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3,814,691

ALKYL (POLYALKOXY) SILANES AS COMPONENTS IN HYDRAULIC FLUIDS

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No Drawing. Continuation-in-part of abandoned application Ser. No. 75,719, Sept. 25, 1970. This application June 5, 1972, Ser. No. 259,894

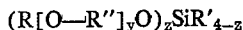
Int. Cl. C09k 3/00

U.S. Cl. 252—78

21 Claims

ABSTRACT OF THE DISCLOSURE

A hydraulic fluid containing as the base component at least one alkyl (polyalkoxy) silane of the formula:



wherein R is an alkyl group of 1 to 10 carbon atoms or an aryl group of 6 to 10 carbon atoms, R' is an alkyl group of 1 to 4 carbon atoms, R'' is alkylene of from 2 to 4 carbon atoms, y is an integer of 1 to 5 and z is an integer of 1 to 3. Additionally, the hydraulic fluid of this invention may contain a base component made up of a mixture of selected alkyl (polyalkoxy) silanes, as defined above, and selected borate esters.

This application is a continuation-in-part of co-pending application Ser. No. 75,719 filed Sept. 25, 1970 and now abandoned.

This invention relates to water-insensitive hydraulic fluids which employ selected alkyl (polyalkoxy) silanes as the base stock or lubricant.

The new and improved water-insensitive hydraulic fluids of this invention are useful as hydraulic pressure transmission fluids in a variety of hydraulic systems such as hydraulic brake systems, hydraulic steering mechanisms, hydraulic transmissions, hydraulic jacks, and hydraulic lifts.

A great number of hydraulic fluid compositions are known in the art as shown for example in "Introduction to Hydraulic Fluids" by Roger E. Hatton, Reinhold Publishing Corporation, 1962. Although the hydraulic fluids of the prior art possess one or more of the desired characteristics of viscosity-temperature relationship, volatility or pour-point, they generally have one or more disadvantages such as having low boiling points, not being water-insensitive and not being stable against oxidation, deterioration and corrosion.

Now it has been found that the hydraulic fluids of this invention which contain selected alkyl (polyalkoxy) silanes, hereinafter referred to as organosilanes, as the base fluid, possess a high boiling point, have a high degree of compatibility with other fluids, have desired viscosity and corrosion properties, have a high degree of water tolerance and are of low cost. These fluids are particularly advantageous in environments which are exposed to water or water vapor such as brake fluids used in automotive brake systems. The effect of water on hydraulic brake fluids has been studied extensively and it is now recognized and agreed that the presence of water has a dramatic effect on lowering of the boiling point (see "Automotive Hydraulic Brake Fluids" by C. F. Pickett published as part of the 51st Mid-Year Meeting Proceedings of the Chemical Specialties Manufacturing Association, Inc., 1965). A high boiling point of the brake fluid is necessary to prevent vapor lock which results in a loss of braking power thus frequently causing an accident. When 3.5 percent water was added to a conventional brake fluid having an initial boiling point of 562° F., the boiling point dropped to a level of about 280° F. In contrast when the same amount of water was added to several examples of the hydraulic fluids of this invention

2

which contain an organosilane base component, the boiling point did not drop as much and resulted in a desirably high wet boiling point of about 400° F. Thus it is apparent that the hydraulic fluids of this invention are distinctly superior to those of the art.

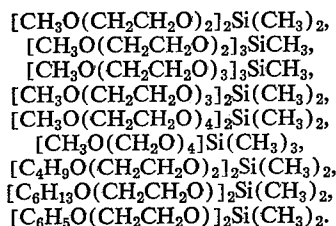
Generally, hydraulic pressure transmission fluids are made up of three principal units. The first is a base or lubricant for the system which may include heavy body fluids such as polyglycols, castor oil, mixtures of these materials etc. The second basic unit is made up of diluents and other additives which modify the physical properties of the base fluid such as the viscosity. Finally, the third basic unit is represented by an inhibitor system comprising small quantities of inhibitors or additives which are added to modify the chemical properties of the base fluid. Such inhibitors include antioxidants, anticorrosion agents and additives to improve wetting and flow properties.

