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3,629,111 HYDRAULIC FLUIDS CONTAINING NOVEL INHIBITOR COMPOSITIONS

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No Drawing. Continuation-in-part of application Ser. No. 634,457, Apr. 28, 1967. This application Oct. 2, 1970, Ser. No. 77,753

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U.S. Cl. 252-75

21 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to improved hydraulic fluids containing a novel inhibitor composition comprising a hydrazine compound and an organic acid compound.

This application is a continuation-in-part of co-pending application Ser. No. 634,457 filed Apr. 28, 1967, now abandoned.

This invention relates to new and improved hydraulic fluids for use in fluid pressure operating devices such as hydraulic brake systems, hydraulic steering mechanisms, hydraulic transmissions, etc. More particularly, this invention relates to hydraulic fluids which employ an inhibitor composition comprising a hydrazine compound and an organic acid compound.

A wide variety of hydraulic fluid compositions have been used in fluid pressure operating devices. The hydraulic fluids which are already known in the art usually consist of a lubricant or base portion, a diluent and an inhibitor portion. Generally, the lubricant or base and diluent comprise alcohols, alcohol ethers or a mixture of both. The inhibitor composition generally consists of an antioxidant and an alkaline buffer composition to maintain the pH value in the range of 7-11.5. Although these fluids of the prior art may be suitable for use in hydraulic systems fabricated from ferrous metals, they are frequently corrosive to aluminum as well as other non-ferrous metals, such as copper and brass. For example, the alkaline buffer inhibitors are believed to be responsible for aluminum, copper and brass discoloration (stain) which is cause for rejection when the fluid is corrosion tested according to Federal specification VV-B-680.

Now it has been found that the hydraulic fluids of this invention which contain an inhibitor composition comprising a hydrazine compound and an organic acid compound, effectively inhibit corrosion of non-ferrous metals such as aluminum, copper and brass and in addition, show good protective attributes against pitting-type corrosion of aluminum in peroxide stability tests when tested in accordance with Federal specification VV-B-680.

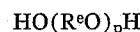
The hydraulic fluids of this invention, like those of the prior art, are made up of three principal units i.e. (1) a base or lubricant, (2) diluent and (3) an inhibitor composition.

The base or lubricant portion of the hydraulic fluid will generally consist of heavy bodied fluids such as polyglycols, castor oil, mixtures of these materials etc. More particularly, the base or lubricant portion of the fluid may comprise one or more polyhydric alcohols or polyhydric alcohol ethers or mixtures thereof. Illustrative of polyhydric alcohols which can be used are the alkylene glycols such as ethylene glycol, propylene glycol and butylene

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glycol; polyoxyalkylene glycols such as polyoxyethylene glycols and polyoxypropylene glycols; mixed polyoxyalkylene glycols such as polyoxyethylene-polyoxypropylene glycols; polyoxyalkylene triols such as oxyalkylated glycerol; and polyoxyalkylene adducts of phenols. Illustrative of polyhydric alcohol ethers which can be used are the alkyl and aryl monoethers and diether of the polyhydric alcohols described above, for example, diethylene glycol monomethyl ether, triethylene glycol monobutyl ether, dipropylene glycol monoethyl ether, polyoxyethylene glycol nonylphenyl ether, polyoxypropylene glycol nonylphenyl ethers and mixtures thereof.

The diluent portion of the hydraulic fluid of this invention may generally comprise an alcohol, glycol or glycol ether. More particularly, the diluent may comprise a mono or dihydric alcohol, a glycol monoether or diether and mixtures thereof. Illustrative of the diluents which may be used are the alkylene glycols of the formula:



where R^e is alkylene of from 2 to 3 inclusive carbon atoms and p is an integer of from 1 to 3 inclusive. Useful glycols include ethylene glycol, propylene glycol, diethylene glycol, dipropylene glycol and triethylene glycol. Further illustrative of diluents which may be used are the glycol monoethers or diethers of the formula:

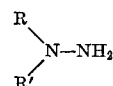


wherein R is alkyl from 1 to 6 carbon atoms, R' is hydrogen or alkyl of 1 to 6 carbon atoms, x is an integer of from 2 to 4 and y is an integer of from 1 to 4. Useful glycol ethers include, for example, ethylene glycol monomethyl ether, diethylene glycol monomethyl ether, triethylene glycol monomethyl ether, propylene glycol monomethyl ether, tripropylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, tetrapropylene glycol monobutyl ether, tributylene glycol mono-n-propyl ether, tetrabutylene glycol mono-n-butyl ether, etc.

The above-described base or lubricant and diluents are merely exemplary and are not intended as in exclusive listing of the many well-known base or lubricant and diluent materials of this type which are used in the hydraulic fluid art. Other illustrations of these materials may be found in U.S. Pat. No. 3,377,288 and in "Introduction to Hydraulic Fluids" by Robert E. Hatton, Reinhold Publishing Corp., 1962.

The essence of this invention resides in the use of an inhibitor composition containing a hydrazine compound and an organic acid compound. Numerous compounds of hydrazine and organic acids are included within the broad scope of this invention including, for example, alkyl and aryl hydrazine derivatives, saturated fatty acids, unsaturated fatty acids and rosin acids.

