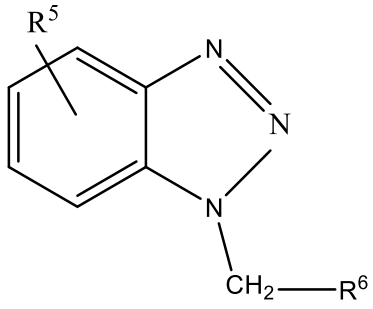
WHAT IS CLAIMED IS:

1. An automotive engine lubricating oil composition comprising

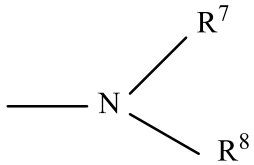
(A) a base oil of lubricating viscosity,

(B) at least one benzotriazole derivative represented by Formula (I):



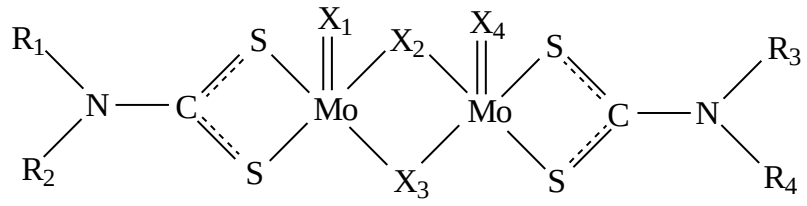
Formula (I)

wherein R^5 is a hydrocarbyl group having 1-3 carbon atoms and R^6 is a tertiary amine group represented by



wherein R^7 and R^8 are independently hydrocarbyl groups having 3 to 10 carbon atoms,

(C) at least one molybdenum dithiocarbamate compound represented by either Formula (II) or Formula (III):



Formula (II)

wherein R_1 through R_4 independently denote a straight chain, branched chain or aromatic hydrocarbyl group having 1 to 24 carbon atoms; and X_1 through X_4 independently denote an oxygen atom or a sulfur atom,

Formula (III)

$Mo_3S_kL_nQ_z$

wherein L are independently selected ligands having organo groups with a sufficient number of carbon atoms to render the compound soluble or dispersible in the oil, n is from 1 to 4, k is from 4 to 7, Q is selected from the group of neutral electron donating compounds such as water, amines, alcohols, phosphines, and ethers, and z ranges from 0 to 5 and includes non-stoichiometric values, and

(D) one or more additional additives chosen from metal containing or ashless detergents, ashless antioxidants, antiwear additives, corrosion inhibitors, rust inhibitors, viscosity index improvers, and dispersants,

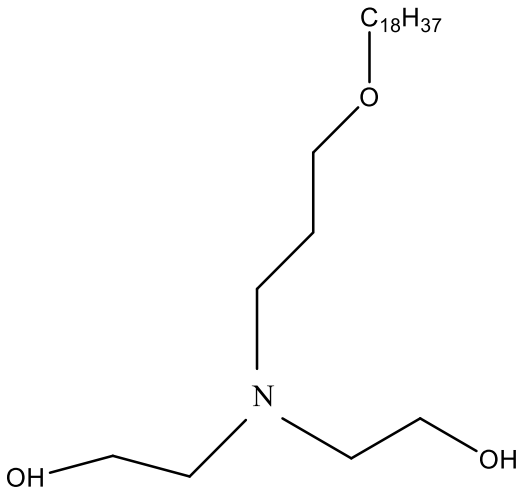
wherein:

1) the lubricating oil composition comprises a total amount of from 450 to 2000 ppm molybdenum from molybdenum dithiocarbamate component (C);

2) wherein the benzotriazole derivative (B) is present in the lubricating oil in an amount from ~~0.001 to 5~~ 0.01 to 0.04 wt% mass%;