The organosilanes used as the base component in the hydraulic fluids of this invention have the following general formula:



wherein R is an alkyl group of 1 to 10 carbon atoms such as methyl, ethyl, butyl, isobutyl, octyl, nonyl, and decyl or an aryl group of 6 to 10 carbon atoms such as phenyl, tolyl, xylyl, mesityl and naphthyl; R' is an alkyl group of 1 to 4 carbon atoms such as methyl, ethyl and butyl; R'' is alkylene of 2 to 4 carbon atoms; y is an integer of 1 to 5 and z is an integer of 1 to 3. The R, R' and R'' groups may include branched or straight chained derivatives and it is also intended that the alkylene oxide group (O—R'') in the above formula (I) include mixtures of said alkylene oxides.

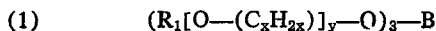
Organosilanes of the above formula include for example:



Organosilanes of the above type (I) can conveniently be prepared for example, by reacting an alkyl-halo-silane with polyalkylene glycol monoalkyl or monoaryl ethers in an inert medium. Various other organosilanes as described above are readily available by the same technique. Further disclosure for the preparation of organosilanes of this type may be found in "The Preparation of Alkoxy-silanes from Glycols and Glycol Monoethers" by H. G. Emblem and K. Hargreaves in J. of Inorganic Nuclear Chemistry, vol. 30, 1968, pp. 721-727 and "Organosilicon Compounds" by C. Eaborn, 1960, New York Academic Press, Inc., pp. 288-297.

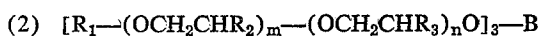
The hydraulic fluids of this invention, which have the organosilanes (I) as the base or lubricant component, may additionally include as part of such base component, varying amounts of the borate esters of the type disclosed in application Ser. No. 717,996, now U.S. Pat. 3,625,899 and the bis-borate and bridged-borate esters of the type disclosed in application Ser. No. 717,997, now abandoned, both applications of A. Sawyer and D. Csejka and filed Apr. 1, 1968. The complete disclosure of the aforementioned applications which define the particular borate esters and their method of preparation are incorporated herein by reference.

The borate esters disclosed in application Ser. No. 717,996 generally consist of the following formulas:



3

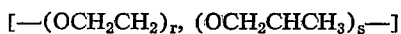
wherein R_1 is an alkyl of from 1 to 4 carbon atoms, x is an integer of from 2 to 4 and y is an integer of from 2 to 4.



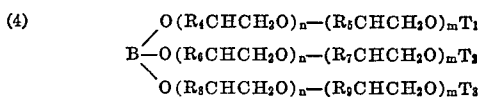
wherein R_1 is alkyl of from 1 to 4 carbon atoms, R_2 and R_3 are independently selected from the group consisting of hydrogen and methyl, m and n are positive integers whose sum is from 2 to 20, and with the proviso that one of R_2 and R_3 is methyl and one of R_2 and R_3 is hydrogen.



wherein R_1 is alkyl of from 1 to 4 carbon atoms, R_g is a heteric oxyalkylene chain of the formula:

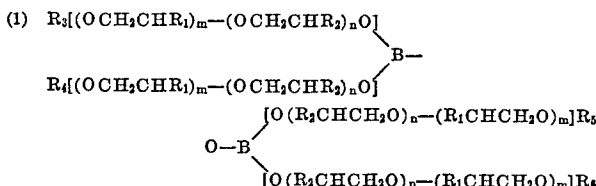


wherein the sum of r and s is not more than 20 and wherein the weight percent of the oxyethylene units is not less than 20 based on the total weight of all the oxyalkylene units, and

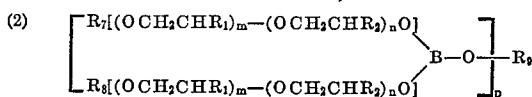


wherein T_1 , T_2 and T_3 are each an independently selected alkyl group having from 1 to 4 carbon atoms; R_4 , R_5 , R_6 , R_7 , R_8 and R_9 are independently selected from the group consisting of hydrogen and methyl, n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20, and with the proviso that in no more than two of the chains is the sum of n and m the same.

