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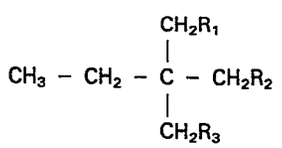
(54) Synthetic transmission lubricant composition.

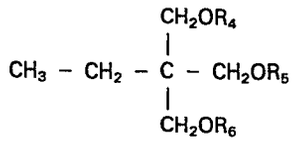
(57) A 10W transmission lubricant composition comprises a mixture of ingredients (A), (B) and (C) wherein;

Ingredient (A) is a polyol ester represented by the formula;



wherein R_1, R_2 and R_3 are the same or different and are $-OCH_2(CH_2)_xCH_3$ radicals where x is an integer from 6 to 10;

Ingredient (B) is a polyol ester represented by the formula;



wherein R_4, R_5 and R_6 are the same or different and are iso-C_n hydrocarbon radicals, where n is an integer from 18 to 24; and

Ingredient (C) is a polyalphaolefin of from about 3 to about 6 centistoke viscosity;

wherein the weight ratio of ingredient (A) to ingredient (B) is from about 2:1 to about 1:2, the weight ratio of the sum of ingredients (A) plus (B) to ingredient (C) is from about 2.4:1 to about 1.5:1, and the sum of ingredient (A) plus ingredient (B) plus ingredient (C) comprises at least about 90 weight percent of said composition.

EP 0 103 884 A2

SYNTHETIC TRANSMISSION LUBRICANT COMPOSITION

Background of the Invention

Synthetic lubricants find increasing utility because of their uniformity and stability. In particular, synthetic lubricants containing polyol esters exhibit many desirable properties.

A lubricant for modern vehicle transmissions must meet a number of exacting criteria. Modern transmissions may be enclosed in sound absorbing materials which have the side effect of acting as a heat insulator and raising the lubricant temperature.

The seal swell characteristics of a lubricant composition are of great importance if leakage of engine fluids is to be held to an acceptable level. Polyol esters used as lubricants often exhibit a tendency for unacceptably high seal swell. Polyalphaolefins used as lubricants often exhibit negative seal swell and are not as thermally stable as polyol esters.

U.S. Patent 4,144,183 describes improvement of the viscosity temperature behavior of ester oils by using mixtures of branched and straight chain carboxylic acids in a polyol esterification. U.S. Patent 4,234,497 describes improvement of seal compatibility characteristics of polyol ester lubricants by esterifying a polyol with a mixture of iso-palmitic acid and a C_5-C_{11} carboxylic acid.

Synthetic lubricants are frequently given desirable viscosity characteristics by inclusion of a viscosity index improver. The viscosity index improver is most

often a polymer which degrades with the passage of time. This gradual degradation limits the useful life of a formulated lubricant. It is desirable to prepare synthetic transmission lubricant compositions having good stability, acceptable range of viscosity, and good seal swell characteristics without the inclusion of degradable viscosity index improver or a seal swell agent.

Field of the Invention

This invention relates to lubricating compositions and methods for their use in lubricating machinery.

Summary of the Invention

A synthetic transmission lubricant composition is formulated from: (A) a polyol ester prepared by the esterification of trimethylolpropane with 8 to 12 carbon atom monocarboxylic acid, (B) a polyol ester prepared by the esterification of trimethylolpropane with a branched chain 18 to 24 carbon atom monocarboxylic acid, and (C) a liquid polyalphaolefin.

Detailed Description of the Invention

The synthetic lubricant of this invention is intended for general and heavy duty use in the transmissions of internal combustion engines. It finds particular application in heavy duty transmissions in over-the-road commercial vehicles such as buses and trucks.