The hydrazine compounds useful in the inhibitor composition of this invention include hydrazine hydrate and hydrazine compounds of the formula:



where R and R' are independently selected from the group consisting of hydrogen, alkyl having 2 to 8 carbon atoms, hydroxyalkyl having 2 to 7 carbon atoms and aryl of not

more than 9 carbon atoms, as exemplified by ethyl hydrazine, diethyl hydrazine, isopropyl hydrazine, n-propyl hydrazine, n-butyl hydrazine, diisobutylhydrazine, n-amyl hydrazine, isohexyl hydrazine, di-n-hexyl hydrazine, isohexyl hydrazine and the like; phenyl hydrazine, ethylphenyl hydrazine, isopropylphenyl hydrazine, diphenyl hydrazine, tolyl hydrazine, ditolyl hydrazine, and the like; hydroxyethyl hydrazine, ethylhydroxyethyl hydrazine, dihydroxyethyl hydrazine, ethylhydroxy-n-propyl hydrazine, hydroxy-n-propyl hydrazine, hydroxyisohexyl hydrazine, n-propyl hydroxyethyl hydrazine, ethyl phenyl hydrazine, hydroxy-n-propyl tolyl hydrazine and the like. Hydrazine compounds which have been found to be especially effective include hydrazine hydrate, hydroxyethyl hydrazine and phenyl hydrazine.

The organic acid compounds which may be used in the inhibitor composition of this invention include compounds of the formula:

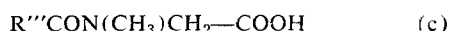


wherein R is alkyl having from 3 to about 26 carbon atoms, such as butyric, caproic, capric, lauric, myristic, palmitic, behenic, stearic, isostearic and cerotic acids and the like. Useful unsaturated organic acids include compounds of the formula:

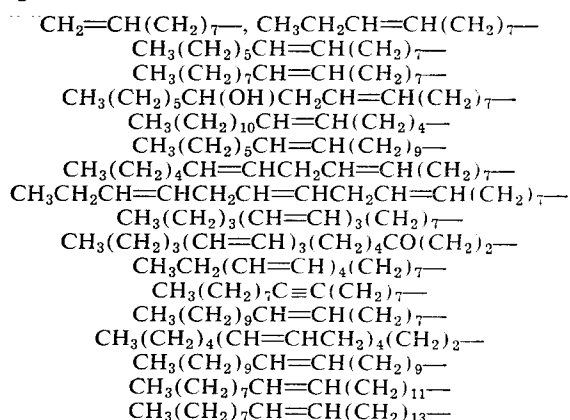


where R' is hydrogen or alkyl of from 1 to 11 carbon atoms and R'' is alkylene of from 4 to 14 carbon atoms. Suitable unsaturated acids include decylenic, dodecylenic, palmitoleic, oleic, vaccenic, linolenic, parinaric, gadoleic, cetoleic, erucic and the like. Polymerized oleic acid such as dimer and trimer acids of oleic acid and mixtures of dimer and trimer acids are also useful in the novel corrosion inhibitor compositions of this invention.

Suitable acid compounds also include high molecular weight carboxylic acids represented by the formula:



where R''' is a radical selected from the group consisting of



and alkyl of from about 7 to about 23 carbon atoms. These compounds may be considered as modified fatty acids in which the hydrocarbon chain is interrupted by an amidomethyl ($-CON(CH_3)-$) group. Specific examples are caproyl sarcosine, lauryl sarcosine, myristyl sarcosine, stearyl sarcosine, isostearyl sarcosine, oleyl sarcosine, gadoleyl sarcosine, linoleyl sarcosine, cetoleyl sarcosine and the like. Also included in the useful acid compounds are (d) the rosin acids, such as abietic acid.

Preferred acid compounds include oleyl sarcosine, isostearic acid and a mixture of polymerized oleic acid, such as polymerized dimer and trimer acids.

In addition to the hydrazine and organic acid compounds, the inhibitor composition contained in the hydraulic fluids of this invention can desirably and preferably contain an alkaline buffer and an antioxidant. The alkaline buffers employed in the fluid of this invention

for pH control are utilized in an amount sufficient to maintain alkaline conditions in the fluid compositions, e.g. a pH value of from about 7.0 to about 11.5. Various alkaline buffers, well known in the hydraulic fluid art, may be used in the hydraulic fluid of this invention. Useful alkaline buffers include alkali metal borates such as sodium borate and potassium tetraborate; alkali metal soaps of fatty acids such as potassium oleate, the potassium soap of rosin or tall oil fatty acids; alkylene glycol condensates with alkali metal borates such as the ethylene glycol condensate of potassium tetraborate; amines such as morpholine, phenyl morpholine, ethanolamine, diethanolamine, triethanolamine, methyl diethanolamine, di-(2-ethylhexyl)amine, di-N-butyl amine, monoamyl amine, diamyl amine, dioctyl amine, salicyl monoethanolamine, di- β -naphthyl-p-phenylene diamine, dicyclohexyl amine; and amine salts such as mono or dibutyl ammonium borates, and dibutyl amine phosphates. Boric acid can also be employed in combination with alkali metal borates.

Various antioxidants, well known in the hydraulic fluid art, may be employed in the fluids of this invention to protect the fluid and primarily the diluents from oxidation degradation. Illustrative of the many antioxidants which may be used are the following: 2,2-di-(4-hydroxyphenyl) propane; phenothiazine; phenothiazine carboxylic acid esters; N-alkyl or N-arylphenothiazines such as N-ethyl phenothiazine, N-phenylthiazine; polymerized trimethyl dihydroquinoline; amines such as phenyl-alpha-naphthylamine, phenyl-beta-naphthylamine, N,N'-dioctyl diphenylamine, N,N-di- β -naphthyl-p-phenylene diamine, p-isopropoxy diphenylamine, N,N-dibutyl-p-phenylene diamine, diphenyl-p-phenylene diamine, N,N'-bis(1,4-dimethyl-pentyl)-p-phenylene diamine, N,N'-diisopropyl-p-phenylene diamine, p-hydrodiphenylamine; hindered phenols such as dibutyl cresol, 2,6-dimethyl-p-cresol, butylated 2,2-di-(4-hydroxyphenyl) propane, n-butylated aminophenol; butylated hydroxy anisoles such as 2,6-dibutyl-p-hydroxy anisole; anthraquinone; dihydroxy anthraquinone; hydroquinone; 2,5-di-tertiarybutyl hydroquinone; 2-tertiary butylhydroquinone; quinoline; p-hydroxydiphenylamine; phenyl benzoate; 2,6-dimethyl p-cresol; p-hydroxy anisole; nordihydroguararetic acid; pyrocatechol; styrenated phenol; polyalkyl polyphenols; sodium nitrite and 4,4'-isopropylidenediphenol.

