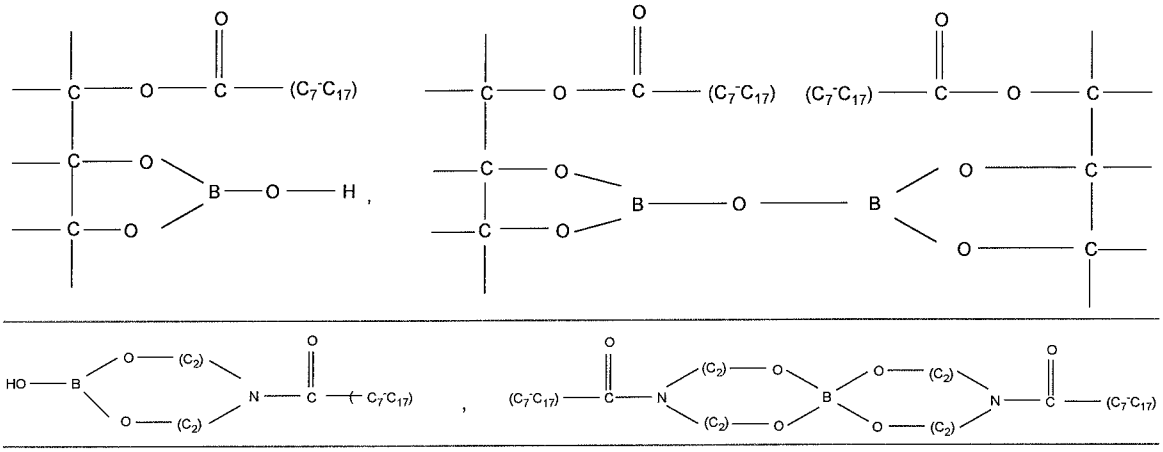
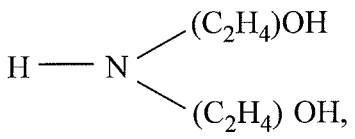
CLAIMS:

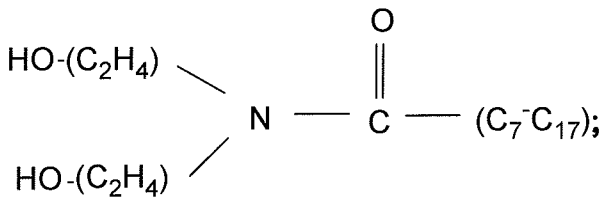
1. A method for improving one or more of the deposit formation or friction in an engine lubricated with a lubricating oil by using as the lubricating oil a formulated oil comprising a Group IV lubricating oil base stock ~~as a major component~~ at greater than or equal to 77.7 wt% and additive amounts of an essential component: (1) a borated hydroxyl saturated hydrocarbon ester amide-amine mixture comprising Vanlube® 289 which is a mixture of materials including:



as well as unreacted glycerol, glycerol mono-, di- and tri-ester,

unreacted 

unreacted boronating agent and unboronated



(2) zinc dialkyl dithiophosphate; and (3) ~~alkali and/or alkaline earth metal~~ calcium salicylate detergent whereby the levels of deposit formation and/or of friction are improved as compared to the levels achieved using a Group IV lubricating oil containing the borated hydroxyl ester amide-amine mixture, the zinc dialkyl

dithiophosphate and a calcium phenate or calcium sulfonate detergent, ~~other than the alkali and/or alkaline earth metal salicylate.~~

wherein the borated hydroxyl saturated hydrocarbyl ester amide-amine mixture is employed in an amount in the range of 1.0 to 2.2 wt%,

wherein the zinc dialkyl dithiophosphate is of the formula:

$$Zn\,[SP(S)(OR^{I})(OR^{II})]_2$$

wherein R^{I} and R^{II} are straight or branched secondary C_1 to C_{18} alkyl groups, present in an amount of about 0.45 wt% to contribute about 460 to 467 ppm phosphorous to the formulated oil, and

wherein the calcium salicylate has a TBN of anout 200 mg KOH/g present in an amount in the range 1.2 to 3 wt%,

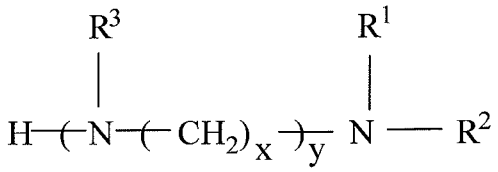
wherein the deposit formation as measured by TEOST 33C (ASTM D6335) is substantially lower than the levels achieved using a Group IV lubricating oil not containing the borated hydroxyl ester amide-amine mixture, the zinc dialkly dithiophosphate and the calcium phenate or calcium sulfonate detergent.

2. The method of claim 1 wherein the borated hydroxyl saturated hydrocarbyl ester amide-amine mixture comprises the unseparated/unpurified product produced by reacting an ester derived from an alcohol selected from aliphatic alcohols and polyhydric alcohols with a saturated fatty acid having 6 to 24 carbon atoms, the ester being reacted with a basic amine and a borating agent.

3. The method of claim 2 wherein the alcohol is glycerol.

4. The method of claim 2 wherein the saturated fatty acid has 6 to 18 carbon atoms.

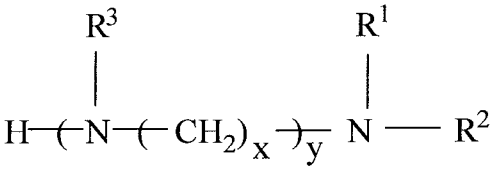
5. The method of claim 2 wherein the basic amine is selected from the group consisting of amines of the formula:



wherein x is an integer ranging from 1 to 10, y is an integer ranging from 0 to 10, R^1, R^2 and R^3 are the same or different and are selected from H, C_1 to C_{30} alkyl, $-(C_2H_4\text{-}C_6H_{4\text{-}12})OH$, provided at least one of R^1, R^2 and R^3 is not hydrogen, and heterocyclic amines.

6. The method of claim 2 wherein the borating agent is boric acid.

7. The method of claim 2 wherein the alcohol is glycerin, the saturated fatty acid contains 7 to 17 carbon atoms, the amine is of the formula:



wherein y is zero, R^1 and R^2 are the same or different and are selected from H and $(C_2H_4\text{-}C_6H_{12})OH$, provided at least one of R^1 and R^2 is $-(C_2H_4\text{-}C_6H_{4\text{-}12})OH$, and the borating agent is boric acid.

8. The method of claim 7 wherein R^1 and R^2 are the same or different and are selected from H and $(C_2H_4)OH$, provided at least one of R^1 and R^2 is $-(C_2H_4)OH$.

9. The method of claim 7 wherein both R^1 and R^2 are $-(C_2H_4)OH$.

~~10. The method of claim 1 wherein the borated hydroxyl saturated hydrocarbyl ester amide-amine mixture is employed in an amount in the range of 0.2 to 4 wt%, contributing about 20 to 800 ppm boron to the formulated oil.~~

~~11. The method of claim 1 wherein the zinc dialkyl dithiophosphate is of the formula:~~

$$\text{~~Zn [SP(S)(OR´ and R´´)]}_2$$

~~wherein R´ and R´´ are straight or branched primary or secondary C_1 to C_{18} alkyl groups, present in an amount in the range 0.8 to 4.0 wt% to contribute from about 120 to 500 ppm phosphorous to the formulated oil.~~

~~12. The method of claim 1 wherein the alkali and/or alkaline earth metal salicylate has a TBN in the range 60 to 400 mg KOH/g present in an amount in the range 0.5 to 5 wt% based on active ingredient.~~