a set of all groups R_1, R_2 and R_3 in all structure (I) compounds, collectively, are alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage; and ~~-~~(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;

(b) an ashless dispersant representing at least 20 mass % of the transmission fluid booster additive package composition;

(c) an overbased calcium phenate detergent;

(d) at least two friction modifiers, a first of which comprises a polyethylene polyamine succinimide derivative~~;~~, and a second friction modifier comprises an amide friction modifier, an amine friction modifier, or a mixture or combination thereof;

(e) a corrosion inhibitor; and

(f) a suspension-stabilizing amount of a lubricating oil basestock, wherein the transmission fluid booster additive package composition exhibits:

a boron content from 0.04 mass % to 0.75 mass %, based on the total mass of the additive package composition;

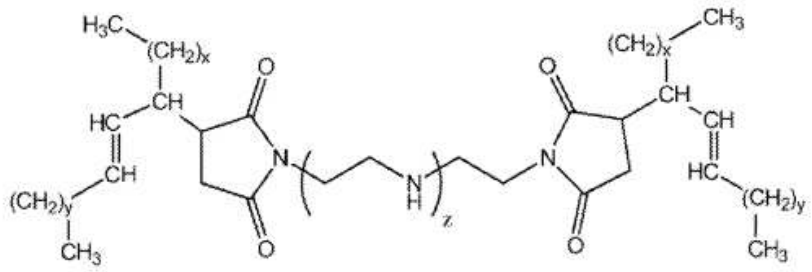
a calcium content from 0.3 mass % to 1.5 mass %, based on the total mass of the additive package composition; and

a phosphorus content from 0.3 mass % to 1.5 mass %, based on the total mass of the additive package composition.

2. A booster additive package composition according to claim 1, 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.

3. A booster additive package composition according to claim 1 ~~or claim 2~~, wherein the ashless dispersant comprises a polyisobutenyl succinimide.

4. A booster additive package composition according to ~~any one of the previous claims~~claim 1, wherein the polyethylene polyamine succinimide derivative has the following structure:



wherein x + y is from 8 to 15 and z is 0 or an integer from 1 to 5.

5. A booster additive package composition according to ~~any one of the previous claims, wherein a second friction modifier comprises an amide friction modifier, an amine friction modifier, or a mixture or combination thereof~~claim 1, wherein the corrosion inhibitor comprises a benzotriazole.

6. A booster additive package composition according to ~~any one of the previous claims, wherein the corrosion inhibitor comprises a benzotriazole.~~

~~7. A booster additive package composition according to any one of the previous claims~~claim 1, wherein the transmission fluid booster additive package composition comprises substantially no additional antioxidants, other than any compounds that may function as antioxidants from components (a), (b), (c), (d), and (e).

~~8~~7. A booster additive package composition according to ~~any one of the previous claims~~claim 1, wherein the lubricating oil basestock comprises a Group II basestock, a Group III basestock, and/or a Group V basestock and is present in a suspension-stabilizing amount from 5.0 mass % to 40 mass %, based on the weight of the booster additive package composition.

~~9~~8. A booster additive package composition according to ~~any one of the previous claims~~claim 1, wherein ~~one or more of the following is satisfied:~~
~~(1)~~ a fully formulated lubricating oil composition, which comprises the booster additive package composition and a lubricating oil basestock that is the same as or different from the lubricating oil basestock in the booster additive package composition ~~(e.g., in~~ a mass ratio of booster additive package composition to lubricating oil basestock of from 1:49 to 1:7~~),~~ is formulated to exhibit an anti-shudder durability (ASD) lifetime under constant torque of at least 85 hours~~;~~.