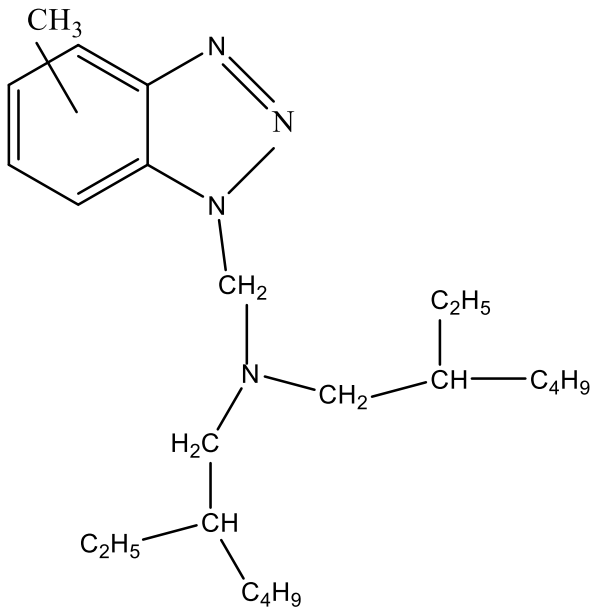
3) the lubricating oil composition is present in an automotive engine operating at temperatures below 80 °C; and

4) when the molybdenum dithiocarbamate compound (C) comprises only a dimeric molybdenum dithiocarbamate of Formula (II), an aminic friction modifier having a structure according to Formula (IV) below is also present:



Formula (IV).

2. An automotive engine lubricating oil composition according to Claim 1, wherein the benzotriazole derivative (B) has the following structure:



~~3. An automotive engine lubricating oil composition according to Claim 1 or 2, wherein the benzotriazole derivative (B) is present in an amount from 0.001 to 5 wt%, preferably in an amount of 0.01 to 2 wt% for example, in an amount of 0.01 to 1 wt% on an active matter basis.~~

~~4. An automotive engine lubricating oil composition according to Claim 3, wherein the benzotriazole derivative is present in the lubricating oil composition of the present invention in an amount of 0.01 to 0.04 wt% on an active matter basis~~.

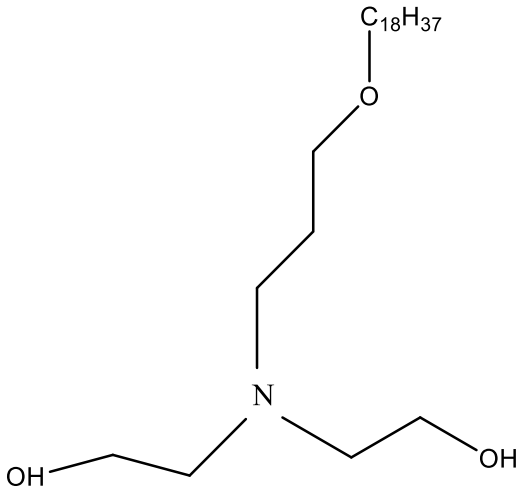
~~5~~3. An automotive engine lubricating oil composition according to ~~any one of~~ Claim~~s~~ 1 ~~–~~or Claim 2~~to 4~~, wherein the molybdenum dithiocarbamate compound (C) comprises only a dimeric molybdenum dithiocarbamate of Formula (II).

~~6~~4. An automotive engine lubricating oil composition according to ~~any one of~~ Claim~~s~~ 1 ~~to 4~~or 2, wherein the molybdenum dithiocarbamate compound (C) comprises a mixture of dimeric molybdenum dithiocarbamate of Formula (II) and trimeric molybdenum dithiocarbamate of Formula (III).

~~7~~5. An automotive engine lubricating oil composition according to ~~any one of~~ Claim~~s~~ 1, 2, 3 or 4 ~~to 6~~, wherein the lubricating oil composition comprises a total amount of from 450 to 1200 ~~-~~ppm molybdenum from molybdenum dithiocarbamate component (C).

~~8~~6. An automotive engine lubricating oil composition according to Claim 1, 2, 3, 4, 5, or 6 ~~7~~, wherein the molybdenum dithiocarbamate compound (C) provides the lubricating oil composition with from 600 to 900 ppm molybdenum.

~~9~~7. An automotive engine lubricating oil composition according to Claim 1, 2, 3, 4, 5, or 6, ~~any one of the preceding claims~~ further comprising an aminic friction modifier having a structure according to Formula (IV) below:



Formula (IV)

~~10~~8. An automotive engine lubricating oil composition according to Claim 9, wherein the amount of aminic friction modifier of Formula (IV) in the lubricating oil composition does not exceed 5 mass %, based on the total mass of the lubricating oil composition ~~and preferably does not exceed 2 mass % and more preferably does not exceed 0.5 mass %.~~

9. An automotive engine lubricating oil composition according to Claim 7, wherein the amount of aminic friction modifier of Formula (IV) in the lubricating oil composition does not exceed 2 mass %, based on the total mass of the lubricating oil composition.

