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Martin et al.

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[54] **ANTI-GUM AND SOLVATING LUBRICANT**

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[51] **Int. Cl.** **C10m 1/48**

[58] **Field of Search** ..... 252/32.7 E, 33.4, 59, 74, 252/76

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[57] **ABSTRACT**

Extended service lubrication properties as evidenced by a reduced viscosity increase are achieved by a lubricant composition of 25 percent to 75 percent by volume of highly compounded mineral oil in the form of type A transmission fluid with the balance highly refined white mineral oil. During accelerated oxidation testing, a significant range of compositions of the combination of oils has a viscosity increase which is less than that of either of the component oils, evidencing enhanced oxidation stability.

4 Claims, No Drawings

ANTI-GUM AND SOLVATING LUBRICANT

BACKGROUND OF THE INVENTION

In a period when increasing costs for servicing machines makes it necessary to pursue designs requiring minimum service on a regular or recurring basis, all aspects of operation must exhibit a common advance in maintenance free function. Advances in electronic reliability must be accompanied by not only reliable, maintenance free mechanical structures, but also, lubricants and lubrication techniques that have similar long term characteristics. Many lubricants commonly used for precision mechanical devices have not been wholly satisfactory.

Lubricants normally recommended for such service are hydraulic oils which are naphthenic and paraffinic in nature and contain anti-oxidants, rust inhibitors and anti-foam agents. Also investigated have been modern types of watchmaker oils which are compounded to resist aging, gumming up, spreading and evaporating. These lubricants have not provided the lubricating life sought.

Generally, satisfactory lubricating properties are found using automatic transmission fluids. These fluids possess superior performance characteristics, especially as to cleanliness and fluid life as measured by oxidative deterioration. In automatic transmissions employing fluid drive or torque converters, the hydraulic fluid performs the functions of a power transmission medium, a heat transfer medium and a lubricant for bearing surfaces. Rigorous requirements have been established for qualifying fluids for such use including a viscosity index of at least 130, a flash point of about 330°F minimum, a pour point below −30°F and additionally must pass the copper strip corrosion test and possess good oxidation resistance.

The viscosity of transmission fluids is normally found to be in the vicinity of 180 SUS whereas in many precision machine applications a viscosity in the range of 70 to 90 SUS is desired. Since an oil that oxidizes easily (or has a poor oxidization resistance) will polymerize and increase in carbon chain length resulting in increased viscosity, it is necessary that any modification of a transmission fluid to reduce viscosity not compromise the oxidization resistance of the resulting lubricant.

We have found that combining a type-A transmission fluid and a highly refined white mineral oil not only achieves superior lubricating qualities, but maintains viscosity over an extended period with a lesser percentage change than either of the oils of the combination individually. The ability of the combination of oils to exceed the ability of either component oil to maintain viscosity over an extended life exists in a range of combinations from 35 percent to in excess of 75 percent with respect to the concentration by volume of type A transmission fluid in the combination. The optimum combination is approximately 50 percent of each component. The range of concentrations utilized extends from approximately 25 percent to 75 percent type A transmission fluid by volume. While a 75 percent concentration has a viscosity increase during an accelerated oxidation test slightly higher than that of type A transmission fluid, the increase was only about one fourth that of a 100 percent concentration of pure white minteral oil.

The oils used to make the anti-gum and solvating oil are as follows:

Oil A is a type A transmission fluid comprising a mineral oil with the following additives:

1. Anti-oxidant and corrosion inhibitor - an alkaline earth metal salt of petroleum sulfonic acid; for example, calcium petroleum sulfonate.
2. Anti-wear agent - metallic salt of a dialkyl dithiophosphate; for example, zinc dithiophosphate.
3. Detergent and dispersant - metal free ashless amine; for example, copolymer of lauryl methacrylate and diethyl aminoethyl methacrylate.
4. Viscosity index improver - alkyl olefin polymer; for example, polyisobutylene.
5. Friction modifier - a fatty ester; for example, methyl-stearate.
6. Pour point depressor - a wax alkylated naphthalene; for example, barium salt of wax substituted naphthalene.
7. Anti-foam agent - silicone polymer; for example, dimethyl silicone.

The viscosity of this compounded mineral oil is 180 ± 10 SUS at 100°F.