~~(2) the~~

9. A booster additive package composition according to claim 1, which contributes at least an additional 40 hours of ASD lifetime under constant torque, when added to a fresh or used fully formulated lubricating oil composition comprising, or having comprised prior to use, at least an anti-wear additive, an ashless dispersant, a detergent, a friction modifier, at least one additional antioxidant, and a lubricating oil basestock, as compared to an ASD lifetime of the fresh or used fully formulated lubricating oil composition alone ~~(e.g.,~~ wherein a mass ratio of the booster additive package composition to fresh or used fully formulated lubricating oil composition is from 1:32 to 1:8~~); and~~.

~~(3) the~~10. A booster additive package composition according to claim 1, which contributes at least a 60% increase in ASD lifetime under constant torque, when added to a fresh or used fully formulated lubricating oil composition comprising, or having comprised prior to use, at least an anti-wear additive, an ashless dispersant, a detergent, a friction modifier, at least one additional antioxidant, and a lubricating oil basestock, as compared to an ASD lifetime of the fresh or used fully formulated lubricating oil composition alone ~~(e.g.,~~ wherein a mass ratio of the booster additive package composition to fresh or used fully formulated lubricating oil composition is from 1:32 to 1:8~~)~~.

~~10~~11. A rejuvenated, used lubricating oil composition comprising an admixture of:

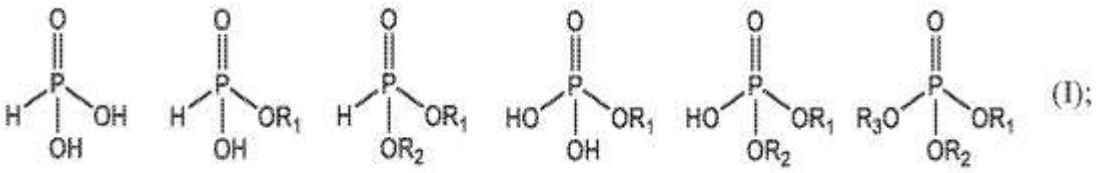
a major amount of a fully formulated lubricating oil composition that has been previously used to lubricate a vehicle transmission for at least 25,000 kilometers, or a lubrication running time equivalent thereto, the fully formulated lubricating oil composition having comprised, prior to use, at least an anti-wear additive, an ashless dispersant, an overbased calcium detergent, a friction

modifier, a corrosion inhibitor, at least two additional antioxidants, and a lubricating oil basestock; and

a minor amount of a suspension-stable transmission fluid booster additive package composition that maintains suspension stability when added to the previously used formulated lubricating oil composition, which booster additive package composition ~~may be according to any of the previous claims or comprises: (a) a mixture comprising:~~ comprises: ~~(i) two or more compounds of structures (I):~~

(a) anti-wear compounds consisting essentially of a mixture comprising:

(i) 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 component (i), at least ~~some of groups R_1, R_2 and R_3~~ one incarnation represented by at least one moiety from the mixture comprising structure (I) as functionalized in a set of all groups R_1, R_2 and R_3 in all structure (I) compounds, collectively, are alkyl groups having 1 to 18 carbon atoms where the alkyl chain is interrupted by a thioether linkage; and ~~(ii) one or more compounds of structures (II):~~

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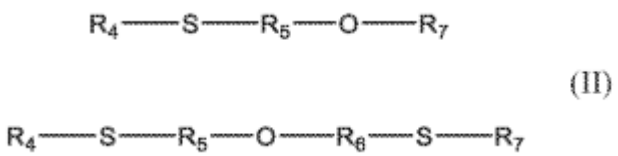


(II)

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;

(b) an ashless dispersant;

(c) an overbased calcium phenate detergent;

(d) at least two friction modifiers, a first of which comprises a polyethylene polyamine succinimide derivative~~;~~, and a second friction modifier comprises an amide friction modifier, an amine friction modifier, or a mixture or combination thereof;

(e) a corrosion inhibitor; and

(f) a suspension-stabilizing amount of a lubricating oil basestock, wherein the rejuvenated, used lubricating oil composition exhibits:

a boron content from 30 to 400 parts per million by mass, based on the total mass of the rejuvenated, used lubricating oil composition;

a calcium content from 250 to 800 parts per million by mass, based on the total mass of the rejuvenated, used lubricating oil composition; and

a phosphorus content from 250 to 800 parts per million by mass, based on the total mass of the rejuvenated, used lubricating oil composition.

