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TRANSFORMER WITH IMPROVED DIELECTRIC LIQUID

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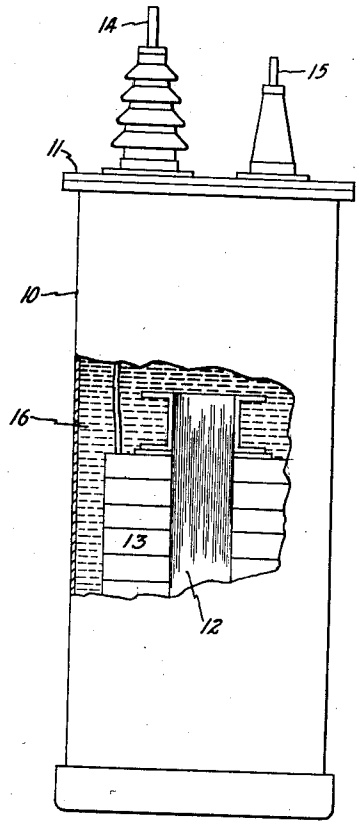

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TRANSFORMER WITH IMPROVED DIELECTRIC LIQUID

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3 Claims. (Cl. 336—58)

This invention relates to a new dielectric liquid and particularly to an improved transformer utilizing the dielectric liquid.

Many large power transformers are cooled by a dielectric liquid such as a high boiling petroleum fraction or the halogenated aromatic compounds known as askarels. A dielectric liquid suitable for use as a transformer cooling agent should have high dielectric strength, a low percent power factor, and good resistance to a high impulse voltage. A satisfactory liquid must not only have a low percent power factor at the time it is placed in use but must retain this property by way of offering resistance to oxidation over a long period of time. An improvement in the dielectric liquid used for cooling is quickly reflected in an improved transformer since the same transformer may have a higher kva. rating if the dielectric liquid is improved.

It is an object of the present invention to provide an improved transformer characterized by a dielectric cooling liquid possessing very good resistance to oxidation.

It is another object of this invention to provide a dielectric liquid in which the condensation of diphenyl and tertiary alkyl groups confers resistance to oxidation and excellent dielectric properties.

The above and other objects are accomplished in accordance with this invention by incorporating in a transformer a dielectric fluid consisting of monotertiary alkyl diphenyl or methyldiphenyl isomers in which the alkyl groups contain from 4–8 carbon atoms.

The drawing is a cross-sectional view of a transformer constructed in accordance with this invention. A liquid tight tank **10** has a cover **11** which may be sealed in air-tight engagement with the tank. Mounted within the tank is a magnetic core **12** on which is wound a plurality of coils **13** constituting the primary and secondary windings of the transformer. Terminals **14** and **15** extend through the cover **11** of the device.

The core and coils **12** and **13** are immersed in a dielectric liquid **16** which is an alkylated diphenyl or methyldiphenyl in which the alkyl group has a tertiary carbon atom and a total of from 4–8 carbon atoms. Where the compound used is diphenyl rather than methyldiphenyl, the dielectric liquid consists of three monotertiary alkyl isomers. In the case of methyldiphenyl compounds the mixture consists of a larger number of monotertiary alkyl isomers since the methylated diphenyl itself consists of a mixture of three isomers.

In preparing the dielectric fluids of this invention, diphenyl or methyl diphenyl is subjected to a Friedel-Crafts condensation with a tertiary alkyl compound containing 4–8 carbon atoms and a fraction is then separated containing the monoalkyl derivatives from the unreacted starting products and the polyalkyl derivatives which are also present to some extent in the final reaction mixture. Of the tertiary alkyl compounds falling within the class described, I prefer to use tertiary butyl compounds first and tertiary amyl compounds second. While these may

be alcohols, halides, and other types of Friedel-Crafts reactants, I find the most convenient tertiary alkyl compounds to use are the chlorides. In order to inhibit the formation of polytertiary alkyl compounds, it is desirable to have the diphenyl present in the reaction mixture in excess. This is shown in the following examples which are representative of means for producing the dielectric liquids of this invention.

Example 1

Diphenyl (512 grams) is added to t-amyl chloride (267 grams) and the mixture is brought to a temperature of 75° C. in a reflux apparatus. While maintaining this temperature aluminum chloride (30 grams) is slowly added while agitating the mixture. The reaction is complete in about 2½ hours. After 2½ hours of reacting, the mixture is treated with 25 grams of fuller's earth after which it is filtered and distilled. The fraction boiling between 300° C. and 375° C. contains the desired monotertiary amyl diphenyls.

Example 2

Diphenyl (77 grams) is mixed with t-butyl alcohol (40 grams) and the mixture is heated to 80° C. after which anhydrous aluminum chloride (34 grams) is slowly added with stirring. After reacting for two hours the mixture is extracted with two 100 ml. portions of aqueous hydrochloric acid. The mixture is then washed three times with water, dried and distilled. The fraction boiling between 300° C. and 330° C. contains the monotertiary butyl diphenyl isomers of this invention.

Example 3

Diphenyl (1010 grams) is mixed with t-butyl chloride (350 grams) and the temperature of the mixture is raised to 50° C. in a reflux apparatus. Aluminum chloride 60 grams is slowly added while the mixture is agitated and the reaction is allowed to continue for 4 hours. It is then extracted twice with 1000 ml. portions of aqueous hydrochloric acid after which it is washed four times with water, dried, and distilled. As in the case of Example 2, the fraction boiling between 300° C. and 330° C. contains the desired monotertiary butyl diphenyl isomers.

Example 4

Methyl diphenyl (50 grams) is added to diisobutylene (50 grams) and the mixture is brought to a temperature of 90° C. Aluminum chloride (25 grams) is slowly added with stirring and the reaction is allowed to continue for 1½ hours. The mixture is then treated with 20 grams of fuller's earth after which it is filtered and distilled. The fraction boiling between 300° C. and 400° C. is the desired mixture of monotertiary octyl methyl diphenyl isomers.

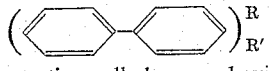
The dielectric liquids of this invention have a sixty cycle dielectric strength of between 50 and 55 kilovolts. Their impulse strength in a test of point to ½ sphere 1.5/40 negative wave varies from 214 kilovolts to 292 kilovolts with gap widths between ½ and one inch.

The dielectric liquids of this invention are very resistant to oxidation. They may be readily distilled at atmospheric pressure without undergoing any decomposition and at normal transformer operating temperatures they operate without sludging or discoloring over very long periods of time.

While the present invention has been described with reference to particular embodiments thereof, it will be understood that numerous modifications may be made by those skilled in the art without actually departing from the invention. Therefore, I aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A transformer comprising a liquid-tight tank, a magnetic core positioned in said tank, a plurality of windings on said core, and a dielectric liquid surrounding said core and coils consisting of a mixture of compounds having the formula



in which R is a tertiary alkyl group having 4 to 8 carbon atoms and is attached to either ring and R′ is selected from the group consisting of hydrogen and —CH_3 and is attached to either ring.

2. A transformer comprising a liquid-tight tank, a magnetic core positioned in said tank, a plurality of windings on said core, and a dielectric fluid consisting of monotertiary butyl diphenyl isomers surrounding said core.

3. A transformer comprising a liquid-tight tank, a magnetic core positioned in said tank, a plurality of windings on said core, and a dielectric fluid consisting of monotertiary amyl diphenyl isomers surrounding said core.

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