

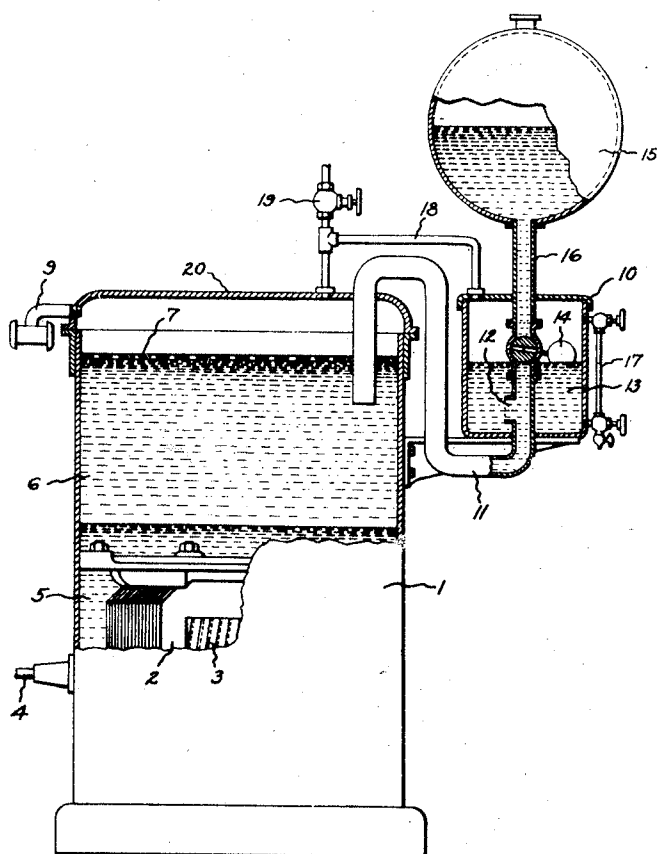
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LIQUID-COOLED ELECTRIC APPARATUS

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LIQUID-COOLED ELECTRIC APPARATUS

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The present invention relates to electric devices such, for example, as transformers which are provided with a body of liquid insulating and cooling material. It is the object of my invention to improve the efficiency and decrease the cost of such devices.

It is highly desirable that liquid insulating and cooling materials in electric devices should be non-inflammable and should be substantially incapable of yielding by decomposition inflammable or explosive gases. These properties, combined with other desirable properties, are found in liquid halogenated compounds such, for example, as chlorinated diphenyl, chlorinated benzene, chlorinated naphthalene, chlorinated phenyl benzoate, chlorinated benzotrifluoride, and various mixtures of such compounds. Examples of such compositions are described in U. S. Patents 1,931,455 of October 17, 1933, 1,999,004 of April 23, 1935, and compositions of this type not only are relatively expensive, but also are somewhat volatile when heated. It is desirable to use such compounds in as small amount as is consistent with efficient service to provide efficient cooling means therefor and to prevent evaporation losses.

In accordance with my invention these conditions are fulfilled by providing one or more suitable auxiliary superimposed sealing liquids having lower specific gravity. The lowermost layer of cooling agent in a transformer, or other electrical device, in which the electrical parts are immersed, preferably consists of a body of halogenated, non-inflammable insulating composition. The electrical parts, such as transformer coils, may be covered with cotton or paper which is permeated by the halogenated material. Chlorinated compounds of aromatic hydrocarbons are suitable for use as cooling agents. Such compounds in general have a high specific gravity. Superimposed thereon are one or more layers of lighter liquids which are insoluble in the insulating composition and function to both seal and cool the latter. The superimposed sealing layer need not be electrically insulating.

The accompanying drawing is a vertical section of a transformer illustrative of my invention.