The bis-borate and bridge borate esters disclosed in application Ser. No. 717,997 generally consist of the following formulas:

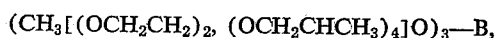
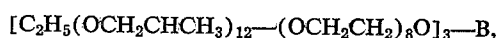
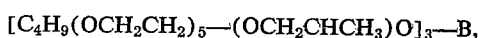
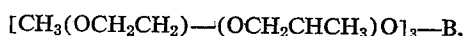


wherein R_1 and R_2 are independently selected from the group consisting of hydrogen and methyl; R_3 , R_4 , R_5 and R_6 are each an independently selected alkyl group having from 1 to 4 carbon atoms and n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20;

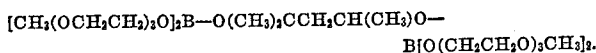
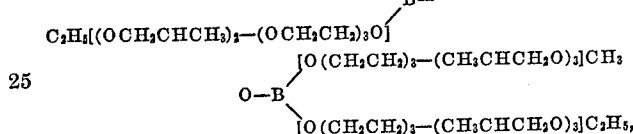
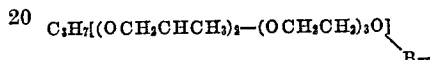
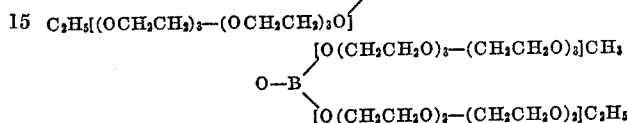
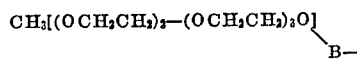
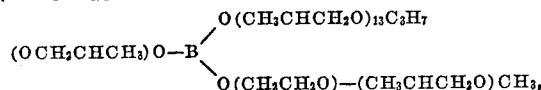
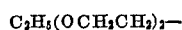
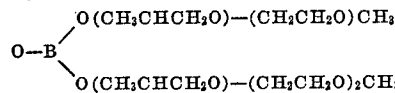
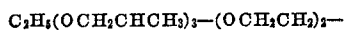


where R_1 and R_2 are independently selected from the group consisting of hydrogen or methyl; R_7 and R_8 are each an independently selected alkyl group having from 1 to 4 carbon atoms; R_9 is the organic residue exclusive of reactive hydroxyl groups of a polyol, p is an integer of from 2 to 6 inclusive and n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20.

The above-noted borate esters include, for example:



4

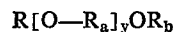


Further examples of the above described borate esters and the methods for preparation are fully disclosed in the previously noted applications Ser. Nos. 717,996 and 717,997.

Generally when the borate esters are admixed with the organosilanes forming the base component of the hydraulic fluid of this invention, widely varying proportions of the organosilanes and borate esters may be used. More particularly, the base component may contain an organosilane and from 0 to 95% by weight of borate ester and preferably from 25 to 90% by weight.

The amount of base component which is used in the hydraulic fluid of this invention can vary widely. Generally the base component will constitute at least about 20 percent by weight of the fluid and preferably at least about 40 percent by weight based on the total weight of the fluid composition.

Various diluents, inhibitors and other additives well known in the hydraulic fluid art may be added to the organosilane containing base component if desired. For example, the diluent portion may consist of one or more glycol monoethers or diethers of the formula:



wherein R is alkyl of 1 to 4 carbon atoms, R_a is alkylene of 2 to 4 carbon atoms, R_b is hydrogen or alkyl of from 1 to 4 carbon atoms and y is an integer of from 2 to 4. The R , R_a and R_b groups may be straight chained or branched and the alkylene oxide group ($O-R_a$) in the above formula may include mixtures of said alkylene oxides. Additionally, one or more glycols such as the alkylene glycols having for example, the following formula may be used:



wherein R_c is alkylene of from 2 to 3 carbon atoms and z is an integer of from 1 to 5.

