chain stretch. Thus, the present disclosure provides a method of employing calcium detergents and detergent combinations in order to provide greater reductions in chain elongation than is provided by combinations of conventional anti-wear agents or dispersants.

SUMMARY AND TERMS

[0013] In a first aspect, the disclosure relates to a method for reducing timing chain stretch in an engine comprising a step of lubricating said timing chain with a lubricating oil composition comprising:

a major amount of a base oil; and

a minor amount of an additive package including:

a) at least one overbased calcium detergent,

b) at least one borated dispersant,

c) a metal dialkyl dithiophosphate, and;

d) at least one oil soluble molybdenum compound;

wherein the lubricating oil composition has a TBN value of at least 7.5 mg KOH/gram lubricating oil composition, determined using the method of ASTM-2896, at least 80 ppm of molybdenum based on a total weight of the lubricating oil composition, a weight ratio of total calcium in the lubricating oil composition to total molybdenum in the lubricating oil composition of less than 8.4; and a weight ratio of nitrogen from the dispersant in the lubricating composition to total boron in the lubricating oil composition of from 2.6 to 3.0.

[0013a] In a second aspect, the present disclosure refers to a method for reducing timing chain stretch in an engine comprising a step of lubricating said timing chain with a lubricating oil composition comprising:

a major amount of a base oil; and

a minor amount of an additive package including:

a) at least one overbased calcium detergent,

b) a borated dispersant that is a reaction product of an olefin copolymer and at least one polyamine or a reaction product of an olefin copolymer with a succinic anhydride, and at least one polyamine, and wherein the borated dispersant is post-treated with an aromatic carboxylic acid, an aromatic polycarboxylic acid, or an aromatic anhydride wherein all carboxylic acid or anhydride groups are attached directly to an aromatic

ring, and with a non-aromatic dicarboxylic acid or anhydride. having a number average molecular weight of less than 500,

c) a metal dialkyl dithiophosphate, and;

d) at least one oil soluble molybdenum compound;

wherein the lubricating oil composition has a TBN value of at least 7.5 mg KOH/g of the lubricating oil composition, determined using the method of ASTM-2896, at least 80 ppm of molybdenum based on a total weight of the lubricating oil composition, a weight ratio of total calcium in the lubricating oil composition to total molybdenum in the lubricating oil composition of less than 8.8; and a weight ratio of nitrogen from the dispersant in the lubricating composition to total boron in the lubricating oil composition of from 2.6 to 3.0.

[0014] In certain embodiments, the base oil has a SAE Viscosity grade of 5W and the lubricating oil composition has a ratio of total ppm of boron in the lubricating oil composition to the TBN of total detergent of from 45 to 63 or from 50 to 63, or from 56 to 63.

[0015] In all the foregoing embodiments, the lubricating oil composition may have a weight ratio of total boron in the lubricating oil composition to total nitrogen in the lubricating oil composition of less than 1.0.

[0016] In all the foregoing embodiments, the lubricating oil composition may have a weight ratio of total sulfur in the lubricating oil composition to total molybdenum in the lubricating oil composition of from about 1:1 to 17:1.

[0017] In each of the foregoing embodiments the base oil may have a SAE viscosity grade of 5W-30 and the lubricating oil composition may have a molybdenum content of greater than 150 ppm.

[0018] In all the foregoing embodiments, the lubricating oil composition ma contain from 1000 ppm to 1800 ppm of calcium, or from 1100 ppm to 1600 ppm, or from 1200 to

CLAIMS

1. A method for reducing timing chain stretch in an engine comprising a step of lubricating said timing chain with a lubricating oil composition comprising:

a major amount of a base oil; and

a minor amount of an additive package including:

a) at least one overbased calcium detergent,

b) at least one borated dispersant,

c) a metal dialkyl dithiophosphate, and;

d) at least one oil soluble molybdenum compound;

wherein the lubricating oil composition has a TBN value of at least 7.5 mg KOH/gram lubricating oil composition, determined using the method of ASTM-2896, at least 80 ppm of molybdenum based on a total weight of the lubricating oil composition, a weight ratio of total calcium in the lubricating oil composition to total molybdenum in the lubricating oil composition of less than 8.4; and a weight ratio of nitrogen from the dispersant in the lubricating composition to total boron in the lubricating oil composition of from 2.6 to 3.0.

2. The method of claim 1, wherein the base oil has an SAE Viscosity grade of 5W and the lubricating oil composition has a ratio of total ppm of boron in the lubricating oil composition to the TBN of total detergent in the lubricating oil composition of from 45 to 63.

