CLAIMS

1. A lubricating oil composition comprising:

a base oil;

a primary antioxidant comprising an alkylated diphenylamine having an alkyl group derived from a propylene oligomer, wherein the propylene oligomer comprises 50-90 wt % $C_{12}H_{24}$ and 1-10 wt% $C_{15}H_{30}$;

a secondary antioxidant comprising a dithiocarbamate, a hindered phenol, or a molybdenum succinimide; and

0.1 wt% to 5 wt% of a sulfonate detergent, selected from an internal olefin sulfonate, an alkyl ether sulfonate, an alcohol ether sulfonate, a linear alkyl aryl sulfonate, and an alkane sulfonate.

2. The lubricating oil composition of claim 1, wherein:

the hindered phenol is selected from 2,6-di-tert-butylphenol, 4-methyl-2,6-di-tert-butylphenol, 4-ethyl-2,6-di-tert-butylphenol, 4-propyl-2,6-di-tert-butylphenol, 4-butyl-2,6-di-tert-butylphenol, and 4-dodecyl-2,6-di-tert-butylphenol;

the dithiocarbamate is an ashless dialkyl dithiocarbamate wherein the alkyl group has from 1 to 6 carbon atoms; or

the molybdenum succinimide is derived from a polyisobutenyl succinic anhydride of 70 to 128 carbon atoms.

3. The lubricating oil composition of claim 1, wherein the sulfonate detergent :

(a) is a petroleum-based detergent or a synthetic detergent, or

(b) is overbased, or

(c) is present in 1 wt % to 3 wt % of the lubricating oil composition.

4. The lubricating oil composition of claim 1, wherein the primary antioxidant is present in 0.01 wt % to 20 wt % of the lubricating oil composition.

5. The lubricating oil composition of claim 1, wherein the secondary antioxidant is present in 0.01 wt % to 20 wt % of the lubricating oil composition.

6. The lubricating oil composition of claim 1, further comprising:

an additional antioxidant, an ashless dispersant, an anti-wear agent, a detergent, a rust inhibitor, a dehazing agent, a demulsifying agent, a friction modifier, a metal deactivating agent, a pour point depressant, a viscosity modifier, an antifoaming agent, a co-solvent, a package compatibilizer, a corrosion-inhibitor, a dye, or an extreme pressure agent.

7. A method of improving oxidation stability of a lubricating oil, the method comprising:

supplying to an engine a lubricating oil composition comprising:

a base oil;

a primary antioxidant comprising an alkylated diphenylamine having an alkyl group derived from propylene oligomer, wherein the propylene oligomer comprises 50-90 wt % $C_{12}H_{24}$ and 1-10 wt% $C_{15}H_{30}$;

a secondary antioxidant comprising a dithiocarbamate, a hindered phenol, or a molybdenum succinimide; and

0.1 wt% to 5 wt% of a sulfonate detergent, selected from an internal olefin sulfonate, an alkyl ether sulfonate, an alcohol ether sulfonate, a linear alkyl aryl sulfonate, and an alkane sulfonate.

8. The method of claim 7, wherein:

the hindered phenol is selected from 2,6-di-tert-butylphenol, 4-methyl-2,6-di-tert-butylphenol, 4-ethyl-2,6-di-tert-butylphenol, 4-propyl-2,6-di-tert-butylphenol, 4-butyl-2,6-di-tert-butylphenol, and 4-dodecyl-2,6-di-tert-butylphenol;

the dithiocarbamate is an ashless dialkyl dithiocarbamate wherein the alkyl group has from 1 to 6 carbon atoms; or

the molybdenum succinimide is derived from a polyisobutenyl succinic anhydride of 70 to 128 carbon atoms.

9. The method of claim 7, wherein the sulfonate detergent:

(a) is a petroleum-based detergent or a synthetic detergent, or

(b)) is overbased, or

(c) is present in 1 wt % to 3 wt % of the lubricating oil composition.

10. The method of claim 7, wherein the primary antioxidant is present in 0.01 wt % to 20 wt % of the lubricating oil composition.

11. The method of claim 7, wherein the secondary antioxidant is present in 0.01 wt % to 20 wt % of the lubricating oil composition.

12. The method of claim 7, wherein the lubricating oil composition further comprises:

an additional antioxidant, an ashless dispersant, an anti-wear agent, a detergent, a rust inhibitor, a dehazing agent, a demulsifying agent, a friction modifier, a metal deactivating agent, a pour point depressant, a viscosity modifier, an antifoaming agent, a co-solvent, a package compatibilizer, a corrosion-inhibitor, a dye, or an extreme pressure agent.