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LUBRICANT

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This invention relates to an improved turbine oil. It relates more particularly to a lubricating oil composition consisting principally of a petroleum lubricating oil, the characteristics of the oil being modified by the addition thereto of a relatively small proportion of bis-(beta-naphthylaminomethyl)-para-tertiary-amylphenol.

A lubricating oil composition to be used as a turbine oil, and especially in modern marine steam turbines, is subject to very exacting requirements. Not only must it perform the ordinary function of lubricating the turbine over prolonged periods without interruption but usually it must serve as a coolant, to lubricate the gearing mechanism and to operate oil-actuated governors or control mechanisms having very nice tolerances and lubricate other auxiliary equipment.

Many lubricating oil compositions highly satisfactory for the lubrication of other mechanisms have been found wholly unsuitable for use as a turbine oil. This is probably due primarily to the fact that in normal use turbine oils rapidly become contaminated with water. Whatever the cause, it is generally recognized that the performance of a turbine oil is not predictable from conventional tests applicable to other oil lubricants.

Essential characteristics of a satisfactory turbine oil include, in addition to ordinary lubricating requirements, extraordinary resistance to oxidation and emulsion in the presence of water. Of equal importance is the avoidance of rusting of the metal parts within the oil system of the turbine and auxiliary apparatus under operating conditions.

The use of many lubricating oil compositions, otherwise satisfactory as turbine oils, has resulted in the oxidation of the oil and the rusting of metal parts within the oil system with consequent serious interference with the operation of the turbine including the oil-actuated governors and other parts, depending upon close tolerances. The results of such rusting not only interfere with the operation of and tend to clog the delicate clearances of the oil system but the products of the rusting appear to catalyze oxidation of the oil with resultant sludge formation which may further aggravate such conditions. The products of such rusting also appear to act as emulsifying agents.

We have found that the previously experienced rusting of metal parts within the oil system in steam turbines and the oxidation of the turbine oil itself may be substantially inhibited by incorporating in the oil a minor amount of bis-(b-naphthylaminomethyl)-p-tert.-amylphenol.

The herein-referred-to bis-(b-naphthylaminomethyl)-p-tert.-amylphenol used in the compounding of the improved turbine oil of our present invention was prepared as follows: In a 1-liter, 3-necked flask equipped with a thermometer, dropping funnel and a motor-driven stirrer there were placed 45.9 grams (0.28 mol.) of para-tertiary-amylphenol, 71.5 grams (0.50 mol.) of beta-naphthylamine, 270 c. c. of benzol and 70 c. c. of methyl alcohol. To this solution, cooled to 68° F., there was added dropwise, over a period of 1 hour, 45 grams of formalin (0.55 mol. of formaldehyde). During this addition, the mixture was constantly stirred and the temperature thereof was maintained within the range of 68° to 77° F. Thereafter, the stirring was continued for 2 hours at room temperature and the mixture then heated on a steam bath for 3 hours using a reflux condenser to return volatile materials to the flask. Thereafter, any moisture and unreacted materials present were distilled off by heating on a steam bath at an absolute pressure of 0.6 mm. of mercury, the steam bath temperature being 210° F. By this procedure, a yield of 118 grams of crude bis-(beta-naphthylaminomethyl)-p-tert.-amylphenol was obtained, this being equivalent to 100% of the theoretical yield. The product was a hard, red resin which by analysis was found to contain 4.89% nitrogen as compared with the theoretical nitrogen content of 5.91% for pure bis-(beta-naphthylaminomethyl)-p-tert.-amylphenol.

In referring to bis-(beta-naphthylaminomethyl)-para-tert.-amylphenol herein and in the appended claims, we refer to the above-described product although, of course, we intend to refer by this term to the same material by whatever process it may be made. It will be understood that our invention is not predicated upon the identification of the addend as a matter of terminology.

The lubricating oil constituent of our improved turbine oil may consist of a petroleum lubricating fraction, such as ordinarily specified for turbine oils. It may with advantage be a highly refined lubricating oil, for instance an acid-treated petroleum lubricating oil fraction or one which has been subjected to solvent refining, such as a phenol-treated fraction from East Texas crude. The solvent-refined oils have generally been found more resistant to sludging. For example, phenol-treated East Texas neutrals having the

following characteristics have been used with advantage:

	Sample I	Sample II
Gravity—A. P. I.	28.9	26.5
Flash °F.	405	400
Fire do.	455	455
Viscosity at 100° F.—S. S. U.	192.3	228.1
Viscosity at 210° F.—S. S. U.	45.3	46.9
Vscosity index (Dean & Davis)	87.1	79.2
Pour °F.	+10	+5
Neutralization number	0.025	0.05
Saponification number	0.27	0.27
Carbon residue (Conradson) per cent	0.031	0.044
Ash do.	0.000	0.002
Sulfur do.	0.21	0.34
Steam emulsion number	1	42
Demulsibility	1620+	600

The "Steam emulsion numbers" appearing in the foregoing tabulation were determined in accordance with the method designated "Standard method of testing for steam emulsion of lubricating oils, A. S. T. M., D157–36."