Mixtures of the above-noted alkaline buffers and antioxidants may be used if desired. In addition, it is noted that the compounds listed above are not an exclusive listing but are merely exemplary of the many well-known alkaline buffers and antioxidants which may be utilized.

Generally, the hydraulic fluid of this invention may constitute widely varying proportions of the individual components making up the fluid. More particularly the base or lubricant portion and the diluent portion taken together may comprise up to about 99.8 percent by weight of the fluid composition and preferably up to about 95 percent by weight. Individually, the base or lubricant portion may constitute from about 10 to about 60 percent by weight and preferably from about 20 to about 50 percent by weight and the diluent may comprise from about 40 to about 90 percent and preferably from about 50 to about 80 percent by weight of the fluid composition.

The inhibitor composition including the hydrazine, organic acid, alkaline buffer and antioxidant may generally comprise up to about 6 percent by weight of the fluid composition. More particularly the inhibitor composition may range from about 0.2 to about 4.0 percent and preferably from about 0.5 to about 3.0 percent by weight, based on the total weight of the fluid composition. Individually, the hydrazine compound may constitute up to about 1.5 percent and preferably from about 0.01 to about 1.0 percent by weight of the total fluid composition. The organic acid compound may constitute up to about 1.5 percent by weight and preferably from about 0.01 to about 1.0 percent by weight of the total fluid composition. The

alkaline buffer and antioxidant, each may constitute up to about 1.5 percent by weight and preferably from about 0.01 to about 1.0 percent by weight based on the weight of the total fluid composition.

Additionally, the fluid composition of this invention may contain a rubber swelling adjuster such as an alkyl benzene having from 10 to 15 carbon atoms in the alkyl group. Illustrative of such compounds are dodecyl benzene, tridecyl benzene and isoheptadecyl benzene. If a rubber swelling adjuster is used, it generally will constitute from about 0.1 to about 3.0 percent by weight of the total fluid composition.

Other well-known additives, utilized in hydraulic fluids for various purposes, may also be incorporated into the fluids of this invention. Several additives useful in hydraulic fluids are disclosed in "Introduction to Hydraulic Fluids" by Roger E. Hatton, Reinhold Publishing Corporation, 1962.

The inhibitor composition of this invention, comprising the hydrazine and organic acid compound, while primarily used in hydraulic fluids may also be used in other fluids such as heat transfer fluids, coolants and antifreeze fluids.

Any suitable method can be used in preparing the hydraulic fluid composition of this invention. The components can be added together or one at a time in any desired sequence. It is preferable to add the solid antioxidant and alkaline buffer as a solution. All components are mixed until a single phase composition is obtained.

The hydraulic fluids of this invention which contain the hydrazine and organic acid compounds as described above, exhibit a beneficial effect with respect to metal staining in corrosion tests and protection against pitting-type corrosion in stability tests when tested according to the Federal specification VV-B-680. This is clearly exhibited in Examples XV to XX. In Examples XV, XIX and XX, hydraulic fluids which contained the hydrazine and organic acid compounds gave no evidence of corrosion or staining of the test metal strips or pitting of the aluminum alloy metal. Example XVI which did not contain the hydrazine or acid compound, resulted in corrosion of the aluminum alloy, a rust spot on the cast iron, heavy staining of the copper and pitting of the aluminum alloy. Example XVII which did not contain the hydrazine, resulted in heavy staining of copper and pitting of the aluminum alloy. Example XVIII, which did not contain the organic acid, resulted in pitting of the aluminum alloy.

The following examples illustrate the fluid compositions of this invention and are not to be considered as limiting the scope of the invention.

EXAMPLES I-IV
[Percent by weight]

	Example Number			
	I	II	III	IV
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹	11.20	12.25	12.25	12.25
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ²	11.20	12.25	12.25	12.25
Ethylene glycol monomethyl ether.....	10.10	2.20		
Diethylene glycol monomethyl ether.....	55.55	65.05	20.30	
Triethylene glycol monomethyl ether.....			48.30	69.35
Ethylene glycol.....	2.50	2.50	0.90	0.90
Diethylene glycol.....	6.00	2.85	3.25	2.50
Potassium tetraborate.....	0.70	0.30	0.27	0.27
4,4'-isopropylidenediphenol.....	0.60	0.50	0.45	0.45
Dodecyl benzene.....	1.50	1.50	1.50	1.50
Hydrazine hydrate.....	0.40	0.35	0.31	0.31
Oleyl sarcosine.....	0.25	0.25	0.22	0.22
	100.00	100.00	100.00	100.00

¹ Kinematic viscosity of about 225 centistokes at 25° C.
² Kinematic viscosity of about 140 centistokes at 25° C.

In the foregoing fluids and those hereinafter, the potassium tetraborate alkaline buffer was first dissolved at a temperature of 70° C. to 80° C. in the ethylene and diethylene glycols. After solution and temperature lowering of to approximately 35° C. to 40° C., the 4,4'-isopropylidene-diphenol antioxidant was added and dissolved. The resulting solution was then introduced into the remainder of the mixture.

