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HYDRAULIC FLUID COMPOSITION

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The present invention relates generally to hydraulic fluids useful for transmitting pressure in closed systems and it relates more particularly to a new and useful hydraulic fluid composition containing alkylene oxide-treated tall oil.

Considerable work has been done on the problem of developing a suitable pressure-transmitting fluid for use in servo-mechanisms and hydraulic braking systems and the like particularly as they relate to aircraft wherein special problems are encountered. Hydraulic fluids having a castor oil base or a polymer-thickened petroleum base have been employed in aircraft systems for some time but these compositions have not proven entirely satisfactory due to the fact that they constitute a serious fire hazard. That is, the inflammability of these conventional hydraulic fluid compositions has frequently caused disastrous fires resulting from breaks in high pressure hydraulic fluid lines or from leaks arising from mechanical or packing failures or from incendiary bullets or shells during warfare. Additionally, these conventional hydraulic fluid compositions are undesirable because they tend to swell the various parts made of rubber or the like which are used in pressure-transmitting systems.

Various glycols have heretofore been tested for this purpose but have proven unsatisfactory due to their extremely high viscosity at the low temperatures (—40° F. and below) which may be encountered during aircraft operation particularly at high altitudes. Moreover, the cost of the glycol-base hydraulic fluids heretofore proposed has been excessive due to the fact that they cannot be mixed with water because glycol-water mixtures do not have a sufficiently low freezing point to remain liquid at these extremely low temperatures.

Various water-base hydraulic fluids have also been proposed but have proven unsatisfactory due to their low surface tension which results in a marked tendency of the fluid to leak out through materials which would normally confine a fluid of high surface tension.

Accordingly, one object of the present invention is to provide a new and useful hydraulic fluid composition which will overcome the disadvantages of the prior art compositions.

Another object of the prevent invention is to provide a new and improved hydraulic fluid composition intended for use particularly in hydraulic braking systems or servo-mechanisms or the like which is non-inflammable, which is capable of operating at high unit-pressures, which has a sufficiently low freezing point to permit its use in aircraft and which is capable of maintaining appropriate viscosity and lubricity at both low and high operating temperatures. A further object is to provide a hydraulic fluid which will not appreciably corrode, attack or otherwise deleteriously affect the various metallic and non-metallic materials commonly employed in servo systems or hydraulic braking systems or the like.

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Other objects and advantages of the present invention will be apparent from the following detailed description and from the appended claims. Generally speaking, the present invention contemplates a new and improved hydraulic fluid composition prepared by reacting tall oil (which is a commercially available oil composed essentially of mixtures of rosin and resin acids and fatty acids obtained as a by-product in the treatment of wood-pulp in paper mills) with an alkylene oxide (as for example ethylene oxide or propylene oxide) and thereafter incorporating the reaction product into a fluid composition comprising essentially ethylene glycol and water along with small amounts of appropriate and well-known corrosion inhibitors, vapor-phase inhibitors and oil-soluble detergents.

In preparing the tall oil-alkylene oxide reaction product referred to above tall oil is heated to a temperature of about 350° F. to 450° F. in a suitable pressure chamber. Ethylene or propylene oxide under a pressure of about 3000 pounds per square inch is then gradually introduced into the pressure chamber and the pressure is allowed to rise in the reaction chamber until it exceeds 2000 pounds per square inch, after which it is maintained during the reaction period within the range from about 2000 pounds per square inch to 3000 pounds per square inch. The amount of alkylene oxide introduced is preferably in the range from about 14 moles alkylene oxide per mole of tall oil to about 18 moles alkylene oxide per mole of tall oil. A somewhat improved product may be obtained by a preliminary purification of the tall oil which may be carried out by heating the tall oil with about 1% by weight of maleic acid and then filtering off the precipitated material. Where this preliminary purification step is employed the amount of alkylene oxide is calculated with respect to the amount of purified tall oil introduced into the reaction chamber. The final reaction product is obtained by allowing the reaction mixture to cool and then adding a few parts by weight of decolorizing charcoal after which the mixture is stirred and filtered. The final filtrate is heated to about 150° F. and agitated to drive off substantially all unreacted alkylene oxide.

The alkylene oxide-treated tall oil (the exact composition of which is not known but which appears to be an esterified product) is then incorporated into a mixture of ethylene glycol or propylene glycol and water. To the mixture are also added small amounts of one or more in-

hibitors such as sodium mercaptobenzothiozole, ortho benzoic ethanolamine, polymethylsiloxane, 2-amino, 2-methyl, 1-propanol and diisopropylamine nitrite.

