May 20, 1952 W. M. BAILEY 2,597,429

CAPACITANCE DEVICE

Filed Jan. 24, 1946 2 SHEETS—SHEET 1

Fig. 1.

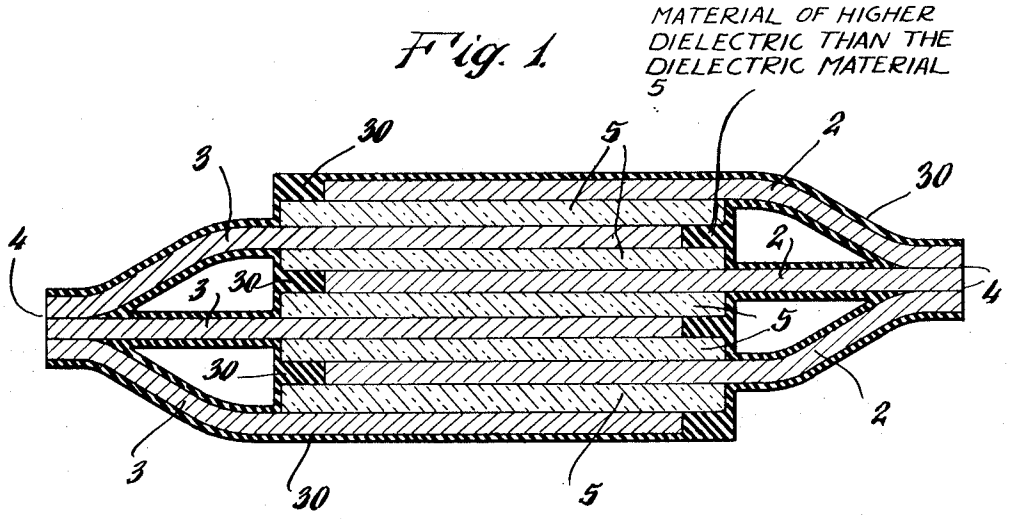
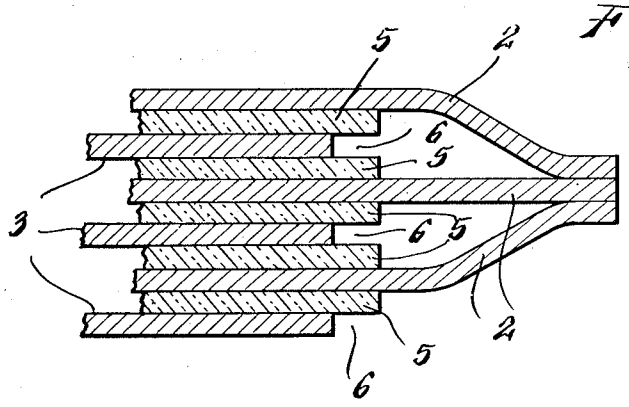


Fig. 2.



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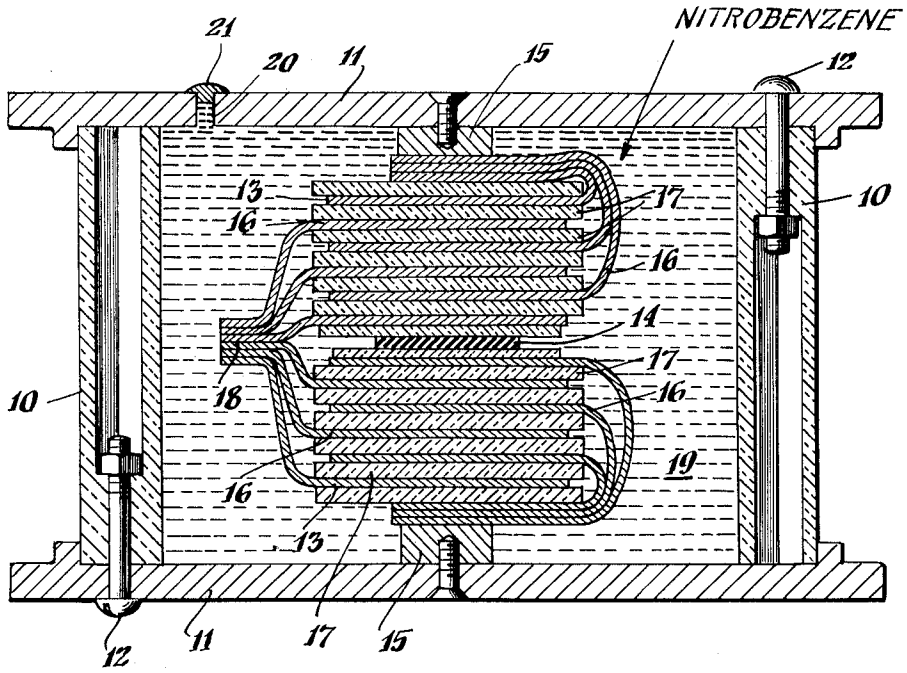


Fig. 3

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CAPACITANCE DEVICE

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6 Claims. (Cl. 175—41)

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This invention relates to improved electrical capacitance devices the conducting elements or electrodes of which are separated by sheets or layers of mica, glass, ceramic or other non-porous dielectric material.