The above hydraulic fluids, thus prepared, were tested for corrosion according to Federal specification VV-B-680 by incorporating in each of the fluids five parts by volume of water. Six metal strips, consisting of tin, steel, aluminum, cast iron, brass and copper were fastened together in that order and were immersed in the hydraulic fluid-water solution. The temperature of the solutions were raised to 212° F., and the temperature was maintained for five days. At the end of the test period, all the metal strips remained bright without any corrosion or discolorization evident. Without the hydrazine and modified fatty acid (oleyl sarcosine) incorporated into the fluids, the fluids caused discolorization (evidence of corrosion) of aluminum, copper and brass. The hydraulic fluids thus prepared were tested, also, for resistance to oxidation according to Federal specification VV-B-680 by incorporating into each fluid five parts by volume of water and 0.2 part by weight of benzoyl peroxide. Two test metal strips consisting of aluminum and cast iron were fastened together. The strips were separated at each end by a piece of tinfoil. The strips were partially immersed in the test solution and were left at room temperature for three days then elevated temperature of 158° F. for seven days. At the end of the test period, the metal strips remained bright without any evidence of pitting type corrosion. Without the hydrazine and modified fatty acid (oleyl sarcosine) incorporated into the fluids, the fluids caused staining and pitting type corrosion of the aluminum metal.

EXAMPLES V-VI
[Percent by weight]

	Example Number	
	V	VI
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹	11.20	12.25
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ²	11.20	12.25
Ethylene glycol monomethyl ether.....	10.00	2.20
Diethylene glycol monomethyl ether.....	54.80	60.60
Ethylene glycol.....	2.50	1.50
Diethylene glycol.....	6.50	7.40
Potassium tetraborate.....	0.70	0.70
4,4'-isopropylidenediphenol.....	0.60	0.60
Dodecyl benzene.....	1.50	1.50
Hydrazine hydrate, 85 percent.....	0.40	0.40
Isostearic acid.....	0.60	0.60
Total.....	100.00	100.00

¹ Kinematic viscosity of about 225 centistokes at 25° C.
² Kinematic viscosity of about 140 centistokes at 25° C.

The above hydraulic fluids were prepared and tested for corrosion and resistance to oxidation according to Federal specification VV-B-680 as indicated above in Example I. The hydrazine hydrate and isostearic acid inhibitors combination eliminated corrosion and staining of all the test strips whereas without the added hydrazine hydrate and isostearic acid inhibitors incorpo-

rated into the fluids, the fluids caused corrosion of aluminum and staining of other metal strips, especially, copper and brass.

EXAMPLE VII

	Percent by weight
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹	11.20
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ²	11.20
Ethylene glycol monomethyl ether	10.00
Diethylene glycol monomethyl ether	54.95
Ethylene glycol	2.50
Diethylene glycol	6.50
Potassium tetraborate	0.70
4,4'-isopropylidenediphenol	0.60
Sodium nitrite	0.05
Dodecyl benzene	1.50
Potassium hydroxide	0.10
Abietic acid	0.50
Hydrazine hydrate, 85 percent	0.20
	100.00

¹ Kinematic viscosity of about 225 centistokes at 25° C.

² Kinematic viscosity of about 140 centistokes at 25° C.

The above hydraulic fluid was prepared and was tested for corrosion and resistance to oxidation according to Federal specification VV-B-680 as indicated above in Example I. The hydrazine and rosin acid inhibitors substantially eliminated corrosion and staining of all the test metal strips whereas without the added inhibitors incorporated into the fluid, the fluid caused corrosion of aluminum in the oxidation test and staining of aluminum, copper and brass metal strips in the corrosion test.

EXAMPLES VIII-IX
[Percent by weight]

	Example Number	
	VIII	IX
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹	11.20	11.20
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ²	11.20	11.20
Ethylene glycol monomethyl ether	13.50	13.45
Diethylene glycol monomethyl ether	53.05	52.85
Diethylene glycol	8.00	8.00
Potassium tetraborate	0.35	0.70
4,4'-isopropylidenediphenol	0.60	0.30
Dodecyl benzene	1.50	1.50
Polymerized fatty acid ³	0.30	0.40
Hydrazine hydrate, 85 percent	0.30	0.40
Total	100.00	100.00

¹ Kinematic viscosity of about 225 centistokes at 25° C.

² Kinematic viscosity of about 140 centistokes at 25° C.

³ Polymerized oleic acid consisting of approximately 55 percent dimer and 15 percent trimer acids.

The above hydraulic fluids were prepared and were tested for corrosion and resistance to oxidation according to Federal specification as indicated in Example I. The hydrazine hydrate and polymerized fatty acids eliminated corrosion and staining of all the test metal strips

whereas without the added inhibitors incorporated into the fluids, the fluids caused corrosion of aluminum and staining of aluminum, copper and brass metal strips.

EXAMPLE X

	Percent by weight
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹	12.25
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ²	12.25
Ethylene glycol monomethyl ether	10.00
Diethylene glycol monomethyl ether	52.60
Ethylene glycol	2.50
Diethylene glycol	6.50
Potassium tetraborate	0.50
4,4'-isopropylidenediphenol	0.50
Dodecyl benzene	1.50
Hydroxyethyl hydrazine	0.80
Isostearic acid	0.60
	100.00

¹ Kinematic viscosity of about 225 centistokes at 25° C.

² Kinematic viscosity of about 140 centistokes at 25° C.

The above hydraulic fluid was prepared and tested for corrosion and resistance to oxidation according to Federal specifications as indicated above in Example I. The hydroxyethyl hydrazine and isostearic acid inhibitors eliminated corrosion and staining of all the test metal strips whereas without the added inhibitors incorporated into the fluid, the fluid caused corrosion or staining of aluminum, copper and brass metal strips.