The defining characteristics of an acceptable transmission lubricant for the purposes of this invention

are those of the Detroit Diesel Allison 10W Type C-3 Hydraulic Transmission Fluid Standard. The synthetic lubricants of this invention qualify for the Detroit Diesel Allison 10W Type C-3 lubricant rating and meet the test specifications set out in Table I below:

TABLE I

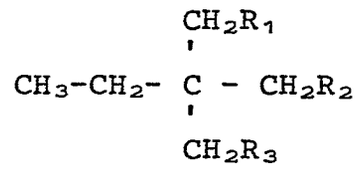
10W TYPE C-3 HYDRAULIC TRANSMISSION LUBRICANT CHARACTERISTICS

Test	Test Limit
Viscosity at -18°C. (0°F.)	2,400 Cp Max.
Viscosity at 37.8°C. (100°F.)	---
Viscosity at 98.9°C. (210°F.)	5.75 cSt min.
Pour Point	-28.9° Max. (-20°F.)
Anti-Foam Property	11 mm (7/16 Inch; 19 Sec. Max.
Anti-Wear Property	Show Grinding Pattern; No Scuff, Score, Chatter, No Varnish or Sludge
Oxidation Resistance	No Varnish or Sludge No Blackening/Flaking of Cu. 15% Max. 98.9°C. (210°F.) Vis. SUS Increase
Seal Tests:	
Total Immersion--	
Candidate Volume	0.45 to 6.70%
Candidate Hardness	5 to -5 Pts.
Dip Cycle--	
Candidate Volume	0 to 10%
Candidate Hardness	-2 to 3 Pts.
Tip Cycle--	
Candidate Volume	1.0 to 6.0%
Candidate Hardness	0 to -10 Pts.
Rust Protection	No Rust or Corrosion
Friction Retention	Max. Slip time less than 0.85 sec.; Torque 75 Pound Feet Min; Torque Differential 30 Pound Feet Max.

Essential Composition Ingredients

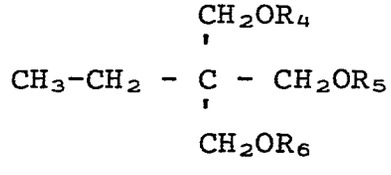
The synthetic transmission lubricant of this invention has as its essential ingredients:

(A) a polyol ester represented by the formula:



wherein R_1, R_2, and R_3 are the same or different and are $-OCH_2(CH_2)_xCH_3$ radicals where x is an integer from 6 to 10;

(B) a polyol ester represented by the formula:



wherein R_4, R_5, and R_6 are the same or different and are iso-C_n hydrocarbon radicals, where in is an integer from 18 to 24; and

(C) a polyalphaolefin of from about 3 to about 6 centistoke viscosity;

wherein the weight ratio of ingredient (A) to ingredient (B) is from about 2:1 to about 1:2, the weight ratio of the sum of ingredients (A) plus (B) to ingredient (C) is from about 2.4:1 to about 1.5:1, and the sum of ingredient (A) plus ingredient (B) plus ingredient (C) comprises at least about 90 weight percent of said composition.

The weight ratio of ingredient (A) to ingredient (B) is preferably from 1.6:1 to 1.2:1, and the weight ratio of the sum of ingredients (A) plus (B) to ingredient (C) is preferably from 2.1:1 to 1.6:1

The sum of ingredient (A) plus ingredient (B) plus ingredient (C) preferably comprises from about 90 to about 93 weight percent of the composition. The synthetic transmission lubricant consists essentially of its essential ingredients (viz., A, B, C) and conventional optional lubricant ingredients. The optional ingredients of the lubricant composition are preferably less than 8 weight percent of the total composition.

It has been found that a suitable ratio of (A):(B) and a suitable ratio of (A+B):(C) may be approximated by a linear additive model wherein each ingredient contributes to total viscosity in direct proportion to its individual viscosity multiplied by its weight proportion in the composition (within the ratio ranges taught by this specification). The viscosity characteristics of the final formulated lubricant composition may be optimized by blending aliquots of all ingredients (with optional additives) and then making slight adjustment of viscosity by appropriate addition of any of ingredients (A), (B) or (C).

The polyol ester ingredients (A) and (B) described in the preceding section may be prepared by conventional esterification methods. Suitable conventional esterification techniques are described in U.S. Patent 3,778,454 column 4, lines 9 through 75 and column 5, lines 1 through 12, the disclosure which is incorporated herein by reference.

Ingredient (A) of the composition of the invention is conveniently prepared by full esterification of

trimethylolpropane (TMP) with a straight chain monocarboxylic acid or a mixture of straight chain monocarboxylic acid having from 8 to 12 carbon atoms. Suitable acids for esterifying TMP to prepare ingredient (A) are n-octanoic acid, n-nonanoic acid and decanoic acid. Mixtures of straight chain C_8-C_{12} carboxylic acids may be used if desired. Nonanoic acid is particularly preferred for esterifying TMP to give an ester oil suitable for ingredient (A).