3. The method of claim 2 wherein the lubricating oil composition has a ratio of total ppm of boron in the lubricating oil composition to the TBN of total detergent in the lubricating oil composition of from 50 to 63.

4. The method of claim 2 wherein the lubricating oil composition has a ratio of total ppm of boron in the lubricating oil composition to the TBN of total detergent in the lubricating oil composition of from 56 to 63.

5. The method of claim 1, wherein the lubricating oil composition has a weight ratio of total boron in the lubricating oil composition to total nitrogen in the lubricating oil composition of less than 1.0.

6. The method of claim 1, wherein the lubricating oil composition has a weight ratio of total sulfur in the lubricating oil composition to total molybdenum in the lubricating oil composition of from 1:1 to 17:1.

7. The method of claim 1, wherein the base oil has a SAE viscosity grade of 5W-30 and the lubricating oil composition has a total molybdenum content of greater than 150 ppm.

8. The method of claim 1, wherein the lubricating oil composition contains an amount of overbased calcium-containing detergent that provides from 1000 ppm to 1800 ppm of calcium to the lubricating oil composition, based on a total weight of the lubricating oil composition.

9. The method of claim 1, wherein the lubricating oil composition contains an amount of overbased calcium-containing detergent that provides from 1100 ppm to 1600 ppm of calcium to the lubricating oil composition, based on a total weight of the lubricating oil composition.

10. The method of claim 1, wherein the lubricating oil composition has a phosphorus content from 100 ppm to1000 ppm.

11. The method of claim 1, wherein the lubricating oil composition has a weight ratio of ppm metal from detergent in the lubricating oil composition to the total ppm of boron in the lubricating oil composition of from 5.7 to 8.5.

12. The method of claim 1, wherein the lubricating oil composition has a weight ratio of ppm metal from detergent in the lubricating oil composition to the total ppm of boron in the lubricating oil composition of from 5.7 to 6.5.

13. The method of claim 1, wherein the metal dialkyl dithiophosphate is a zinc dialkyl dithiophosphate and the zinc dialkyl dithiophosphate delivers 700 ppm to 900 ppm of zinc to the lubricating oil composition.

14. The method of claim 1, wherein the additive package comprises at least one detergent selected from the group consisting of a magnesium sulfonate detergent, and a neutral

calcium sulfonate detergent.

15. The method of claim 1, wherein the base oil has a viscosity grade of 0W-16, and the lubricating oil composition has a total boron content of at least 200 ppm, a total molybdenum content of at least 600 ppm, and a total sulfur content of no greater than 2550 ppm.

16. The method of claim 1, wherein the lubricating oil composition has a total boron content of no greater than 310 ppm and the lubricating oil composition includes at least one non-borated dispersant.

17. The method of claim 1, wherein the engine is a spark ignition engine.

18. The method of claim 1, wherein the engine is a spark ignition passenger car gasoline engine.

19. The method of claim 1, wherein the lubricating oil composition is capable of reducing the timing chain stretch in an engine to 0.1 % or less, as measured by the Ford Chain Wear Test over 216 hours.

20. The method of claim 1, wherein the additive package further comprises one or more additives selected from the group consisting of antioxidants, friction modifiers, pour point depressants, and viscosity index improvers.

21. A method for reducing timing chain stretch in an engine comprising a step of lubricating said timing chain with a lubricating oil composition comprising:

a major amount of a base oil; and

a minor amount of an additive package including:

a) at least one overbased calcium detergent,

b) a borated dispersant that is a reaction product of an olefin copolymer and at least one polyamine or a reaction product of an olefin copolymer with a succinic anhydride, and at least one polyamine, and wherein the borated dispersant is post-treated with an aromatic carboxylic acid, an aromatic polycarboxylic acid, or an aromatic anhydride wherein all carboxylic acid or anhydride groups are attached directly to an aromatic

ring, and with a non-aromatic dicarboxylic acid or anhydride. having a number average molecular weight of less than 500,

c) a metal dialkyl dithiophosphate, and;
d) at least one oil soluble molybdenum compound;

wherein the lubricating oil composition has a TBN value of at least 7.5 mg KOH/g of the lubricating oil composition, determined using the method of ASTM-2896, at least 80 ppm of molybdenum based on a total weight of the lubricating oil composition, a weight ratio of total calcium in the lubricating oil composition to total molybdenum in the lubricating oil composition of less than 8.8; and a weight ratio of nitrogen from the dispersant in the lubricating composition to total boron in the lubricating oil composition of from 2.6 to 3.0.