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BRAKE FLUID

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This invention relates to brake fluids and its object is to provide a brake fluid that utilizes available synthetic products in place of natural products, such as castor oil, in forming the fluid, which fluids will have the same or improved properties as those possessed by prior fluids and which will be lower in cost.

Hydraulic brake fluids, as manufactured and sold in the past, consisted chiefly of an oil or lubricant to provide the required amount of lubrication, and a diluent, usually of low viscosity, to give the required fluidity at low temperatures. One such fluid contains approximately 50% by volume of diacetone alcohol and 50% by volume of castor oil, or mixtures of castor oil and ethyl alcohol or castor oil and other solvents. Ricinoleate esters, better than castor oil, also have been used along with a diluent. These fluids, consist chiefly of an oil and a diluent, and have certain disadvantages. They usually have a fairly high oil content varying from 30 to 50%, which makes them very costly. The high oil-content fluids tend to have a rather high viscosity at —30° F. or lower, and if castor oil is used, they actually freeze at low temperatures. If the diluent content is raised too high, then the rubber-swelling effect becomes too great for satisfactory use in brakes.

The improved fluid of the instant invention contains several ingredients whose proportions with reference to the total volume of the fluid are held within rather narrow limits. One of these ingredients, mono- or di-ricinoleate of an ethylene, propylene or butylene glycol constituting from 10% to 25% by volume of the fluid is employable as a lubricant. The diluent, which is another ingredient, is preferably from 45% to 70% by volume of the fluid of one of the group consisting of the propyl alcohols, the butyl alcohols, the amyl alcohols, methoxy-methoxy ethanol, and the lower mono-alkyl ethers of ethylene glycol, diethylene glycol, propylene glycol and dipropylene glycol. Another ingredient is combined with this aforementioned oil and diluent, which is an aliphatic glycol having from 2 to 4 carbon atoms per molecule, inclusive, and varies between 3%–15% by volume of the total volume of fluid. Another ingredient is 2-methyl-2, 4-pentane diol, which varies from 10% to 24% of the volume of the fluid. It is generally desirable to add a small but effective amount of corrosion inhibitor to this fluid, which may be material such as potassium ricinoleate.

The glycol ricinoleate in this new composition has the function of providing the proper amount

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of lubrication. If too low a percentage of oil is used, the fluid will be lacking in lubricating qualities and if more than about 25% of this oil is used in this composition the viscosity at low winter temperatures becomes high. The small amount of aliphatic glycol used has the property of reducing the adverse or deteriorating effect on rubber. If less than about 3% is used, this will not be satisfactorily accomplished, but if more than about 15% is used, then the hydroscopic and corrosive properties of these glycols tend to give the finished fluid undesirable properties. The 2-methyl-2, 4-pentane diol acts partially as a replacement for oil, due to its considerable viscosity, and it also acts as a coupling agent, to improve the solubility of the oil in the diluent at low temperatures. If more than about 20 to 24% is used, this, plus the oil present, will give the fluid an undesirably high viscosity at low winter temperatures. The 45% to 70% of diluent used serves to give the fluid an operable viscosity at all operating temperatures. If too high a percentage of diluent is used, the lubricating value of the fluid is too low, and the adverse or deteriorating effect on rubber is increased, and if less than about 45% of diluent is used, the fluid will not operate efficiently under extreme low temperature conditions. Besides the compounds above mentioned, other organic solvents, having a boiling point of about 90° C. or higher, and which are relatively inert to rubber and metals, and have a low freezing point, can be used as the diluent. Suitable corrosion inhibitors include potassium, sodium or other alkali-metal salts of castor oil or other fatty acids, amine-phosphates, nitrites, borates and other buffer materials. The amount of corrosion inhibitor I prefer to use is from about 0.2% to about 3.0% of the finished fluid by weight.

Examples of the new composition in which the percentages given are only approximate are as follows:

Example 1

	Per cent by volume
Propylene glycol mono-ricinoleate	about 17
Propylene glycol	about 6
2-methyl-2, 4-pentane diol	about 15
Isobutanol	about 62

A corrosion inhibitor comprising potassium ricinoleate was added to a fluid of the above composition at the rate of about 1.9 grams per 100 cubic centimeters of the fluid. This fluid had a boiling point of 241° F. and in a cold test remained readily fluid after five days at —40° F. The specific gravity at 20°/20° C. is 0.8714 and the vis-

cosity at 100° F. is 50 seconds Saybolt, and at —40° F. is 3900 seconds Saybolt. A 1¼ inch rubber sealing cup immersed in this fluid for five days at 70° C. gained only 6.7% in weight.