Ingredient (B) of the composition of the invention is conveniently prepared by the full esterification of trimethylolpropane with a branched chain carboxylic acid of from 18 to 24 carbon atoms. Examples of suitable monocarboxylic acids for the esterification of TMP to give ingredient (B) are isostearic acid; iso-octadecanoic acids, and the symmetrical branched chain acids of 18 or more carbon atoms such as described in U.S. Patent 4,144,183; Col. 4, lines 55-68 and Col. 5, lines 1-39. Mixtures of iso C_{18-24} monocarboxylic acids may be used. Trimethylolpropane tri-isostearate is a particularly preferred ester oil for use as ingredient (B).

Ingredient (C) of the composition of the invention is polyalphaolefin having a viscosity of from about 3 to about 6 cSt (viscosity measured at 98.9°C.). Polyalphaolefins of suitable viscosity may be prepared by a variety of cracking or oligomerization processes such as described in the Encyclopedia of Chemical Technology, Third Ed., Vol. 16, pages 487-492, ISBN 0-471-02069-9, the disclosure of which is incorporated hereby by reference. Olefin oligomers which are in the range of C_6 to C_{20} fractions (as described on p. 492 of the Encyclopedia of Chemical Technology reference, supra)

are preferred for use as ingredient (C). A polyalphadecene having a viscosity of about 4 cSt is particularly preferred in the practice of this invention.

The balance of the lubricant composition (less than 10 weight percent) may optionally comprise conventional lubricant additives such as corrosion inhibitor, an antioxidant, an antiwear agent, a metal deactivator, an antifoam agent, and a dye. It is a preferred aspect of this invention that the lubricant composition contain no polymeric viscosity index improver or seal swell agent. Viscosity improvers are unnecessary to attaining the required physical propeties of the lubricant composition and provide a site for degradation.

The synthetic transmission lubricant composition of this invention is obtained by uniformly mixing the essential ingredients (A), (B) and (C) with any selected optional ingredients. The solution of some optional ingredients is assisted by use of elevated temperatures. The final formulated composition may be filtered or otherwise treated to remove particulate contaminants.

The synthetic lubricant composition of this invention may be employed in a method to lubricate machinery. Lubrication of machinery is achieved by contacting the moving parts of a machine with lubricant composition. The lubricant may be contacted with the machine parts by such conventional means as spraying, dipping or padding. This method of lubrication finds particular utility for treating the metal parts of a vehicle transmission.

The following example illustrates the practice of the invention.

EXAMPLE

MATERIALS:

Grams	Wt. %	Ingredients
23,759	34.94	trimethylolpropane tripelargonate (TMP/3.0 nC_9)
17,000	25.00	trimethylolpropane tri-isostearate (TMP/3.0 iso-C_{18})
22,399	32.94	polyalphadecene-4cs, product of Gulf Oil and Chemicals
4,488	6.6	Lubrizol 7910™, multifunctional additive Sp.G. of 0.95 at 15.6°C., viscosity at 100°C. of 45 cSt. Chemical characteristics (weight percent) Ca, 1.1 min., 1.3 max, P, 0.24 min. 0.30 max., S 2.2 min., 2.7 max., B 0.24 min., 0.32 max, N, 0.75 min., 1.05 max.; product of The Lubrizol Corp.
340	0.50	phenyl-alpha-naphthylamine, antioxidant
13.6	0.02	benzotriazole, metal deactivator
17	25 ppm	SWS-101 ANTIFOAM™, antifoam agent; product SWS Corp., diluted to 10% strength in toluene

METHOD: Approximately 75.7 liters (about 68,000 grams) of transmission lubricant were prepared as follows: To a clean dry pot, the above stated amounts of phenyl-alpha-naphthylamine and benzotriazole were added to the trimethylolpropane tripelargonate. These materials were stirred with heating at 71.1-76.7°C. for one hour to dissolve solids and form a preblend.

Next, to a 75.7 liter pot, stated amounts of the remaining lubricant composition components were added together with the preblend. The entire combined formulation was stirred with heating for one and one-half hours at 60°-65.6°C. to effect uniform mixing. The cooled composition was thereafter filtered through Viscon filter paper and filtrate stored.