EXAMPLE XI

	Percent by weight
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹	12.25
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ²	12.25
Ethylene glycol monomethyl ether	10.05
Diethylene glycol monomethyl ether	53.30
Ethylene glycol	2.50
Diethylene glycol	6.50
Potassium tetraborate	0.50
4,4'-isopropylidenediphenol	0.50
Dodecyl benzene	1.50
Hydroxyethylhydrazine	0.40
Oleyl sarcosine	0.25
	100.00

¹ Kinematic viscosity of about 225 centistokes at 25° C.

² Kinematic viscosity of about 140 centistokes at 25° C.

The above hydraulic fluid was prepared and tested for corrosion and resistance to oxidation according to Federal specification as indicated above in Example I. The hydroxyethyl hydrazine and oleyl sarcosine inhibitors eliminated corrosion and staining of all the test metal strips whereas without the added hydroxyethyl hydrazine and oleyl sarcosine incorporated into the fluid, the fluid caused corrosion of aluminum and staining of aluminum, copper and brass metal strips in the corrosion test.

9 EXAMPLE XII

	Percent by weight
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹ -----	11.20
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ² -----	11.20
Ethylene glycol monomethyl ether -----	13.60
Diethylene glycol monomethyl ether -----	54.55
Ethylene glycol -----	0.73
Diethylene glycol -----	5.85
Sodium tetraborate -----	0.27
Polybutylated 4,4'-isopropylidenediphenol -----	0.30
Dodecyl benzene -----	1.50
Polymerized fatty acid ³ -----	0.40
Diphenyl hydrazine -----	0.40
	100.00

¹ Kinematic viscosity of about 225 centistokes at 25° C.

² Kinematic viscosity of about 140 centistokes at 25° C.

³ Polymerized oleic acid consisting of approximately 85 percent dimer and 15 percent trimer acids.

The above hydraulic fluid was prepared and tested for corrosion and resistance to oxidation according to Federal specification as indicated above in Example I. The diphenyl hydrazine and fatty acids inhibitors eliminated corrosion and staining of all the test metal strips whereas without the added inhibitors, the fluid caused corrosion of aluminum and staining of aluminum, copper and brass metal strips in the corrosion test.

The above hydraulic fluid was prepared and tested for corrosion and resistance to oxidation according to Federal specification as indicated above in Example I. The phenyl hydrazine and potassium salt of fatty acids eliminated corrosion and staining of all the test metal strips whereas without the added inhibitors, the fluid caused corrosion of aluminum and staining of aluminum, copper and brass metal strips in the corrosion test.

EXAMPLE XIII

	Percent by weight
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹ -----	11.500
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ² -----	11.500
Triethylene glycol monomethyl ether -----	71.100
Dodecylbenzene -----	1.500
Diethylene glycol -----	2.25
Ethylene glycol -----	0.900
Potassium tetraborate -----	0.135
Boric acid -----	0.135
Bisphenol A (4,4'-isopropylidenediphenol) -----	0.450
Oleyl sarcosine -----	0.220
Hydrazine hydrate (85 percent) -----	0.310
	100.000

¹ Kinematic viscosity of about 225 centistokes at 25° C.

² Kinematic viscosity of about 140 centistokes at 25° C.

The potassium tetraborate and boric acid buffer components were dissolved in the ethylene and diethylene glycols at ambient temperature. After solution, the 4,4'-isopropylidenediphenol antioxidant was added and dis-

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solved. The oleyl sarcosine, a modified fatty acid, was then blended with the above solution. Finally the hydrazine hydrate was added to form the inhibitor composition package. The resulting inhibitor composition was then blended into the nonylphenol ether type lubricants, glycol ether diluent and dodecylbenzene rubber swelling components.

The above hydraulic brake fluid was prepared and tested for corrosion and resistance to oxidation according to the Federal specification VV-B-680 as indicated in Example I. The inhibitor composition consisting of buffer, corrosion inhibitors and antioxidant specified above eliminated corrosion and staining of all test metal strips. Whereas, without the added corrosion inhibitors incorporated into the fluid, the fluid caused corrosion of aluminum and staining of the metal strips, especially, copper and brass, and failed to pass the requirements of Federal specification VV-B-680.

Also, the corrosion inhibitors and specifically the hydrazine hydrate prevented color development in the hydraulic brake fluid at elevated temperatures. During the boiling point determination (468° F.) and corrosion test evaluation (120 hours at 212° F.), the hydraulic brake fluid remained water white. Whereas, without the added corrosion inhibitors, the fluid turned an amber color at elevated temperatures, indicating degradation.

EXAMPLE XIV

	Percent by weight
Adduct of nonyl phenol plus 4½ moles of ethylene oxide ¹ -----	12.25
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ² -----	12.25
Ethylene glycol monomethyl ether -----	15.00
Diethylene glycol monomethyl ether -----	22.25
Diethylene glycol -----	32.85
Ethylene glycol -----	2.50
Dodecylbenzene -----	1.50
Potassium tetraborate -----	0.30
Bisphenol A (4,4'-isopropylidenediphenol) -----	0.50
Oleyl sarcosine -----	0.25
Hydrazine hydrate (85 percent) -----	0.35
	100.00

¹ Kinematic viscosity of about 225 centistokes at 25° C.

² Kinematic viscosity of about 140 centistokes at 25° C.

An inhibitor composition was prepared by solubilizing the solid potassium tetraborate and bisphenol A antioxidant in the ethylene glycol and a portion of diethylene glycol. After solution, the oleyl sarcosine was blended into this glycol, buffer and antioxidant solution. Finally, the hydrazine hydrate was added to form the complete inhibitor composition for blending in the nonylphenyl ether lubricants and diluents.

