Patented Feb. 2, 1932 1,843,541

UNITED STATES PATENT OFFICE

HAROLD I. DANZIGER AND MAX KEVELSON, OF NEW YORK, N. Y., ASSIGNORS TO CONDENSER CORPORATION OF AMERICA, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW YORK

IMPREGNATION OF ELECTRICAL CONDENSERS

No Drawing. Application filed June 12, 1928. Serial No. 284,878.

Our present invention relates generally to electrical condensers, and has particular reference to the impregnation of so-called "paper-dielectric" condensers.

The type of condenser to which our invention has particular reference is generally constructed by interwinding strips of conducting material, such as foil, and strips of non-conducting material, such as paper, the entire rolled or wound condenser body being then compressed into a substantially flattened condition and impregnated with a suitable dielectric material.

As a rule, the condenser bodies are arranged in stacked relationship within a chamber or vat, and completely immersed in a heated bath of paraffin wax. The bodies are also subjected to a heat and vacuum treatment for driving out all entrained moisture and air and the molten wax is thereby permitted to permeate thoroughly throughout the condenser bodies, filling in all the interstices of the non-conducting layers, and resulting ultimately in a condenser body wherein sets of superposed conducting layers are separated from one another by solid dielectric layers constituted of the impregnated non-conducting material.

The employment of wax has numerous advantages. It is a normally solid and hence dry material of comparatively high dielectric constant, it has adhesive and cohesive qualities which help to retain the superposed layers of the condenser body in close relationship, and it is relatively inexpensive.

It is well known, however, that condenser bodies impregnated with wax will ultimately break down and will have particularly short lives under comparatively high voltages. The breakdown of such condensers is probably the result of some sort of heat phenomenon since the unwinding of a broken-down condenser will disclose holes in the non-conducting layers which resemble holes which have been burnt.

One of the factors leading to breakdown is the relatively small but ever-present conductivity of the dielectric material to leakage currents, and the passage of leakage currents through relatively weak portions of the dielectric most probably create heat at concentrated points, the heat only serving to increase the conductivity and thus hastening an ultimate complete breakdown.

It is one object of our present invention to provide an impregnated condenser of the foregoing character wherein the likelihood of breakdown, even at relatively high voltages, has been minimized; and wherein the life of the condenser has thereby been considerably increased.

It is another object of our invention to achieve this desirable result without materially altering the general nature of the manufacturing process referred to, and without an inordinate increase in expense.

We have ascertained, by experiment, that oil, when used as in impregnating medium, has long-life characteristics. Its dielectric constant is practically the same as, or only slightly less than, the dielectric constant of the paraffin wax usually employed. Its conductivity for leakage currents is, however, far smaller than the conductivity of ordinary wax; and as a result we have found that there is no likelihood of breakdown even under relatively high voltages.

One of the disadvantages of oil lies in the fact that it is normally liquid and hence devoid of the adhesive and cohesive qualities of wax.

Our present invention resides in the employment, as an impregnating medium, of a composite dielectric material wherein oil and wax are combined, the combination being such as to achieve the desirable advantages of each of these ingredients while at the same time obviating the respective disadvantages thereof.

We have ascertained that oil will form an intimate intermixture with wax, the mixture being in the nature of a colloidal solution. Such solution is creamy in nature and has a greater viscosity than oil by itself; it has a comparatively low leakage-current conductivity; and it has relatively great heat-dissipating qualities. As a result, we have found such a solution to be a highly efficient impregnating material for our present purposes.

The material is, however, liquid as distin-

guished from ordinary wax employed by itself. Accordingly, the superposed layers of the condenser body are not as intimately held together as they would be when wax alone is employed, and therefore, to compensate for this, we employ a wax having a relatively high dielectric constant. We have found that a chlorinated hydrocarbon wax, for example, a wax in the form of a chloro-naphthalene substitution product, with a dielectric constant of approximately 2.8 as distinguished from a constant of about 2.0 (ordinary paraffin wax), is highly satisfactory.

We have also found that mineral oils are far preferable to vegetable oils, such as castor oil, for the reason that the mineral oils have less affinity for moisture and hence far less current conductivity, and furthermore, mineral oils decompose less readily than vegetable oils and do not become gummy. It will be understood that the term "mineral oil" as herein employed refers to any natural oil of the petroleum series, such as paraffin-base oil, naphthene-base oil, olefine-base oil, or combinations of these oils.

Briefly and broadly stated, our invention resides in the provision of a condenser body of the character mentioned, the body being impregnated with an intimate creamy intermixture of two dielectric materials, one of which is normally solid and the other of which is normally liquid, one of said materials having a relatively high dielectric constant, and the other having a relatively low leakage-current conductivity.