The blended transmission lubricant composition of this Example had the following physical properties:

TABLE II

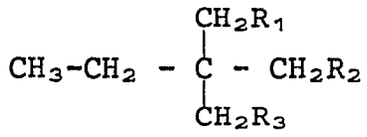
Viscosity at 98.9°C., (cs)	6.4
37.8°C., (cs)	36.2
-17.8°C., (cs)	1049
-28.9°C., (cs)	3121
Vsicosity index	141
Pour Point (°C.)	—43
Total Acid Number (mgKOH/g)	0.46
Flash Point, COC (°C.)	238
Fire Point, COC, (°C.)	266
Autoignition, (°C.)	421.1
Specific Gravity, 15.6°/15.6°C.	0.8960
25°/25°C.	0.8900
Solubility	Soluble in gasoline, hexane, chloroform, and toluene
Seal Swell: Buna-N % Swell 148.9°C. for 70 hrs.	3.31
Hardness Change	-1

While the present invention has been described with reference to particular embodiments, it should be understood that such embodiments are not intended to limit the scope of the claimed invention.

I claim:

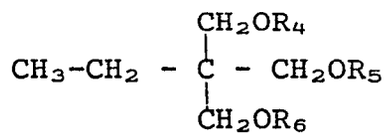
1. A 10W transmission lubricant composition comprising a mixture of ingredients (A), (B), and (C) wherein;

Ingredient (A) is a polyol ester represented by the formula;



wherein R_1, R_2, and R_3 are the same or different and are $-OCH_2(CH_2)_xCH_3$ radicals where x is an integer from 6 to 10;

Ingredient (B) is a polyol ester represented by the formula;



wherein R_4, R_5, and R_6 are the same or different and are iso-C_n hydrocarbon radicals, where n is an integer from 18 to 24; and

Ingredient (C) is a polyalphaolefin of from about 3 to about 6 centistoke viscosity;

wherein the weight ratio of ingredient (A) to ingredient (B) is from about 2:1 to about 1:2, the weight ratio of the sum of ingredients (A) plus (B) to ingredient (C) is from about 2.4:1 to about 1.5:1, and the sum of ingredient (A) plus ingredient (B) plus ingredient (C) comprises at least about 90 weight percent of said composition.

2. The transmission lubricant composition of Claim 1 wherein ingredient (A) is trimethylolpropane triheptanoate.

3. The transmission lubricant composition of Claim 1 wherein ingredient (B) is trimethylolpropane triisostearate.

4. The lubricant composition of Claim 1 wherein ingredient (C) is a polyalphaolefin obtained as a C_6 to C_{20} fraction.

5. The transmission lubricant composition of Claim 1 or 2 or 3 wherein ingredient (C) is polyalphadecene having a viscosity of 3.5 to 4.2 centistokes.

6. The transmission lubricant composition of Claim 1 or 2 or 3 or 4 wherein the weight ratio of ingredient (A) to ingredient (B) is from 1.6:1 to 1.2:1, and the weight ratio of the sum of ingredients (A) plus (B) to ingredient (C) is from 2.1:1 to 1.6:1.

7. The transmission lubricant composition of Claim 6 wherein ingredient (A) is trimethylolpropane triheptanoate, ingredient (B) is trimethylolpropane triisostearate, ingredient (C) is polyalphadecene.

8. The transmission lubricant composition of Claim 1 wherein said composition contains up to 10 weight percent of optional ingredients selected from the group consisting of; a corrosion inhibitor, an antioxidant, an antiwear agent, a metal deactivator, an antifoam agent, and a dye.

9. The transmission lubricant composition of Claim 8 wherein the optional ingredients constitute less than 8 weight percent of said lubricant composition.

10. A method of lubricating machinery by contacting the moving parts of said machinery with the lubricant composition of Claim 1.

11. A method of lubricating machinery by contacting the moving parts of said machinery with the lubricant of Claim 6.

12. A method of lubricating machinery by contacting the moving parts of said machinery with the lubricant of Claim 8.

13. A method of lubricating according to Claim 10 or 11 or 12 wherein said machinery is a vehicle transmission.