The "demulsibility" values appearing in the foregoing tabulation were determined in accordance with the method designated "Demulsibility test for lubricating oils" prescribed by "Federal Standard Stock Catalog, section IV, (part 5), Federal Specifications for Lubricants and Liquid Fuels, general specifications (Methods for sampling and testing), VV–L–791a, October 2, 1934, method 320.32."

The unique requirements of a turbine oil have resulted in the formulation of special test methods for determination of the characteristics of the oil with respect to rusting and oxidation. The results of rusting tests and oxidation tests, hereinafter noted, were obtained in accordance with methods prescribed by the American Society of Testing Materials and designated, respectively, "A. S. T. M. specification D–665–42T for turbine oils" and "Proposed method for determining oxidation characteristics of turbine oils, section III, Technical committee C, A. S. T. M. committee D–2, July 2, 1941."

By incorporating a minor proportion of the above-identified addend in a suitable lubricating oil constituent, oxidation of the oil under conditions to which turbine oils are subjected is materially inhibited. Depending upon the severity of the oxidation conditions involved, including temperature, access of air to the oil, amount of water present and the amount of salt or the like in the oil, the proportion of the addend used may with advantage be varied from about 0.05% to about 1% by weight of the oil.

For example, the oxidation induction period of the East Texas phenol-treated neutral, previously identified herein as Sample I, was found by the previously-identified test for determining the oxidation characteristics of turbine oil to be 80 hours. By compounding with this oil 0.5% of the bis-(beta-naphthylaminomethyl)-p-tert.-amylphenol, the oxidation induction period of the resultant turbine oil was increased to 440 hours.

Similarly determined, the oxidation induction period of the oil, previously identified herein as Sample II, was 150 hours and, by compounding with this oil 0.08% of this addend, the oxidation induction period thereof was increased to 300 hours.

In addition to substantially inhibiting oxidation of the oil, we have found the above-identified addend to materially reduce rusting of the metal parts within the oil system of steam turbines. For example, the previously-identified sample I, when subjected to the prescribed rusting test for turbine oils, resulted in the rusting of 75% to 100% of the surface of the test specimen. By adding to this oil 0.5% of the bis-(beta-naphthylaminomethyl)-p-tert.-amylphenol and subjecting the oil composition to the identical test, less than 25% of the surface of the test specimen showed indications of rusting.

The ability of the addend of the present invention effectively to inhibit oxidation of the turbine oil is unexpected and not readily accounted for. This is particularly evident from the fact that other somewhat similar chemical compounds have been found to be either inert or pro-oxidant under conditions encountered by turbine oils. An example of such compounds found ineffective as anti-oxidants in turbine oils is bis-(diamylaminomethyl)-p.-tert.-ampylphenol.

In the compounding of our improved turbine oil, a small amount of the above-identified addend is admixed with a suitable petroleum lubricating oil in the conventional manner of compounding such oil compositions. In addition to the lubricating oil constituent and the addend previously described, various other addition agents having the ability favorably to influence the characteristics of the turbine oil may be incorporated in the improved turbine oil of our present invention further to improve the properties thereof in various respects.

A further essential characteristic of turbine oils is that they do not form objectionable emulsions under conditions of use. Consequently, in the compounding of such oils, it is necessary to avoid the use of addends which might deleteriously affect the emulsibility of the oil. A further advantage of our improved turbine oil is that the satisfactory emulsifying characteristics of the base oil are not destroyed by the addition of bis-(beta-naphthylaminomethyl)-p-tert.-amylphenol.

A further notable characteristic of our improved turbine oil is its ability to withstand contamination by water without material separation of the addend from the oil or substantial deterioration of the addend itself.

As previously indicated, depending upon conditions of use, the addend may with advantage be used in proportions ranging from about 0.05% to 1% on the weight of the oil. Proportions even in excess of 1% may be used but such larger proportions have not generaly been found warranted. Though proportions less than 0.05% may be used, such smaller proportions are usually not sufficiently effective. Accordingly, proportions ranging from about 0.05% to about 1% are generally recommended.

We claim:

1. An improved turbine oil which comprises a petroleum lubricating oil containing a proportion of bis-(beta-naphthylaminomethyl)-p-tert.-amylphenol effective to retard rusting.

2. An improved lubricating oil which comprises a lubricating oil containing about 0.05% to about 1% of bis-(beta-naphthylaminomethyl)-p-tert.-amylphenol.

3. An improved lubricating oil which comprises a lubricating oil containing about 0.5% to about 1% of bis-(beta-naphthylaminomethyl)-p-tert.-amylphenol.

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