This fluid was tested as to lubrication by a stroking test and after 150,000 strokes there was very little wear on the cylinders or pistons, in the wheel cylinders and master cylinder, and the rubber parts of the braking system were in good condition. Corrosion tests run on this fluid for 120 hours at 210° F. against the metals usually present in the brake system, namely, tin-plated steel, steel, aluminum, cast-iron, brass and copper gave losses in weight of the metal in each case from zero to a few tenths of a milligram per square centimeter of exposed surface.

The tests in the brake systems of a number of automobiles under winter and summer conditions have shown that this is an operative hydraulic brake fluid.

Example 2

	Per cent by volume
Propylene glycol mono-ricinoleate	about 15
Propylene glycol	about 5.5
2-methyl-2, 4-pentane diol	about 17.5
Isobutanol	about 62

A corrosion inhibitor comprising potassium ricinoleate was added to the above fluid at the rate of about 1.9 grams per cc. of the fluid. This fluid had properties very much like the fluid in Example 1. It had a boiling point of 243° F. and viscosity at 100° F. of 51 seconds Saybolt, and at —40° F. of 3480 seconds Saybolt. The lubrication, corrosion, effect on rubber and other tests all indicated that this fluid is operable in hydraulic brake systems.

Example 3

	Per cent by volume
Propylene glycol mono-ricinoleate	about 23
Propylene glycol	about 5
2-methyl-2, 4-pentane diol	about 16
Methoxy-methoxy ethanol	about 56

A corrosion inhibitor comprising potassium ricinoleate was added to the above fluid at the rate of about 1.4 grams per 100 cc. of the fluid. This fluid had a specific gravity at 20°/20° C. of 1.007 and a boiling point of 331° F. After holding it at —40° F. for three days it was readily fluid and the other tests on it showed it to be operable as a hydraulic brake fluid.

Example 4

	Per cent by volume
Ethylene glycol mono-ricinoleate	about 25
Ethylene glycol	about 7
2-methyl-2, 4-pentane diol	about 20
Mono-butyl ether of ethylene glycol	about 48

Diamylamine as a corrosion inhibitor was added to a fluid of the above composition at the rate of 0.75% by volume and 85% phosphoric acid at the rate of 0.125% by volume of the fluid. After mixing, this fluid had a specific gravity at 20°/20° C. of 0.940 and a boiling point of 330° F. After four days at —40° F. the mixture was readily fluid and in the other tests was found to be operable as a brake fluid.

Example 5

	Per cent by volume
Ethylene glycol mono-ricinoleate	about 25
Ethylene glycol	about 3
2-methyl-2, 4-pentane diol	about 24
Propylene glycol mono-ethyl ether	about 48

A corrosion inhibitor comprising sodium ricinoleate was added to a fluid of the above composition at the rate of 0.4 gram per 100 cc. of the fluid. After solution, this fluid had a clear straw-color and a specific gravity of 0.935 at 20° C. After three days at —40° F. it was readily fluid and the other tests on it indicated that it was operable as a brake fluid.

Example 6

	Per cent by volume
1,3 butylene glycol mono-ricinoleate	about 11
1,3 butylene glycol	about 10
2-methyl-2, 4-pentane diol	about 10
Mono-ethyl ether of diethylene glycol	about 69

A corrosion inhibitor comprising potassium ricinoleate was added to a fluid of the above composition at the rate of 1 gram per 100 cc. of the fluid. After mixing these ingredients the fluid had a specific gravity at 20°/20° C. of 1.012. After four days at —40° F. it was readily fluid and the other tests indicated that it is operable as a brake fluid.

Example 7

	Per cent by volume
Propylene glycol mono-ricinoleate	about 15
Propylene glycol	about 15
2-methyl-2, 4-pentane diol	about 10
Mono-ethyl ether of di-propylene glycol	about 60

A corrosion inhibitor comprising potassium ricinoleate was added to a fluid of the above composition at the rate of 1 gram per 100 cc. of fluid. After mixing, this fluid had a boiling point of 329.5° F. and a specific gravity of 20°/20° C. of .953. After three days at —40° F. in the cold test this fluid was clear, readily fluid and fairly low in viscosity, and is operable as a brake fluid.

Example 8

	Per cent by volume
Propylene glycol mono-ricinoleate	about 20
Propylene glycol	about 8
2-methyl-2, 4-pentane diol	about 15
Butanol (normal)	about 57

A corrosion inhibitor comprising potassium ricinoleate was added to a fluid of the above composition at the rate of 1 gram per 100 cc. of fluid. After mixing, this fluid had a boiling point of 249° F. and a specific gravity of 20°/20° C. of 0.882. In the cold test, after 3 days at —40° F., the fluid was clear and readily fluid, and in other tests this fluid was shown to be operable as a brake fluid.