10. An automotive engine lubricating oil composition according to Claim 7, wherein the amount of aminic friction modifier of Formula (IV) in the lubricating oil composition does not exceed 0.5 mass %, based on the total mass of the lubricating oil composition.

11. An automotive engine lubricating oil composition according to Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 ~~any one of the preceding claims~~, wherein the lubricating oil composition further comprises one or more metal detergents that are neutral or overbased alkali or alkaline earth metal salicylates ~~preferably a neutral or overbased magnesium and/or calcium salicylate detergent~~.

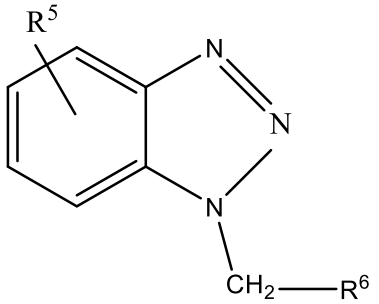
12. An automotive engine lubricating oil composition according to Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10, wherein the lubricating oil composition further comprises one or more metal detergents that are a neutral or overbased magnesium and/or calcium salicylate detergent.

~~12~~13. An automotive engine lubricating oil composition according to any ~~one of the preceding claims~~Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11, wherein the lubricating oil composition further comprises one or more oil-soluble zinc dihydrocarbyl dithiophosphates~~, preferably comprising only secondary alkyl groups~~.

14. An automotive engine lubricating oil composition according to Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12, or 13, wherein the lubricating oil composition further comprises one or more oil-soluble zinc dihydrocarbyl dithiophosphates comprising only secondary alkyl groups.

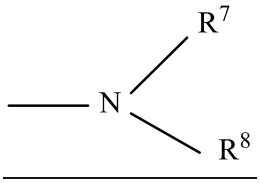
~~13~~15. A method of lubricating an automotive engine comprising lubricating the engine with an automotive engine lubricating oil composition as claimed in Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, or 14~~any one of the preceding claims~~.

~~14~~16. The use, in the lubrication of an automotive engine, of at least one benzotriazole derivative (B)~~,~~ represented by Formula (I):



Formula (I)

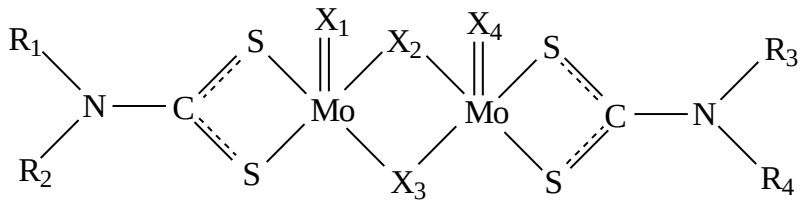
wherein R^5 is a hydrocarbyl group having 1-3 carbon atoms and R^6 is a tertiary amine group represented by



wherein R^7 and R^8 are independently hydrocarbyl groups having 3 to 10 carbon atoms

~~as defined in any one of claims 1 to 12~~, as an additive in an effective minor amount, in a lubricating oil composition comprising a base oil of lubricating viscosity (A) and at least one molybdenum dithiocarbamate compound (C),

represented by either Formula (II) or Formula (III):



Formula (II)