The above hydraulic brake fluid was prepared and tested for corrosion and resistance to oxidation according to the Federal specification VV-B-680 as indicated in Example I. The inhibitor composition consisting of buffer, corrosion inhibitors and antioxidant specified above eliminated corrosion and staining of all test metal strips. Whereas, without the added corrosion inhibitors incorporated into the fluid, the fluid caused corrosion of aluminum and staining of metal strips, especially, copper and brass, and

failed to pass the requirements of Federal specification VV-B-680.

Hydraulic Brake Fluid—SAE Standard J-70-c. Pertinent data relating to these tests, which illustrates the outstand-

EXAMPLES XV TO XX
[Percent by weight]

	Example Number					
	XV	XVI	XVII	XVIII	XIX	XX
Formula:						
Adducts of nonyl phenol plus 4.5 moles of ethylene oxide ¹	12.25	12.25	12.25	12.25	12.25	12.25
Nonyl phenol plus 13 moles of a mixture of 60 weight percent ethylene oxide and 40 weight percent propylene oxide (Random addition product) ²	12.25	12.25	12.25	12.25	12.25	12.25
Diethylene glycol monomethyl ether	65.05	65.65	65.40	65.30	65.40	64.55
Ethylene glycol monomethyl ether	3.70	3.70	3.70	3.70	3.70	3.70
Ethylene glycol	2.50	2.50	2.50	2.50	2.50	2.50
Diethylene glycol	2.85	2.85	2.85	2.85	2.85	2.85
Bisphenol A	0.50	0.50	0.50	0.50	0.50	0.50
Potassium tetraborate	0.30	0.30	0.30	0.30	0.30	0.30
Hydrazine hydrate, 85%	0.35			0.35	0.15	0.65
Oleyl sarcosine	0.25		0.25		0.10	0.45
Total	100.00	100.00	100.00	100.00	100.00	100.00
Corrosion test results: Federal specification VV-B-680a						
Specification limits (weight change in mg./sq. cm.):						
Timed iron:						
0.20 max.	0.00	0.00	0.00	0.00	0.00	0.00
Slight staining	(3)	(3)	(3)	(3)	(3)	(3)
Steel:						
0.20 max.	0.00	0.00	0.00	0.02	0.00	0.00
Slight staining	(3)	(3)	(3)	(4)	(3)	(3)
Aluminum alloy:						
0.10 max.	0.00	0.04	0.00	0.00	0.00	0.00
Slight staining	(3)	(5)	(3)	(4)	(3)	(3)
Cast iron:						
0.20 max.	0.01	0.02	0.01	0.02	0.02	0.02
Slight staining	(2)	(5)	(3)	(4)	(3)	(3)
Brass:						
0.40 max.	0.00	0.00	0.01	0.00	0.00	0.02
Slight staining	(3)	(3)	(4)	(3)	(3)	(3)
Copper:						
0.40 max.	0.00	0.06	0.13	0.00	0.02	0.01
Moderate staining	(3)	(7)	(7)	(3)	(3)	(3)
Neutrality (pH):						
Before, 7.0-11.0	10.6	11.0	10.7	11.1	11.1	10.5
After, 7.0-11.0	10.5	10.4	9.2	10.7	10.5	10.2
Oxidation stability test results: Federal specification VV-B-680a						
Specification limits (weight change in mg./sq. cm.):						
Cast iron:						
0.30 max.	0.01	0.01	0.00	0.02	0.03	0.01
No pitting	None	None	None	None	None	None
Aluminum alloy:						
0.05 m.	0.01	0.02	0.02	0.02	0.02	0.02
No pitting	None	(*)	(*)	(*)	None	None
¹ Kinematic viscosity of about 225 centistokes at 25° C. ² Kinematic viscosity of about 140 centistokes at 25° C. ³ No stain. ⁴ Slight stain. ⁵ Corrosion. ⁶ Rust spot. ⁷ Heavy stain. ⁸ Pitting. ing properties of these novel fluids, is shown in Table I. All of the fluids tested (i.e., the fluids of the examples mentioned above) were found to satisfy completely the requirements for Heavy Duty J-70-c Type Hydraulic Brake Fluid.						

The above hydraulic brake fluids (Examples XV to XX) were prepared and tested for corrosion and resistance to oxidation according to the Federal specification VV-B-680a as indicated in Example I.

The fluid compositions of Examples I, VI, VII, XIII and XIV were tested according to the procedures set forth in

ing properties of these novel fluids, is shown in Table I. All of the fluids tested (i.e., the fluids of the examples mentioned above) were found to satisfy completely the requirements for Heavy Duty J-70-c Type Hydraulic Brake Fluid.

TABLE I
TESTING OF HYDRAULIC BRAKE FLUID COMPOSITIONS

[Test conducted according to procedures set forth in Society of Automotive Engineers Standard J-70c]