Illustrative of the above-described diluents are the following: diethylene glycol monoethyl ether, diethylene glycol-monobutyl ether, triethylene glycol monomethyl ether, triethylene glycol monoethyl ether, tetraethylene glycol monomethyl ether, ethylene glycol, propylene glycol, diethylene glycol and tetraethylene glycol. Various other diluents and mixtures thereof, which are well known in the art may also be used with the organosilane containing base component of this invention. U.S. Pat. 3,377,288 and

applications 717,996 and 717,997, previously noted, disclose various diluents which may be utilized.

Generally the particular amount of diluents which is used is not critical and widely varying amounts may be used. More particularly, the diluent components may constitute from 0 up to about 80 percent by weight of the fluid and preferably from about 20 to about 60 percent.

Various additives may be added to the hydraulic fluids of this invention containing the organosilane base component to control or modify various chemical and physical properties. Among the various types of additives which can be added to the hydraulic fluids of this invention are included inhibitors for pH and corrosion control, antioxidants, rust inhibitors, viscosity index improvers, pour point depressants, lubricating additives, antifoamants, stabilizers, vapor phase corrosion inhibitors, rubber swelling adjusters, demulsifiers, dyes and odor suppressants. Generally, the total amount of additives which may be incorporated into the fluid composition will vary between about 0.01 to about 20 percent, preferably from about 0.1 to 8 percent and more preferably from about 0.2 to about 5 percent by weight, based on the total weight of the hydraulic fluid composition.

For example, alkaline inhibitors for pH and corrosion control can be employed in an amount sufficient to maintain alkaline conditions in the fluid compositions, e.g. at a pH value of from about 7.0 to about 11.5 if desired. These inhibitors are generally added in an amount of from about 0.01 to about 8.0 percent by weight based on the total weight of fluid composition and preferably from about 0.5 to about 6.0 percent. Useful alkaline inhibitors include for example: alkali metal borates such as sodium borate and potassium tetraborate, alkali metal salts of higher fatty acids such as potassium oleate, the potassium soap of rosin or tall oil fatty acids, amines such as morpholine and ethanolamine and amine salts such as mono- or dibutyl ammonium borates.

An antioxidant may be used, if desired. Typical antioxidants include, 2,2-di-(4-hydroxyphenyl)propane, phenothiazine, amines such as phenyl-alpha-naphthylamine and hindered phenols such as dibutyl cresol. Generally, the amount of antioxidant used will vary from 0 to about 3 percent by weight and preferably from about 0.001 to about 2 percent by weight based on the total weight of the fluid composition.

Additionally, other additives if desired, may be incorporated into the fluid composition. For example, corrosion inhibitors such as butynediol and rubber swelling adjusters such as dodecyl benzene may be used.

The above-noted inhibitors and additives are merely exemplary and are not intended as an exclusive listing of the many well-known materials which can be added to fluid compositions to obtain various desired properties. Other illustrations of additives and diluents which may be used can be found in U.S. Pat. 3,377,288 and copending applications 717,996 and 717,997 previously noted and in "Introduction to Hydraulic Fluids" by Roger E. Hatton, Reinhold Publishing Corp. (1962).

The following examples are further illustrative of this invention.

EXAMPLE I

	Percent by weight
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_2\text{O}]_2\text{Si}(\text{CH}_3)_2$	99.8
Tolutriazole	0.1
Bisphenol A	0.1

The reflux boiling point of the above fluid was measured and found to be 547° F. at atmospheric pressure. To test the water insensitivity of the fluid composition, a sample consisting of 100 parts by volume of the fluid plus 3.5 parts by volume of water was prepared and it was found to have a reflux boiling point at atmospheric pressure of 398° F. indicating that the fluid is exceptionally water insensitive when contrasted with a conventional brake

fluid (B.P. 550° F.) which showed a drop of about 270° F. to about 280° F.