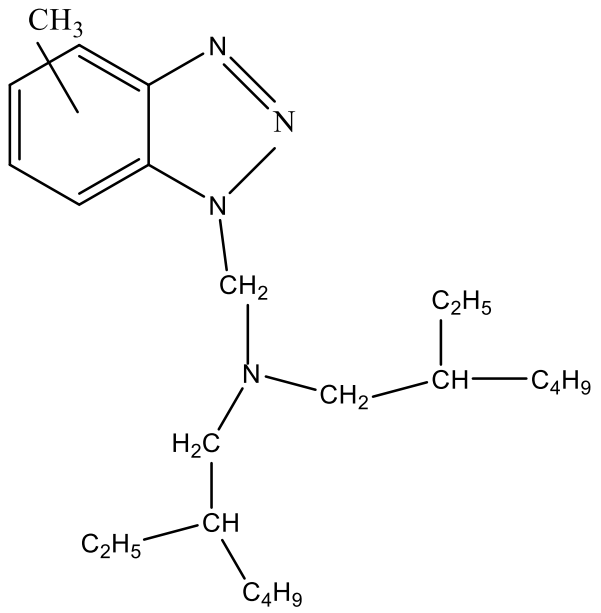
wherein R_1 through R_4 independently denote a straight chain, branched chain or aromatic hydrocarbyl group having 1 to 24 carbon atoms; and X_1 through X_4 independently denote an oxygen atom or a sulfur atom,

Formula (III)

$Mo_3S_kL_nQ_z$

wherein L are independently selected ligands having organo groups with a sufficient number of carbon atoms to render the compound soluble or dispersible in the oil, n is from 1 to 4, k is from 4 to 7, Q is selected from the group of neutral electron donating compounds such as water, amines, alcohols, phosphines, and ethers, and z ranges from 0 to 5 and includes non-stoichiometric values, ~~as defined in any one of claims 1 to 12,~~ to improve the friction reducing performance properties of the molybdenum dithiocarbamate compound(s) (C) during operation of the automotive engine, wherein said molybdenum dithiocarbamate compound(s) (C) provide the lubricating oil composition with from 450 to 2000 ppm of molybdenum and wherein the benzotriazole derivative (B) is present in the lubricating oil in an amount from 0.001 to 5 mass % and wherein the automotive engine operates at temperatures below 80 °C.

17. The use according to Claim 16, wherein the benzotriazole derivative (B) has the following structure:



18. The use according to Claim 16, wherein the molybdenum dithiocarbamate compound (C) comprises only a dimeric molybdenum dithiocarbamate of Formula (II).

19. The use according to Claim 16, wherein the molybdenum dithiocarbamate compound (C) comprises a mixture of dimeric molybdenum dithiocarbamate of Formula (II) and trimeric molybdenum dithiocarbamate of Formula (III).

20. The use according to Claim 16, wherein the molybdenum dithiocarbamate compound (C) provides the lubricating oil composition with from 600 to 900 ppm molybdenum.

~~15~~21. The use, in the lubrication of an automotive engine, of the combination of at least one benzotriazole derivative (B), as defined in any one of claims 1 to ~~12~~14, and at least one molybdenum dithiocarbamate compound (C), as defined in any one of claims 1 to ~~12~~14, as a combination of additives in an effective minor amount, in a lubricating oil composition comprising a base oil of lubricating viscosity (A), to improve friction reduction of the lubricating oil composition during operation of the automotive engine, wherein said molybdenum dithiocarbamate compound(s) (C)

provide the lubricating oil composition with from 450 to 2000 ppm of molybdenum~~.~~, and wherein the automotive engine operates at temperatures below 80 °C.

~~16~~22. The use, in the lubrication of an automotive engine, of the combination of at least one benzotriazole derivative (B), as defined in any one of claims 1 to ~~12~~14, and at least one molybdenum dithiocarbamate compound (C), as defined in any one of claims 1 to ~~12~~14, as a combination of additives in an effective minor amount, in a lubricating oil composition comprising a base oil of lubricating viscosity (A), to reduce fuel consumption of the automotive engine during operation of the engine,

wherein said molybdenum dithiocarbamate compound(s) (C) provide the lubricating oil composition with from 450 to 2000 ppm of molybdenum, and wherein the automotive engine operates at temperatures below 80 °C.

~~17. The use as claimed in any one of claims 14 to 16, wherein the automotive engine operates at temperatures below 80 °C.~~

~~18~~23. An automotive engine lubricating oil composition as claimed in claim 1, wherein the automotive engine lubricating oil composition operating in an engine at temperatures below 80°C has a reduced boundary regime friction coefficient as compared to the same composition absent benzotriazole derivative (B).

24. An automotive engine lubricating oil composition as claimed in claim 1, wherein the lubricating oil composition is present in an automotive engine operating at temperatures below 80 °C