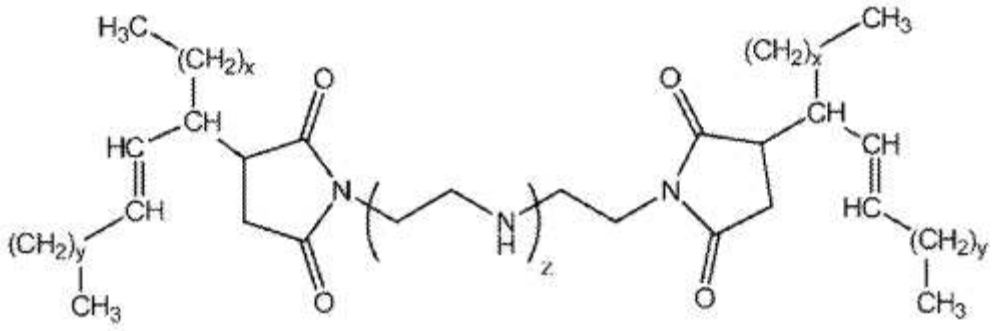
~~11~~12. A rejuvenated composition according to claim ~~10~~11, wherein at least 20 mass % of the transmission fluid booster additive package composition is comprised of the ashless dispersant.

~~12~~13. A rejuvenated composition according to ~~claim 10 or~~ claim 11, wherein the compounds of component (i) and component (ii) are each present in the composition in an amount from 0.05 to 1.2% by mass, based on the total mass of the composition.

~~13~~14. A rejuvenated composition according to ~~any one of claims 10 through 12~~claim 11, 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.

~~14~~15. A rejuvenated composition according to ~~any one of claims 10 through 13~~claim 11, wherein the ashless dispersant comprises a polyisobutenyl succinimide and the corrosion inhibitor comprises a benzotriazole.

16. ~~15.~~ A rejuvenated composition according to ~~any one of claims 10 through 14~~claim 11, wherein the polyethylene polyamine succinimide derivative has the following structure:



wherein x + y is from 8 to 15 and z is 0 or an integer from 1 to 5.

17. ~~16.~~ A rejuvenated composition according to ~~any one of claims 10 through 15, wherein a second friction modifier comprises an amide friction modifier, an amine friction modifier, or a mixture or combination thereof.~~
claim 11~~17. A rejuvenated composition according to any one of claims 10 through 16~~, wherein the transmission fluid booster additive package composition comprises substantially no additional antioxidants, other than any compounds that may function as antioxidants from components (a), (b), (c), (d), and (e).

18. A rejuvenated composition according to ~~any one of claims 10 through 17~~claim 11, wherein a mass ratio of the booster additive package composition to the used fully formulated lubricating oil composition is from 1:49 to 1:~~5~~7.

19. A rejuvenated composition according to ~~any one of claims 10-18~~claim 11, wherein the lubricating oil basestock from the booster additive package composition comprises a Group II basestock, a Group III basestock, and/or a Group V basestock, and wherein the lubricating oil basestock from the fully formulated lubricating oil composition, prior to use, comprised a Group II basestock and/or a Group III basestock.

20. A rejuvenated composition according to ~~any one of claims 10 through 19, wherein one or more of the following is satisfied:~~
~~(1)~~claim 11, wherein the rejuvenated, used lubricating oil composition exhibits an anti-shudder durability (ASD) lifetime under constant torque of at least 80 hours~~;~~.