Other properties of this fluid are as follows:

Kin. viscosity:	
At -40° F.	43.5 cs.
At 212° F.	1.14 cs.
Pour point	Below -85° F.
Flash point	320° F.
Water Tolerance Test at -40° F.	
and 140° F.	Passed.

All the above tests and all tests for the remaining examples were run in accordance with SAE specification J 1703a.

EXAMPLE II

	Percent by weight
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_2\text{Si}(\text{CH}_3)_2$	99.8
Tolutriazole	0.1
Bisphenol A	0.1

This composition was tested in the same manner as Example I and showed the following properties:

Reflux boiling point	625° F.
Wet reflux boiling point (3.5% water added)	405° F.
Kin. viscosity:	
-40° F.	180 cs.
212° F.	1.73 cs.
Pour point	Below -85° F.
Flash point	385° F.
Water Tolerance Test at -40° F.	
and 140° F.	Passed.

EXAMPLE III

	Percent by weight
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_3\text{SiCH}_3$	99.8
Tolutriazole	0.1
Bisphenol A	0.1

The following properties obtained in accordance with SAE J 1703a were found:

Reflux boiling point	625° F.
Wet reflux boiling point (3.5% water added)	401° F.
Kin. viscosity:	
-40° F.	547 cs.
212° F.	2.55 cs.
Pour point	Below -85° F.
Flash point	Above 425° F.
Water Tolerance Test at -40° F.	
and 140° F.	Passed.

EXAMPLE IV

	Percent by weight
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_2\text{Si}(\text{CH}_3)_2$	10.0
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_3\text{B}$	67.5
$\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{OH}$	5.58
$\text{C}_2\text{H}_5(\text{OCH}_2\text{CH}_2)_4\text{OH}$	15.30
Diethanolamine	1.51
NaNO_2	0.02
Tolutriazole	0.09

The following properties obtained in accordance with SAE J 1703 were found:

Reflux boiling point, ° F.	552
Wet reflux boiling point (3.5% water added), ° F.	404
Kin. viscosity at -40° F., cs.	1270
Water tolerance	Pass
Chemical stability	Pass
Compatability	Pass

7

EXAMPLE V

	Percent by weight	
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3(\text{OCH}(\text{CH}_3)\text{CH}_2)_{0.8}(\text{OCH}_2\text{CH}_2)_{0.8}\text{O}]_2\text{Si}(\text{CH}_3)_2$	10.0	
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_3\text{B}$	65.0	5
$\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{OH}$	9.0	
$\text{C}_2\text{H}_5(\text{OCH}_2\text{CH}_2)_4\text{OH}$	15.0	
Monoethanolamine	1.0	

The following properties obtained in accordance with SAE J 1703 were found:

Reflux boiling point, ° F.	540	
Wet reflux boiling point (3.5% water added), ° F.	403	
Kin. viscosity at -40° F., cs.	1460	
Flash point, ° C.	295	15
Water tolerance	Pass	
Chemical stability	Pass	
Compatability	Pass	

EXAMPLE VI

	Percent by weight	
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_2\text{Si}(\text{CH}_3)_2$	20.0	20
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_3\text{B}$	60.0	
$\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{OH}$	8.9	
$\text{CH}_3(\text{OCH}_2\text{CH}_2)_4\text{OH}$	10.0	
Monoethanolamine	1.0	25
NaNO_2	0.1	

The following properties obtained in accordance with SAE J 1703 were found:

Reflux boiling point, ° F.	545	30
Wet reflux boiling point (3.5% water added), ° F.	384	
Kin. viscosity at -40° F., cs.	1140	
Water tolerance	Pass	
Chemical stability	Pass	35
Compatability	Pass	

EXAMPLE VII

	Percent by weight	
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_2\text{Si}(\text{CH}_3)_2$	10.0	
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_2\text{BO}(\text{CH}_2\text{CH}_2\text{O})_3\text{B}$	60.0	40
$[\text{O}(\text{CH}_2\text{CH}_2\text{O})_3\text{CH}_3]_2$	23.9	
$\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{OH}$	5.0	
$\text{C}_2\text{H}_5(\text{OCH}_2\text{CH}_2)_4\text{OH}$	1.0	
Monoethanolamine	0.1	45
VPI 260 (dicyclohexylammonium nitrite)	0.1	

