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3,379,644

HYDRAULIC FLUID COMPOSITIONS

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The present invention relates generally to hydraulic fluids useful for transmitting pressure in closed systems. More particularly, it relates to a new and useful hydraulic fluid composition containing an ethoxylated long chain alkylated phenol thickening agent.

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. Hydraulic fluids having a castor oil base or a polymer-thickened petroleum base have been employed but have not been entirely satisfactory due to the fact that they constitute a serious fire hazard. Because of the inflammability of these conventional hydraulic fluid compositions, there is a constant danger of fires resulting from breaks in high pressure hydraulic fluid lines or from leaks rising from mechanical or packing failures or from other obvious means. Moreover, 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 glycol-base hydraulic fluids have heretofore been proposed, but have proven unsatisfactory due to their low viscosity and, more particularly, due to their excessive cost. 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 present invention is to provide a new and improved, low-cost hydraulic fluid composition intended for use particularly in hydraulic braking systems or servo-mechanisms or the like which is non-flammable, of good viscosity and 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. Other objects and advantages of the present invention will be readily apparent from the following detailed description as well as the appended claims.

Generally speaking, the present invention contemplates a new and improved hydraulic fluid composition prepared by the addition of an effective, low cost, compatible thickener to an ethylene glycol-water fluid composition. Said new and improved composition may also contain small amounts of appropriate and well known additives, such as corrosion inhibitors, vapor-phase inhibitors and also soluble detergents if desired.

More particularly, the instant invention pertains to hydraulic fluid compositions containing ethylene glycol, water, and as the thickening agent an ethoxylated dinonyl phenol and if desired, a small amount of the above mentioned additives. The ethoxylated dinonyl phenol referred to in this invention is one in which dinonyl phenol has been condensed with about 12 to 18.5 molar proportions of ethylene oxide, in other words, one in which the polyoxyethylene radical comprises 60-70% by weight of the compound. It may also be defined as ethoxylated dinonyl phenol +60-70% EtO. While it is obvious that the amount of thickener to be used depends on the viscosity

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of the fluid that the particular pump and hydraulic system requires, it is preferred to use this thickener in amounts comprising approximately from 8-25% of the total formulation of the hydraulic fluid composition. Due to the use of this low cost thickener, the economics of glycol-water hydraulic fluids are appreciably more attractive and the viscosity of said fluids has been improved. The ethylene glycol-water mixture of this invention may consist essentially of from about 40-65 parts by weight of ethylene glycol and 35-60 parts by weight of water. However, it is preferred to utilize a glycol-water weight ratio in the range of 50-65 parts of ethylene glycol and 35-50 parts of water. Thus the instant invention is directed to a hydraulic fluid composition comprising (1) 75 to 92 parts by weight of an ethylene glycol-water mixture and (2) as a thickening agent, 25 to 8 parts by weight of an ethoxylated dinonyl phenol in which its polyoxyethylene radical comprises 60 to 70% by weight of said ethoxylated dinonyl phenol; 100 parts of said ethylene glycol-water mixture consisting essentially of about 40 to 65 parts by weight of ethylene glycol and about 60-35 parts by weight of water.

As examples of the above mentioned additives that may also be present, if desired, in a small amount such as from about 0.1 to 5.0 parts by weight of the total hydraulic fluid composition, there may be mentioned inhibitors such as sodium mercaptobenzothiazole, orthobenzoic ethanolamine, polymethylsiloxane, 2-amino-2-methyl-1-propanol and diisopropylamine nitrite.

The unique discovery that the instant ethoxylated dinonyl phenols may be used as viscosity improvers for glycol-water hydraulic fluids is most surprising since other ethoxylated higher alkyl phenols have been found to be unsatisfactory in that they do not appreciably affect the viscosity and/or precipitate out at lower temperatures. The ethoxylated dinonyl phenols used in this invention may be prepared by the conventional known process of reacting the dialkylphenol with the alkylene oxide, for example, as shown in U.S. Patent 2,593,112, issued Apr. 15, 1952.

The following examples are illustrative of the present invention and are not to be regarded as limitative. It is to be understood that all parts, percentages and proportions referred to herein and in the appended claims are by weight unless otherwise indicated.

Example I

A novel hydraulic fluid composition was prepared by adding 8 parts by weight of dinonyl phenol condensed with about 15 molar proportions of ethylene oxide, i.e., one in which the polyoxyethylene radical comprises 65.8% by weight of the compound (hereinafter defined as ethoxylated dinonyl phenol +65.8% EtO), to 92 parts by weight of a 50:50 percent mixture of ethylene glycol and water. The resulting composition is an excellent hydraulic fluid which is nonflammable. A second composition was prepared by following the same procedure except that 12 parts by weight of the ethoxylated dinonyl phenol +65.8% EtO were used. The viscosities in centistokes at 100° F. and 130° F. of the above prepared compositions were determined and compared to a mixture of 50 parts of ethylene glycol and 50 parts of water free from said ethoxylated dinonyl phenol +65.8% EtO. The results were as follows.

TABLE I

| Conc. of Ethoxylated<br>Dinonyl Phenol plus 65.8% EtO | KV-130 | Ethylene Glycol-Water<br>50-50 parts by wt. |                  |
|-------------------------------------------------------|--------|---------------------------------------------|------------------|
|                                                       |        | KV-100                                      | Cloud Pt. (° F.) |
| 0                                                     | -----  | 2.14                                        | -----            |
| 8                                                     | 6.80   | 8.30                                        | 199              |
| 12                                                    | 16.58  | 19.50                                       | 203              |

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## Example II

By way of comparison the procedure in Example I was repeated to prepare two separate compositions, one of which contained 8 parts by weight of nonyl phenol condensed with about 10.5 molar proportions of ethylene oxide (ethoxylated nonyl phenol +67.8% EtO) and the other contained 8 parts by weight of dodecyl phenol condensed with about 18 moles of ethylene oxide (ethoxylated dodecyl phenol +75.3% EtO). The former was found to have a viscosity in centistokes of 3.90 at 100° F., while the latter was found to have a viscosity in centistokes of 3.70 at 100° F.