Test	SAE require- ment	Example Number				
		I	VI	VII	XIII	XIV
Boiling point, ° F.....	1 302	322	346	320	466	328
Flash point, ° F.....	1 145.4	190	190	180	280	190
Viscosity, cs.: -40° F.....	2 1,800	442	717	446	1,306	1,641
122° F.....	1 3.5	4.4	5.0	4.4	6.0	6.7
212° F.....	1 1.3	1.7	1.9	1.7	2.2	2.3
pH.....	7.0-11.5	10.9	10.7	10.9	10.7	10.6
Stability at high temperature: Boiling point, ° F.....	1 294.8	324	348	324	470	329
Boiling point change, ° F.....	2 ±9	+2	+2	+4	+4	+1
Corrosion weight change, mg./sq. cm.: Tinned iron.....	2 0.20	0.00	0.01	0.00	0.02	0.01
Steel.....	2 0.20	0.00	0.01	0.00	0.01	0.01
Aluminum.....	2 0.10	0.01	0.00	0.00	0.01	0.00
Cast iron.....	2 0.20	0.02	0.04	0.02	0.01	0.02
Brass.....	2 0.40	0.01	0.01	0.02	0.00	0.00
Copper.....	2 0.40	0.01	0.01	0.03	0.02	0.00
Pitting or roughening of metal strip.....	None	None	None	None	None	None
Jelling of fluid-water mixture.....	None	None	None	None	None	None
Crystalline deposit on glass jar walls or metal strips.....	None	None	None	None	None	None
Sedimentation, percent by volume.....	2 0.10	0.05	0.03	0.03	0.05	0.05
pH fluid-water mixture.....	7.0-11.5	10.6	10.2	10.5	10.0	10.0
Disintegration rubber cups evidenced by excessive tackiness or blisters.....	None	None	None	None	None	None
Sloughing rubber cups evidenced by carbon black separation.....	None	None	None	None	None	None
Decrease hardness rubber cups, deg.....	2 15	-8	-5	-9	-6	-4
Increase base diameter rubber cups, in.....	2 0.055	0.034	0.033	0.035	0.030	0.038
Fluidity and appearance low temperature: -40° F.: Discernibility black contrast lines.....	(3)	(4)	(4)	(4)	(4)	(4)
Stratification—sedimentation.....	None	None	None	None	None	None
Time air bubble travel to stop, sec.....	2 10	1	2	1	2	3
-53° F.: Discernibility black contrast lines.....	(3)	(4)	(4)	(4)	(4)	(4)
Stratification—sedimentation.....	None	None	None	None	None	None
Time air bubble travel to stop, sec.....	2 35	2	3	2	4	7
Evaporation: Percent weight loss.....	2 80	73.4	73.9	76.1	76.3	74.6
Gritty or abrasive residue.....	None	None	None	None	None	None
Pour point residue, ° F.....	2 23	-5	-5	0	0	0
Water tolerance: -40° F.: Discernibility black contrast lines.....	(3)	(4)	(4)	(4)	(4)	(4)
Stratification—sedimentation.....	None	None	None	None	None	None
Time air bubble travel, sec.....	2 10	1	2	1	2	3
140° F.: Stratification.....	None	None	None	None	None	None
Sedimentation, percent by vol.....	2 0.05	None	None	None	None	None
Compatibility: -40° F.: Discernibility black contrast lines.....	(3)	(4)	(4)	(4)	(4)	(4)
Stratification—sedimentation.....	None	None	None	None	None	None
140° F.: Stratification.....	None	None	None	None	None	None
Sedimentation, percent by vol.....	2 0.05	None	None	None	None	None
Resistance to oxidation: Pitting or roughening metal strips.....	None	None	None	None	None	None
Gum deposit metal strips.....	(6)	None	None	None	None	None
Weight loss mg./sq. cm.: Aluminum.....	2 0.05	0.01	0.00	0.00	0.01	0.00
Iron.....	2 0.30	0.00	0.02	0.00	0.00	0.00
Effect on rubber, 158° F.: Hardness decrease, deg.: Natural.....	2 10	4	6	4	2	3
SBR.....	2 10	6	4	4	6	5
Base diameter increase, in.: Natural.....	0.006-0.055	0.027	0.032	0.030	0.029	0.034
SBR.....	0.006-0.055	0.028	0.027	0.025	0.032	0.031
Disintegration evidenced by excessive tackiness or blisters, Natural.....	None	None	None	None	None	None
Disintegration evidenced by excessive tackiness or blisters, SBR.....	None	None	None	None	None	None
Sloughing indicated by carbon black separation: Natural.....	None	None	None	None	None	None
SBR.....	None	None	None	None	None	None
Specific gravity 60/60° F.....	(9)	1.033	1.0375	1.0345	1.0485	1.051
Pounds per gallon at 60° F.....	(9)	8.61	8.64	8.62	8.73	8.75

¹ Minimum.

² Maximum.

³ Clearly discernible.

⁴ Clear.

⁵ Trace.

⁶ No requirement.

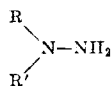
What is claimed is:

1. A hydraulic fluid composition consisting essentially of a base component selected from the group consisting of alkylene glycols, polyoxyalkylene glycols, polyoxy-

alkylene triols, polyoxyalkylene adducts of phenols, glycol ethers and mixtures thereof and an inhibitor composition consisting essentially of (A) from about 0.01 to about 1.0 percent by weight of the total fluid composition of a

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hydrazine compound selected from the group consisting of hydrazine hydrate and a hydrazine compound of the formula:



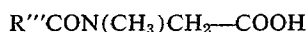
wherein R and R' are independently selected from the group consisting of hydrogen, alkyl of from 2 to 8 carbon atoms, hydroxyalkyl having from 2 to 7 carbon atoms and aryl having not more than 9 carbon atoms and (B) from about 0.01 to about 1.0 percent by weight of the total fluid composition of an organic acid compound selected from the group consisting of (aa) a compound of the formula:



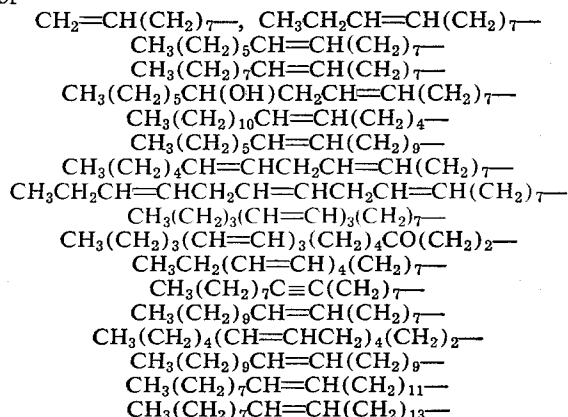
wherein R is alkyl of from 3 to 26 carbon atoms, (bb) a compound of the formula:



wherein R' is hydrogen or alkyl of from 1 to 11 carbon atoms and R'' is alkylene of from 4 to 14 carbon atoms, (cc) a compound of the formula:



wherein R''' is a radical selected from the group consisting of



and alkyl of from about 7 to about 23 carbon atoms, (dd) a rosin acid, and (ee) a mixture of polymerized oleic acid consisting of dimer and trimer acids.