Example 9

	Per cent by volume
Propylene glycol mono-ricinoleate	about 17.5
Propylene glycol	about 6.5
2-methyl-2, 4-pentane diol	about 15
Propanol (normal)	about 61

A corrosion inhibitor comprising potassium ricinoleate was added to a fluid of the above composition at the rate of 1 gram per 100 cc. of the fluid. After mixing these materials a clear, straw-colored liquid resulted having a specific gravity of 0.8777 at 20°/20° C. After being held at —40° F. for three days, this fluid was very readily fluid and apparently operative as a brake fluid.

What I claim is:

1. An operating fluid for pressure apparatus comprising per 100 parts by volume, from 10 to 25 parts by volume of a lubricant selected from

the group consisting of the mono- and di-ricinoleates of the aliphatic glycols having the formula $HO—C_nH_{2n}—OH$, in which n is an integer from 2 to 4, inclusive, from 3 to 15 parts by volume of an aliphatic glycol having the formula $HO—C_nH_{2n}—OH$, in which n is an integer from 2 to 4, inclusive, from 10 to 24 parts by volume of 2-methyl-2, 4-pentane diol, from 45 to 70 parts by volume of a diluent selected from the group consisting of the propyl alcohols, the butyl alcohols, the amyl alcohols, methoxy-methoxy ethanol, and the lower mono-alkyl ethers of ethylene glycol, diethylene glycol, propylene glycol and di-propylene glycol, and a small but effective amount of corrosion inhibitor.

2. An operating fluid for pressure apparatus comprising per 100 parts by volume, from 10 to 25 parts by volume of butylene glycol monoricinoleate, from 3 to 15 parts by volume of butylene glycol, from 10 to 24 parts by volume of 2-methyl-2, 4-pentane diol, from 45 to 70 parts by volume of a diluent selected from the group consisting of the propyl alcohols, the butyl alcohols, the amyl alcohols, methoxy-methoxy ethanol, and the lower mono-alkyl ethers of ethylene glycol, diethylene glycol, propylene glycol and dipropylene glycol, and a small but effective amount of a corrosion inhibitor.

3. An operating fluid for pressure apparatus comprising per 100 parts by volume, from 10 to 25 parts by volume of a lubricant selected from the group consisting of the mono- and di-ricinoleates of the aliphatic glycols having the formula $HO—C_nH_{2n}—OH$, in which n is an integer from 2 to 4, inclusive, from 3 to 15 parts by volume of an aliphatic glycol having the formula $HO—C_nH_{2n}—OH$, in which n is an integer from 2 to 4, inclusive, from 10 to 24 parts by volume of 2-methyl-2, 4-pentane diol, from 45 to 70 parts by volume of an alcohol having the formula C_4H_9OH, and a small but effective amount of a corrosion inhibitor.

4. An operating fluid for pressure apparatus comprising per 100 parts by volume, from 10 to 25 parts by volume of propylene glycol monoricinoleate, from 3 to 15 parts by volume of propylene glycol, from 10 to 24 parts by volume of 2-methyl-2, 4-pentane diol, from 45 to 70 parts by volume of a diluent selected from the group consisting of the propyl alcohols, the butyl alcohols, the amyl alcohols, methoxy-methoxy ethanol, and the lower mono-alkyl ethers of ethylene glycol, diethylene glycol, propylene glycol and dipropylene glycol, and a small but effective amount of a corrosion inhibitor.

5. An operating fluid for pressure apparatus comprising per 100 parts by volume, from 10 to 25 parts by volume of propylene glycol monoricinoleate, from 3 to 15 parts by volume of propylene glycol, from 10 to 24 parts by volume of 2-methyl-2, 4-pentane diol, from 45 to 70 parts by volume of an alcohol having the formula C_4H_9OH, and a small but effective amount of a corrosion inhibitor.

6. An operating fluid for pressure apparatus comprising per 100 parts by volume, from 10 to 25 parts by volume of propylene glycol monoricinoleate, from 3 to 15 parts by volume of propylene glycol, from 10 to 24 parts by volume of 2-methyl-2, 4-pentane diol, from 45 to 70 parts by volume of methoxy-methoxy ethanol, and a small but effective amount of a corrosion inhibitor.

7. An operating fluid for pressure apparatus comprising per 100 parts by volume, from 10 to 25 parts by volume of propylene glycol monoricinoleate, from 3 to 15 parts by volume of propylene glycol, from 10 to 24 parts by volume of 2-methyl-2, 4-pentane diol, from 45 to 70 parts by volume of isobutanol, and a small but effective amount of a corrosion inhibitor.

8. An operating fluid for pressure apparatus comprising per 100 parts by volume, from 10 to 25 parts by volume of propylene glycol monoricinoleate, from 3 to 15 parts by volume of propylene glycol, from 10 to 24 parts by volume of 2-methyl-2, 4-pentane diol, from 45 to 70 parts by volume of the ethyl ether of ethylene glycol, and a small but effective amount of a corrosion inhibitor.

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