## Example III

Three separate hydraulic fluid compositions were prepared by adding to 90 parts by weight of a 50:50 percent mixture of ethylene glycol and water, 10 parts by weight of a thickener. The thickener for the first composition was ethoxylated dinonyl phenol +65.8% EtO, the thickener for the second composition was ethoxylated nonyl phenol +67.8% EtO and the thickener for the third composition was ethoxylated dodecyl phenol +75.3% EtO. The viscosities in centistokes at 100° F. were determined and the results were as follows:

TABLE 2

| Conc. 10% Ethoxylated Thickener    | Ethylene Glycol-Water 50-50, parts by weight |                  |
|------------------------------------|----------------------------------------------|------------------|
|                                    | KV-100                                       | Cloud Pt. (° F.) |
| 0.....                             | 2.14                                         | -----            |
| Dodecyl phenol plus 75.3% EtO..... | 4.32                                         | >210             |
| Nonyl phenol plus 67.8% EtO.....   | 4.35                                         | >210             |
| Dinonyl phenol plus 65.8% EtO..... | 12.65                                        | 190              |

## Example IV

Three separate hydraulic fluid compositions were prepared. The first composition was made up of 90 parts by weight of a mixture of ethylene glycol and water, and 10 parts by weight of ethoxylated dinonyl phenol +65.8% EtO. The second composition was made up of 86 parts by weight of a mixture of ethylene glycol and water, and 14 parts by weight of ethoxylated dinonyl phenol +65.8% EtO and the third composition was made up of 82 parts by weight of a mixture of ethylene glycol and water, and 18 parts by weight of ethoxylated dinonyl phenol +65% EtO. The ethylene glycol-water mixture in all three compositions was made up of 65 percent ethylene glycol and 35 percent water. The viscosities in centistokes of the three compositions at 100° F. were determined and the results were as follows:

TABLE 3

| Conc. Ethoxylated Dinonyl Phenol Plus 65.8% EtO | Ethylene Glycol-Water 65-35, parts by weight |                  |
|-------------------------------------------------|----------------------------------------------|------------------|
|                                                 | KV-100                                       | Cloud Pt. (° F.) |
| 0.....                                          | 3.19                                         | -----            |
| 10.....                                         | 11.98                                        | >212             |
| 14.....                                         | 22.60                                        | >212             |
| 18.....                                         | 43.53                                        | >212             |

## Example V

Three separate hydraulic fluid compositions were prepared. The first composition was made up of 90 parts by weight of a mixture of ethylene glycol and water, and 10

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parts by weight of ethoxylated dinonyl phenol +70% EtO. The second composition was made up of 86 parts by weight of a mixture of ethylene glycol and water, and 14 parts by weight of ethoxylated dinonyl phenol +70% EtO and the third composition was made up of 82 parts by weight of a mixture of ethylene glycol and water, and 18 parts by weight of ethoxylated dinonyl phenol +70% EtO. The ethylene glycol-water mixture in all three compositions was made up of 65 percent ethylene glycol and 35 percent water. The viscosities in centistokes of the three compositions at 100° F. were determined and the results were as follows:

TABLE 4

| Conc. Ethoxylated Dinonyl Phenol Plus 70% EtO | Ethylene Glycol-Water 65-35, parts by weight |                  |
|-----------------------------------------------|----------------------------------------------|------------------|
|                                               | KV-100                                       | Cloud Pt. (° F.) |
| 0.....                                        | 3.19                                         | -----            |
| 10.....                                       | 6.25                                         | >212             |
| 14.....                                       | 9.54                                         | >212             |
| 18.....                                       | 14.95                                        | >212             |

Various modifications and variations of this invention will be obvious to a worker skilled in the art and it is understood that such modifications and variations are to be included within the purview of this application and the spirit and scope of the appended claims.

I claim:

1. A hydraulic fluid composition comprising (1) 75 to 92 parts by weight of an ethylene glycol-water mixture and (2) as a thickening agent, 25 to 8 parts by weight of an ethoxylated dinonyl phenol in which its polyoxethylene radical comprises 60 to 70% by weight of said ethoxylated dinonyl phenol; 100 parts of said ethylene glycol-water mixture consisting essentially of about 40 to 65 parts by weight of ethylene glycol and about 60-35 parts by weight of water.

2. A hydraulic fluid composition according to claim 1, wherein the ethylene glycol-water mixture consists essentially of about 50-65 parts by weight of ethylene glycol and about 50-35 parts by weight of water.

3. A hydraulic fluid composition according to claim 1, wherein the thickening agent is an ethoxylated dinonyl phenol in which its polyoxethylene radical comprises 65.8% by weight of said ethoxylated dinonyl phenol.

4. A hydraulic fluid composition according to claim 1, wherein the thickening agent is an ethoxylated dinonyl phenol in which its polyoxethylene radical comprises 70% by weight of said ethoxylated dinonyl phenol.

5. A hydraulic fluid composition according to claim 3, wherein the ethylene glycol-water mixture consists essentially of about 50 parts by weight of ethylene glycol and 50 parts by weight of water.

## References Cited

## UNITED STATES PATENTS

2,593,112 4/1952 Cross et al. 260-613  
2,947,699 8/1960 Wasson et al. 252-76

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