2. The composition of claim 1 wherein the said hydrazine compound is hydrazine hydrate.

3. The composition of claim 1 wherein the said hydrazine compound is hydroxyethyl hydrazine.

4. The composition of claim 1 wherein the said hydrazine compound is phenyl hydrazine.

5. The composition of claim 1 wherein the said hydrazine compound is diphenyl hydrazine.

6. The composition of claim 1 wherein the said organic acid compound is oleyl sarcosine.

7. The composition of claim 1 wherein the said organic acid is isostearic acid.

8. The composition of claim 1 wherein the said organic acid is abietic acid.

9. The composition of claim 1 wherein the said organic acid is polymerized oleic acid containing approximately 85 percent dimer and 15 percent trimer acids.

10. The composition of claim 1 wherein said hydrazine compound is hydrazine hydrate and said organic acid compound is oleyl sarcosine.

11. The composition of claim 1 wherein said hydrazine compound is hydrazine hydrate and said organic acid compound is isostearic acid.

12. The composition of claim 1 wherein the said hydrazine compound is hydrazine hydrate and said organic acid compound is polymerized oleic acid containing approximately 85 percent dimer and 15 percent trimer acids.

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13. The composition of claim 1 wherein said inhibitor composition additionally includes (C) from about 0.01 to about 1.0 percent by weight of the total fluid composition of an alkaline buffer to maintain the pH from about 7.0 to about 11.5 and (D) from about 0.01 to about 1.0 percent by weight of the total fluid composition of an antioxidant.

14. The composition of claim 13 wherein said alkaline buffer is potassium tetraborate.

15. The composition of claim 13 wherein said alkaline buffer is a mixture of potassium tetraborate and boric acid.

16. The composition of claim 13 wherein said alkaline buffer is sodium tetraborate.

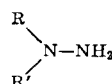
17. The composition of claim 13 wherein said antioxidant is 4,4'-isopropylidenediphenol.

18. The composition of claim 13 wherein said hydrazine compound is hydrazine hydrate, said organic acid compound is oleyl sarcosine, said alkaline buffer is potassium tetraborate and said antioxidant is 4,4'-isopropylidenediphenol.

19. The composition of claim 13 wherein said hydrazine compound is hydrazine hydrate, said organic acid compound is isostearic acid, said alkaline buffer is potassium tetraborate and said antioxidant is 4,4'-isopropylidenediphenol.

20. The composition of claim 13 wherein said hydrazine compound is hydrazine hydrate of 85 percent strength, said organic acid compound is polymerized oleic acid containing approximately 85 percent dimer and 15 percent trimer acids, said alkaline buffer is potassium tetraborate and said antioxidant is 4,4'-isopropylidenediphenol.

21. In the method of inhibiting corrosion when using a hydraulic fluid wherein the base component of said fluid is selected from the group consisting of polyhydric alcohols, polyhydric alcohol ethers and mixtures thereof, the improvement comprising using in admixture with said base component an inhibitor composition consisting essentially of (A) from about 0.01 to about 1.0 percent by weight of the total fluid composition of a hydrazine compound selected from the group consisting of hydrazine hydrate and a hydrazine compound of the formula:



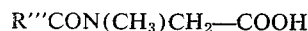
wherein R and R' are independently selected from the group consisting of hydrogen, alkyl of from 2 to 8 carbon atoms, hydroxyalkyl having from 2 to 7 carbon atoms and aryl having not more than 9 carbon atoms and (B) from about 0.01 to about 1.0 percent by weight of the total fluid composition of an organic acid compound selected from the group consisting of (aa) a compound of the formula:



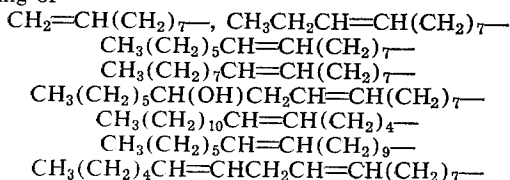
wherein R is alkyl of from 3 to 26 carbon atoms, (bb) a compound of the formula:



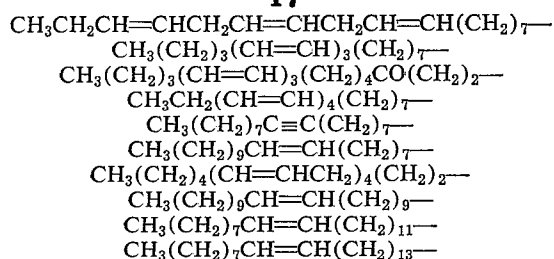
wherein R' is hydrogen or alkyl of from 1 to 11 carbon atoms and R'' is alkylene of from 4 to 14 carbon atoms, (cc) a compound of the formula:



wherein R''' is a radical selected from the group consisting of



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and alkyl of from about 7 to about 23 carbon atoms, (dd) a rosin acid, and (ee) a mixture of polymerized oleic acid consisting of dimer and trimer acids.

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252—51, 51.5, 74, 76, 390, 394, 396, 404