The following properties obtained in accordance with SAE J 1703 were found:

Reflux boiling point, ° F.	524	
Wet reflux boiling point (3.5% water added), ° F.	398	50
Kin. viscosity at -40° F., cs.	3140	
Water tolerance	Pass	
Chemical stability	Pass	
Compatability	Pass	55

EXAMPLE VIII

	Percent by weight	
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_2\text{Si}(\text{CH}_3)_2$	25.0	
$[\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}]_3\text{B}$	56.3	
$\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{OH}$	4.65	
$\text{C}_2\text{H}_5(\text{OCH}_2\text{CH}_2)_4\text{OH}$	12.7	60
Diethanolamine	1.26	
Sodium nitrite	0.02	
Tolutriazole	0.07	

The following properties obtained in accordance with SAE J 1703 were found:

Reflux boiling point, ° F.	554	
Wet reflux boiling point (3.5% water added), ° F.	430	
Viscosity at -40° F., cs.	800	70

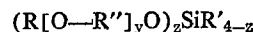
What is claimed is:

1. A hydraulic fluid composition consisting essentially of:

(a) at least about 20 percent by weight, based on the total weight of the hydraulic fluid composition of a

8

base component containing at least one organosilane of the formula:



wherein R is selected from the group consisting of alkyl of 1 to 10 carbon atoms and an aryl group of 6 to 10 carbon atoms, R' is an alkyl group of 1 to 4 carbon atoms, R'' is alkylene of from 2 to 4 carbon atoms, y is an integer of 1 to 5 and z is an integer of 1 to 3

(b) from 0 to about 80 percent by weight, based on the total weight of the hydraulic fluid composition, of at least one diluent selected from the group consisting of:

(i) glycol ethers having the formula:



wherein R is alkyl of 1 to 4 carbon atoms, R_a is alkylene of 2 to 4 carbon atoms, R_b is selected from the group consisting of hydrogen and alkyl of 1 to 4 carbon atoms and y is an integer of 2 to 4, and

(ii) a glycol of the formula:



wherein R_c is alkylene of from 2 to 3 carbon atoms and z is an integer of from 1 to 5 and

(c) from about 0.01 to about 20 percent by weight, based on the total weight of the hydraulic fluid composition, of an additive which is an alkaline inhibitor for pH and corrosion control.

2. The composition of claim 1 which contains from about 0.01 to about 8.0 percent by weight of said alkaline inhibitor for pH and corrosion control.

3. The composition of claim 1 which contains at least about 40 percent by weight of said organosilane base component.

4. The composition of claim 3 which contains from about 20 to about 60 percent by weight of said diluent.

5. The composition of claim 1 wherein said additive is an antioxidant.

6. The composition of claim 1 wherein said additive is a rubber swelling adjuster.

7. The composition of claim 1 wherein said alkaline inhibitor is used in an amount of from about 0.5 to about 6.0% by weight, based on the total weight of the hydraulic fluid composition.

8. The composition of claim 5 wherein said antioxidant is used in an amount of from about 0.001 to about 2% by weight, based on the total weight of the hydraulic fluid composition.

9. The composition of claim 1 wherein said additive is a mixture of an alkaline inhibitor for pH and corrosion control and an antioxidant.

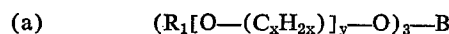
10. The composition of claim 9, wherein in said organosilane R is methyl and R' methyl.

11. The composition of claim 10, wherein in said organosilane R'' contains two carbon atoms, y is 2 and z is 2.

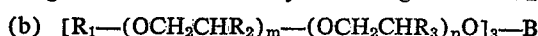
12. The composition of claim 10, wherein in said organosilane R'' contains two carbon atoms, y is 3 and z is 2.