The sealing and cooling material advantageously, but not necessarily, may be vaporizable at the normal working temperature of the electric device, or at least at a more elevated temperature which is not deleterious to such device. Water is an example of such a sealing material. Its boiling temperature of 100° C. becomes the limiting temperature of the lower insulating liquid. The insulating liquid hence does not become heated

above the permissible temperature to which organic insulation immersed therein may be exposed. Water is substantially insoluble in chlorinated hydrocarbons and, of course, does not add to the cost of an electrical installation.

Monohydric alcohols, such as methyl alcohol boiling at 66° C., ethyl alcohol boiling at 78° C., also may be used as sealing materials. Polyhydric alcohols, such as ethylene glycol boiling at 197° C., and glycerine boiling at 290° C., also are usable as sealing agents in accordance with my invention. Paraffin wax, cellulose acetate and ethyl cellulose are examples of less volatile materials which are capable of use as sealing agents.

As shown in the drawing, the apparatus includes a tank 1, containing a magnetic core 2 and inductive windings 3, the terminal conductors for which, as indicated at 4, enter the tank below the upper level of the relatively dense, non-inflammable liquid insulating material 5 of the type above described. The insulating liquid may consist, for example, of a suitable mixture of hexachlor diphenyl and trichlorobenzene. Above the insulating liquid 5 is a body 6 of suitable heat-absorbing and sealing material. Above the sealing body 6 there may be provided, if desired, a thin layer 7 of still lighter relatively non-volatile material, such as ordinary mineral oil. A vent 9 is provided for the escape of vapor.

As shown in the drawing, automatic means may be provided, if desired, for replenishing the material 6, assuming a liquid to be used. The particular apparatus illustrated, which, of course, may assume a variety of forms, consists of an auxiliary tank 10 which communicates with the main tank by a conduit 11 having an inlet 12. Hence, the level of the liquid 13 in the tank 10 is the same as the level of the liquid 6 in the main tank 1. Should the level of the liquid 13 fall materially, then the float valve 14 opens and permits liquid from the reservoir 15 to flow by gravity through the conduit 16 into the auxiliary reservoir 10, and from thence replenishes the liquid body 6 through the conduit 11. A sight glass 17 may be provided to give visual indication of the liquid level. A conduit 18 may be provided which communicates both with the main and auxiliary tanks to permit of equalization of gaseous pressure in the spaces above the liquid contents. This conduit may be provided with a vent valve 19.

When water, monohydric alcohol, or other volatile sealing liquid, is used to cover the insulating liquid 6, then one of the important functions of such sealing liquid is its capacity of absorbing excess heat during temporary overloads of

the electrical device, a function which may be termed that of a heat brake. This function is facilitated both by the relatively large bulk of the sealing liquid, and by the boiling of this liquid should the temperature rise as high as its boiling point. When a high boiling liquid, such as a polyhydric alcohol, is used, the capacity of the "heat brake," of course, is limited by the heat capacity of such liquid as the temperature ordinarily would not be permitted to rise to its boiling point. In either case, however, the supernatant liquid seals the insulating liquid from the atmosphere and recondenses any vapors that may be evolved from the insulating liquid.

15 The specific heat of some materials available for the purposes of my invention, such as water or an alcohol, is higher than that of the halogenated fireproof materials which are suitable for use as liquid cooling agents for electrical devices.

20 Hence, they are capable of absorbing a relatively large amount of heat with a small rise of temperature.

It is obvious that various changes may be made

in the described apparatus without departing from my invention. For example, not only may the automatic replenishing device be omitted, but also the cover 20 for the tank 1 may be omitted.

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

1. The combination of an electric transformer, a container therefor, a liquid chlorinated organic compound surrounding and insulating said device and a heat brake comprising a relatively large body of immiscible lighter liquid having a higher specific heat superimposed on said chlorinated compound, said material being volatilizable at temperatures too low to injure said device.

2. An electric transformer comprising a tank, inductive elements therein, a body of liquid halogenated hydrocarbon surrounding said elements, and a heat brake comprising a relatively large body of water superimposed on said hydrocarbon.

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