~~(2)~~21. A rejuvenated composition according to claim 11, wherein the rejuvenated, used lubricating oil composition exhibits an anti-shudder durability (ASD) lifetime under constant torque of an additional 40 hours, as compared to an ASD lifetime of the used fully formulated lubricating oil composition alone ~~(e.g.,~~ wherein a mass ratio of the booster additive package composition to used fully formulated lubricating oil composition is from 1:32 to 1:8~~); and~~.

~~(3)~~22. A rejuvenated composition according to claim 11, wherein the rejuvenated, used lubricating oil composition contributes at least a 60% increase in ASD lifetime under constant torque, as compared to an ASD lifetime of the used fully formulated lubricating oil composition alone ~~(e.g.,~~ wherein a mass ratio of the booster additive package composition to used fully formulated lubricating oil composition is from 1:32 to 1:8~~).~~.

~~21~~23. A rejuvenated composition according to ~~any one of claims 10 through 20~~claim 11, which composition exhibits:

(A) a coefficient of friction, μ, of at least 0.100 and not greater than 0.140 under LFW-1 standard test conditions at a sliding speed of about 0.125 m/s, a temperature of about 110~~°C,~~° C., and at an applied load of about 1.~~1kN (~250~~1 kN (˜250 lbs);

(B) a coefficient of friction, μ(5), that is no more than 40% below and no greater than 10% above a corresponding coefficient of friction, μ(5), of the rejuvenated, used lubricating oil composition without the transmission fluid booster additive package composition, in which μ(5) is measured according to constant-torque modified JASO M349 standard anti-shudder durability test conditions; or

(C) both (A) and (B).

~~22~~24. A method of rejuvenating a fully formulated lubricating oil composition that has been previously used to lubricate a vehicle transmission for at least 25,000 kilometers, or a lubrication running time equivalent thereto, the method comprising:

admixing the suspension-stable transmission fluid booster additive package composition according to ~~any one of claims 1 through 9~~claim 1 with the used, fully formulated lubricating oil composition to form a rejuvenated, used lubricating oil composition, the used, fully formulated lubricating oil composition having comprised, prior to use, at least an anti-wear additive, an ashless dispersant, an overbased calcium detergent, a friction modifier, a corrosion inhibitor, at least two additional antioxidants, and a lubricating oil basestock; and

lubricating the vehicle transmission to enable operation for at least an additional 30,000 kilometers, or a lubrication running time equivalent thereto.

~~23~~25. A method of rejuvenating a fully formulated lubricating oil composition that has been previously used to lubricate a vehicle transmission for at least 25,000 kilometers, or a lubrication running time equivalent thereto, the method comprising:

admixing a suspension-stable transmission fluid booster additive package composition with the used, fully formulated lubricating oil composition to form the rejuvenated, used lubricating oil composition according to ~~any one of claims 10 through 21~~claim 11, the used, fully formulated lubricating oil composition having comprised, prior to use, at least an anti-wear additive, an ashless dispersant, an overbased calcium detergent, a friction modifier, a corrosion inhibitor, at least two additional antioxidants, and a lubricating oil basestock; and

lubricating the vehicle transmission to enable operation for at least an additional 30,000 kilometers, or a lubrication running time equivalent thereto.

~~24. Use of the suspension-stable transmission fluid booster additive package composition according to any one of claims 1 through 9 in combination with a fresh or used fully formulated lubricating oil composition to rejuvenate lubricant properties at least partially lost during previous operation of a vehicle transmission, in particular rejuvenating one or more of anti-shudder durability, friction modification, dynamic-static friction balance, anti-wear, soot dispersion capability, detergency, suspension stability, and corrosion inhibition.~~

~~25. Use of the rejuvenated, used lubricating oil composition according to any one of claims 10 through 21 to rejuvenate lubricant properties at least partially lost during previous operation of a vehicle transmission, in particular rejuvenating one or more of anti-shudder durability, friction modification, dynamic-static friction balance, anti-wear, soot dispersion capability, detergency, suspension stability, and corrosion inhibition.~~