13. The composition of claim 10, wherein in said organosilane R'' contains two carbon atoms, y is 3 and z is 3.

14. The composition of claim 1 wherein the base component contains from about 0 to about 95 percent by weight, based on the total weight of base component, of at least one borate ester selected from the group consisting of:



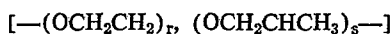
wherein R₁ is an alkyl of from 1 to 4 carbon atoms, x is an integer of from 2 to 4 and y is an integer of from 2 to 4,



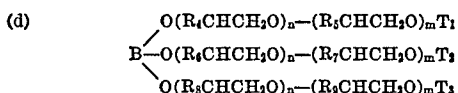
wherein R_1 is alkyl of from 1 to 4 carbon atoms, R_2 and R_3 are independently selected from the group consisting of hydrogen and methyl, m and n are positive integers whose sum is from 2 to 20, and with the proviso that one of R_2 and R_3 is methyl and one of R_2 and R_3 is hydrogen



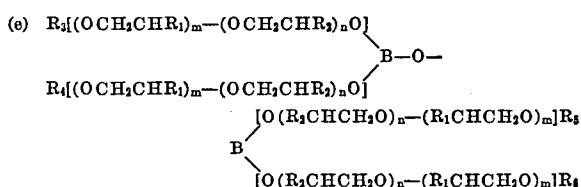
wherein R_1 is alkyl of from 1 to 4 carbon atoms, Rg is a heteric oxyalkylene chain of the formula:



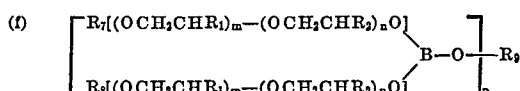
wherein the sum of r and s is not more than 20 and wherein the weight percent of the oxyethylene units is not less than 20 based on the total weight of all the oxyalkylene units



wherein T_1 , T_2 and T_3 are each an independently selected alkyl group having from 1 to 4 carbon atoms; R_4 , R_5 , R_6 , R_7 , R_8 and R_9 are independently selected from the group consisting of hydrogen and methyl, n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20, and with the proviso that in no more than two of the chains is the sum of n and m the same



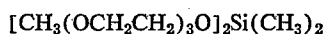
wherein R_1 and R_2 are independently selected from the group consisting of hydrogen and methyl; R_3 , R_4 , R_5 and R_6 are each an independently selected alkyl group having from 1 to 4 carbon atoms and n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20 and



where R_1 and R_2 are independently selected from the group consisting of hydrogen or methyl; R_7 and R_8 are each an independently selected alkyl group having from 1 to 4 carbon atoms; R_9 is the organic residue exclusive of reactive hydroxyl groups of a polyol, p is an integer of from 2 to 6 inclusive and n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20.

15. The composition of claim 14 wherein said additive is an antioxidant.

16. The composition of claim 14 wherein said organosilane has the formula:



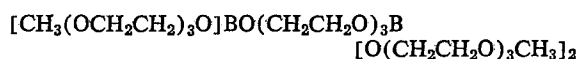
and said borate ester has the formula:



17. The composition of claim 14 wherein said organosilane has the formula:

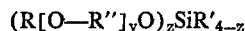


and said borate ester has the formula:



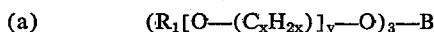
18. In the operation of a fluid pressure operative device which uses hydraulic pressure transmission fluid, the improvement comprising using as said hydraulic pressure

transmission fluid a composition including as the base component at least one organosilane of the formula:

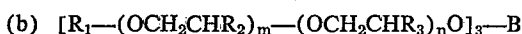


wherein R is selected from the group consisting of alkyl of 1 to 10 carbon atoms and aryl of 6 to 10 carbon atoms, R' is an alkyl group of 1 to 4 carbon atoms, R'' is alkylene of from 2 to 4 carbon atoms, y is an integer of 1 to 5 and z is an integer of 1 to 3.