The proportions of oil and wax may be varied in accordance with varying requirements. The proportionate amounts will depend upon the length of life desired at certain voltages, and upon the capacity to be achieved in a predetermined size of condenser body.

For example, one method of carrying out our invention lies in intimately mixing one part of mineral oil with one part of a chlorinated naphthalene hydrocarbon wax. For a condenser body having its non-conducting layers composed of three paper layers, each of which is .0005 inches in thickness, the impregnation with the above mixture may be made to produce a condenser having a capacity of about 2½ microfarads, and a life of approximately 75 hours under a direct current voltage of approximately 2000 volts. If this same condenser body were impregnated with ordinary wax, the capacity would be only about two microfarads and the condenser would have a life of only about 2½ hours under a similar voltage.

Similarly, a condenser body impregnated with wax and having, say, two paper layers of the same thickness as before might be made to have a capacity of one microfarad and a life of approximately 2½ hours under a direct current voltage of about 933 volts. If this condenser body is impregnated with a colloidal solution of the present character consisting of approximately nine parts of oil and one part of chlorinated naphthalene, the capacity of the condenser would be increased by approximately 4%, and the life of the condenser, under the same voltage, would be approximately 500 hours, which is 200 times as great.

The foregoing examples have been cited merely for purposes of explaining the nature of our invention. The proportionate ingredients may be varied at will. If great capacity is desired, the wax ingredient would be present in a relatively large proportion; and if long-life were the determining factor, the oil would preponderate.

Also, although we have illustrated the employment of our invention with mineral oil and chlorinated naphthalene, it will be understood that other ingredients of a similar character and having similar properties may be resorted to.

We attribute the advantageous characteristics of our invention to the intimate intermingling of a solid ingredient and a liquid ingredient. Apparently, the liquid oil forms membranous coverings around the minute particles of the solid wax, and the leakage conductivity of the wax is in this way rendered powerless to induce a breakdown. At the same time, the relatively high dielectric constant of the wax compensates for the lack of adhesive qualities of the oil. And furthermore, the constantly and normally liquid state of the oil ingredient enables the mixture as a whole to dissipate heat at a rapid rate and thereby to minimize the dangers of concentrated heat at points where leakage may occur.

It will be understood that the details herein described for the purpose of explaining the nature of our invention may be changed by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is therefore intended that these details be interpreted as illustrative, and not in a limiting sense.

Having thus described our invention and illustrated its use, what we claim as new and desire to secure by Letters Patent is—

1. A condenser body comprising alternate layers of paper and foil, the body being impregnated with an intimate intermixture of mineral oil and a chlorinated wax, the latter having a relatively high dielectric constant as compared with that of the oil and serving thereby to increase the capacity of the condenser, and the oil having a relatively low leakage-current conductivity and serving thereby to increase the life of the condenser.

2. A condenser body comprising alternate layers of conducting material and absorbent dielectric material, the layers of dielectric material being impregnated with an inti-

mate intermixture of a normally solid dielectric material and a normally liquid dielectric material of different chemical constituency capable of forming a colloidal solution with the former.

3. A condenser body comprising alternate layers of conducting material and absorbent dielectric material, the layers of dielectric material being impregnated with an intimate intermixture of mineral oil and a normally solid dielectric material capable of forming a colloidal solution with said oil and having a dielectric constant higher than that of the oil.

4. A condenser body comprising alternate layers of conducting material and absorbent dielectric material, the body being impregnated with an intimate intermixture of a mineral oil having a relatively low leakage-current conductivity, and a chlorinated hydrocarbon which is normally solid yet liquefiable under heat for purposes of impregnation, said hydrocarbon having a relatively high dielectric constant as distinguished from that of the mineral oil.

5. A condenser body comprising alternate layers of conducting material and absorbent dielectric material, the body being impregnated with an intimate intermixture of a mineral oil having a relatively low leakage-current conductivity, and a chlorinated naphthalene-base hydrocarbon which is normally solid yet liquefiable under heat for purposes of impregnation, said hydrocarbon having a relatively high dielectric constant as distinguished from that of the mineral oil.

6. A condenser body comprising alternate layers of conducting material and absorbent dielectric material, the body being impregnated with an intimate intermixture of a mineral oil having a relatively low leakage-current conductivity, and tri-chloro-naphthalene, the latter being normally solid and yet liquefiable under heat for purposes of impregnation.

In witness whereof we have signed this specification this 8 day of June, 1928.

HAROLD I. DANZIGER.
MAX KEVELSON.