The following examples represent preferred embodiments of the novel hydraulic fluid compositions of the present invention.

Example I

15 parts by weight of ethylene oxide-treated tall oil is mixed with 45 parts of ethylene glycol and 35 parts of water. The resultnig fluid is an excellent hydraulic fluid which is non-inflammable, and has a pour point of minus 70° F. Its kinematic viscosity is approximately 10.5 centistokes at 130° F., 450 centistokes at —40° F. and 2350 centistokes at minus 65° F. The fluid has a freezing point of about —85° F. and a boiling point of about 235° F. The fluid is a true solution at all temperatures between the pour point and the boiling point and remains homogeneous throughout this temperature range. The fluid has no appreciable tendency to vaporize at any temperature much below its boiling point so that there is no danger of "vapor lock" resulting at high-temperature operation.

Example II

	Parts by weight
Ethylene oxide-treated tall oil	10–20
Ethylene glycol	40–50
Water	30–40
Inhibitors	0.2–1
Light mineral oil	1–2

Example III

	Parts by weight
Propylene oxide-treated tall oil	10–20
Ethylene glycol	40–50
Water	30–40
Inhibitors	.2–1
Light mineral oil	1–2

As used in the present specification and the appended claims, the expression "alkylene oxide-treated tall oil" is intended to mean the reaction products obtained when tall oil is reacted with an alkylene oxide under conditions of elevated temperature and elevated pressure.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiments be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Having thus described my invention, I claim:

1. A hydraulic fluid composition comprising a mixture consisting essentially of about 40–50 parts by weight of a glycol, about 30–40 parts by weight water, and a minor proportion on the order of about 10–20 parts by weight of the product obtained by reacting an alkylene oxide with tall oil at elevated temperature of about 350° F.–450° F. and pressure of about 2000–3000 pounds per square inch, said alkylene oxide being selected from the class which consists of ethylene oxide and propylene oxide, and being initially present in proportions of about 14–18 mols alkylene oxide per mol tall oil.

2. A hydraulic fluid composition comprising a mixture consisting essentially of about 40–50 parts by weight of a glycol selected from the group which consists of ethylene glycol and propylene glycol, 30–40 parts by weight water, and 10–20 parts by weight of the product of reaction of about 14–18 mols alkylene oxide with about one mol tall oil, said alkylene oxide being selected from the class which consists of ethylene oxide and propylene oxide, and said reaction being carried out at elevated temperature and pressure.

3. A hydraulic fluid composition comprising a mixture consisting essentially of about 40–50 parts by weight glycol selected from the group consisting of ethylene glycol and propylene glycol, 30–40 parts by weight water, and 10–20 parts by weight of the product of reaction of about 14–18 mols of alkylene oxide with about one mol tall oil, said alkylene oxide being selected from the class which consists of ethylene oxide and propylene oxide, and said reaction being carried out at average temperatures of about 350° F.–450° F. and at average pressures of about 2000–3000 pounds per square inch.

4. A hydraulic fluid composition comprising a mixture consisting essentially of about 45 parts by weight ethylene glycol, 35 parts by weight water, and 15 parts by weight of the product of reaction at 350–450° F. and 2000–3000 pounds per square inch pressure between ethylene oxide and tall oil in a proportion of about 14–18 mols ethylene oxide per mol tall oil.

5. A hydraulic fluid composition comprising a mixture consisting essentially of about 40–50 parts by weight ethylene glycol, 30–40 parts by weight water, 1–2 parts by weight light mineral oil, and 10–20 parts by weight of the product of reaction of about 14–18 mols ethylene oxide with about one mol tall oil, said alkylene oxide being selected from the class which consists of ethylene oxide and propylene oxide, and said reaction being carried out at average temperatures of about 350° F.–450° F. and at average pressures of about 2000–3000 pounds per square inch.

6. A composition as defined in claim 2, further characterized by the fact that the glycol is ethylene glycol.

7. A composition as defined in claim 2, further characterized by the fact that the glycol is propylene glycol.

8. A composition as defined in claim 2, further characterized by the fact that the alkylene oxide is ethylene oxide.

9. A composition as defined in claim 2, further characterized by the fact that the alkylene oxide is propylene oxide.

10. A composition as defined in claim 5, further characterized by the fact that the alkylene oxide is ethylene oxide.

11. A composition as defined in claim 5, further characterized by the fact that the alkylene oxide is propylene oxide.

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