19. The method of claim 18 wherein the base component contains from 0 to about 95 percent by weight, based on the total weight of base component, of at least one borate ester selected from the group consisting of:



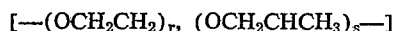
wherein R_1 is an alkyl of from 1 to 4 carbon atoms, x is an integer of from 2 to 4 and y is an integer of from 2 to 4



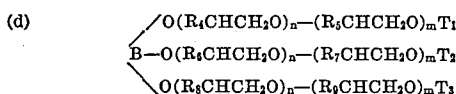
wherein R_1 is alkyl of from 1 to 4 carbon atoms, R_2 and R_3 are independently selected from the group consisting of hydrogen and methyl, m and n are positive integers whose sum is from 2 to 20, and with the proviso that one of R_2 and R_3 is methyl and one of R_2 and R_3 is hydrogen



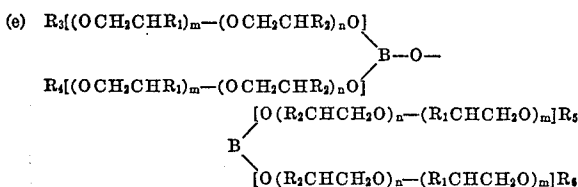
wherein R_1 is alkyl of from 1 to 4 carbon atoms, Rg is a heteric oxyalkylene chain of the formula:



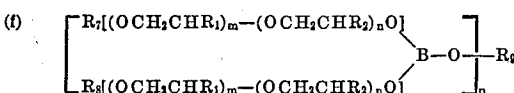
wherein the sum of r and s is not more than 20 and wherein the weight percent of the oxyethylene units is not less than 20 based on the total weight of all the oxyalkylene units



wherein T_1 , T_2 and T_3 are each an independently selected alkyl group having from 1 to 4 carbon atoms; R_4 , R_5 , R_6 , R_7 , R_8 and R_9 are independently selected from the group consisting of hydrogen and methyl, n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20, and with the proviso that in no more than two of the chains is the sum of n and m the same



wherein R_1 and R_2 are independently selected from the group consisting of hydrogen and methyl; R_3 , R_4 , R_5 , and R_6 are each an independently selected alkyl group having from 1 to 4 carbon atoms and n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20 and



where R_1 and R_2 are independently selected from the group consisting of hydrogen or methyl; R_7 and R_8 are each an independently selected alkyl group having from 1 to 4 carbon atoms; R_9 is the organic residue exclusive of reactive hydroxyl groups of a polyol, p is an integer of from 2 to 6 inclusive and n and m are positive integers independently selected in each chain and whose sum in each chain is from 2 to 20.

11

20. The method of claim 18 wherein said hydraulic pressure transmission fluid contains from about 0.01 to about 20% by weight, based on the total weight of the hydraulic fluid composition, of an alkaline inhibitor for pH and corrosion control.

21. The method of claim 18 wherein said hydraulic pressure transmission fluid contains from about 0.01 to about 20% by weight, based on the total weight of the hydraulic fluid compositions of an antioxidant.

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10 LEON D. ROSDOL, Primary Examiner

H. A. PITLICK, Assistant Examiner

U.S. Cl. X.R.

15 252—49.6; 260—448.8 R, 462 R

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,814,691 Dated June 4, 1974

Inventor(s) David A. Csejka and Henry F. Lederle

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In column 9, line 70, " $\overline{\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}}\overline{\text{BO}(\text{CH}_2\text{CH}_2\text{O})_3\text{B}}$

$\overline{\text{O}(\text{CH}_2\text{CH}_2\text{O})_3\text{CH}_3}\overline{\text{O}}_2$ "

should read -- $\overline{\text{CH}_3(\text{OCH}_2\text{CH}_2)_3\text{O}}\overline{\text{O}}_2\text{BO}(\text{CH}_2\text{CH}_2\text{O})_3\text{B}\overline{\text{O}(\text{CH}_2\text{CH}_2\text{O})_3\text{CH}_3}\overline{\text{O}}_2$ --.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHLL DANN
Commissioner of Patents