A representative type A transmission fluid used as oil A and possessing the above qualities and composition is set forth and described in U.S. Pats. No. 3,156,652 and 3,175,976.

Oil B is a white mineral oil meeting the purity and test requirements of the U.S. Pharmacopoeia (U.S.P.) and National Formulary. These seven requirements are as follows:

1. Colorless, odorless, and tasteless.
2. Insoluble in water and alcohol.
3. Miscible with oils.
4. No acidity or alkalinity.
5. Must pass "readily carbonizable substances test" (hot acid test).
6. Must pass sulfur content test.
7. Must pass solid paraffin test.

The viscosity of this oil is 51 ± 3 SUS at 100°F.

Second only in importance to the primary function of a lubricant in reducing friction (in lubricating) is its ability to provide long life (oxidation stability) so that it may complete its heat transfer/coolant functions without triggering off sludge and varnish formation. The prevention of sludge formation and inhibition of polymerization by our oil has been shown in comparative physical tests and this is an attempt to describe the mechanism that occurs.

Metals such as copper and iron, when in the soluble state, catalyze the liquid phase oxidation of lubricating oils. The presence of a metal salt reduces the length of the induction period associated with the oxidation reaction by facilitating the decomposition of the hydroperoxide to provide the free radicals essential to the chain propagating (polymerization) mechanism. These reactions are as follows:

1. $2RH + O_2$ $2R^\circ$ (free radical) $+ H_2O$
2. $R^\circ + O_2$ ROO°
3. $RH + ROO^\circ$ $R^\circ + ROOH$ (hydroperoxide)
4. $ROOH + M^{n+}$ (metal ion) $RO^\circ + M^{n+1} + OH^-$
5. $ROO^- + M^{n+1}$ $ROO^\circ + M^{n+}$

It is seen that the oxidation/reduction cycle of the metal catalyst is maintained by these two reactions. Anti-oxidants used as additives in our formulation reduce polymerization by metal deactivation and directly decompose the hydroperoxides. The purified white min-

eral oil has tremendous solubilizing ability. It is capable of solubilizing any polymerization products and therefore keeps sludge formation to a minimum. The combination of solubilizing and oxidation inhibition that is produced by the mixture results in an anti-gum and solvating oil.

TABLE I: Viscosity change of oils in oxidation test. Samples of each oil or mixture were tested with copper and iron particles added to accelerate oxidation.

Lubricant	A Original Viscosity Centistokes (CS)	B Viscosity after 110 hrs at 220°F (CS)	Percent Change B-A A
Oil B	7.43	13.96	87.9%
50% Oil A 50% Oil B	16.27	18.00	10.6%
25% Oil B 75% Oil A	24.84	29.07	17.0%
Oil A	40.51	47.68	17.7%

What is claimed is:

1. In a lubricating oil comprising a highly compounded mineral oil containing: as an anti-oxidant and corrosion inhibitor, a calcium petroleum sulfonate; as an anti-wear agent, zinc dithiophosphate; as an detergent-dispersant, a polypolar polymer consisting of a nitrogen containing monomer linked to a long chain methacrylate; and as a viscosity index improver, polyisobutylene, the improvement comprising adding to the base oil 25 to 75 percent by volume of a highly refined white mineral oil not exceeding a viscosity of 180 SUS.

2. The lubricant of claim **1** wherein said highly refined white mineral oil is a colorless, odorless, tasteless white mineral oil insoluble in water and alcohol, miscible with oils, and which is non-alkaline and non-acid.

3. In an extended life lubricant for precision mechanisms comprising a highly compounded mineral oil containing: as an anti-oxidant and corrosion inhibitor, a calcium petroleum sulfonate; as an anti-wear agent, zinc dithiophosphate; as a detergent-dispersant, a polypolar polymer consisting of a nitrogen containing monomer linked to a long chain methacrylate, the improvement comprising adding to the base oil 40 to 60 percent by volume of a highly refined white mineral oil not exceeding a viscosity of 180 SUS.

4. The lubricant of claim **3** wherein said highly refined white mineral oil is a colorless, odorless, tasteless white mineral oil insoluble in water and alcohol, miscible with oils, and which is non-alkaline and non-acid.

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