The problems to which this invention is directed are those arising when capacitance devices of this type are subjected to high voltage potentials of an intensity which tends to produce corona or brush discharge effects. The consequent heating of the condenser or capacitor is often sufficiently excessive to substantially increase the electrical losses, lower the insulation resistance of the dielectric sheets and promote eventual electrical breakdown of the dielectric with consequent impairment of the desirable functions of the capacitance device.

The leading object of the present invention is to provide an improved capacitance device of the type described which will, under the imposition of given high voltage potentials, more efficiently resist failure induced by the above-mentioned causes than will present capacitance devices of equal or similar capacity, design and function.

To this end the improvement of the invention consists in surrounding exposed surfaces of the electrodes or conducting elements with a substance having a dielectric constant greater than that of the separating sheets. Specifically if the separating sheets be of mica, the substance used should have a dielectric constant of the order of 9 or greater, since most good grades of mica used in such capacitance devices have a dielectric constant ranging from 5 to 8. The practice of this invention does not necessarily require any essential alteration of the design or construction of any given capacitance device employing mica, glass, or ceramic or similar non-porous material as dielectric, the purpose of the invention being to replace materials or substances heretofore in contact with those portions of the electrode which do not directly contact the separating material with a substance having a dielectric constant greater than that of the separating material. The success of the invention does not, moreover, essentially depend upon contact of all of the exposed electrode surfaces with a substance of such a high dielectric constant, the major benefits of the invention being achieved when the edges of the electrodes in or adjacent the electrode-separating material stack have been insulated with such substance. Thus, in practice, the manner in which such insulation is achieved, or the manner in which the high dielectric substance is introduced into or around the capacitor structure, may usually be dictated by other considerations of design, the type of capacitance device and similar considerations.

To illustrate the above statements, reference will be made to the attached drawing, Fig. 1 of which shows, in cross-sectional elevation, a conventional electrode-mica stack, the surfaces of

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the electrodes exposed as above indicated. Fig. 2 is a cross-sectional elevation through the same stack with the insulation removed. Fig. 3 shows, in cross sectional elevation, a conventional electrode-mica stack held in contact with a high dielectric liquid. The structure shown in Fig. 1 and the manner in which insulation is applied is merely a diagrammatic illustration serving to illustrate principle rather than form. The stack as shown includes two sets of electrodes, i. e., electrodes 2 and electrodes 3, of the metallic foil type. These electrodes are separated by the sheets of mica 5. One end of each electrode is extended from the stack thus formed and connected at 4, as shown, to the extending ends of the other electrodes of the same set. The other end of the electrodes, as well as the side edges of the electrodes, is positioned inwardly from the edges of the mica sheets 5, thus insuring against possibility of direct contact between alternate electrodes in the stack. This inset of the electrodes causes formation of the spaces or interstices 6 between mica sheets. In accordance with this invention the exposed electrode edges are covered with a layer of a substance 30 having a dielectric constant greater than those of the mica sheets, and preferably a substantial portion or all of each space 6 is likewise filled with such substance. Where condenser design permits, it is also desirable to coat or cover all other exposed surfaces of the electrodes with the substance.

In the schematic form shown in Fig. 1 the outer surfaces of the electrodes are coated with and the interstices 6 are filled with the substance 30. In many condenser structures embodying this invention considerations of manufacture or efficiency may require that the entire stack and the extension of its electrodes be supported in a mass of the substance 30, the present drawing sufficing to illustrate the principle of the invention rather than its most desirable or commercial forms. Fig. 3 illustrates in cross sectional elevation a type of capacitor assembly in which the outer container consists of a porcelain tube 10 to which metal tops 11 are attached by bolts such as 12. Within the enclosure thus formed are located a plurality of stacks such as those generally indicated at 13 which are separated from each other by an insulating material such as 14 and are held in position by the clamps 15 which, being secured to the metal covers 11, likewise serve to electrically connect the capacitor stacks to the metal covers 11 so that the metal covers actually serve as connecting plates or leads to the capacitor stacks. Each of the stacks 13 is composed of metal electrodes 16 and mica plates 17. The electrodes 16 may be of such length that they may be extended, as shown, and joined together, as at 18, to form a connection between the two stacks 13. Other of the electrodes may be of such length as shown, to

be extended into contact with the surface of the clamps 15 thus to form the electrical connection between the stack and the metal plates 11. Such a structure, having been assembled in place, is then, in accordance with this invention, surrounded with a liquid having a higher dielectric constant than the mica plates 17, the liquid 19 shown in the drawing being, as indicated, nitrobenzene. In one assembly of such capacitor the parts are first assembled together and the nitrobenzene is introduced in any convenient manner as through the fill hole 20 which can then be sealed with the solder plug 21. In many well known forms of capacitors several stacks, such as those herein illustrated, are present in the condenser structure, or electrically connected therein, and separated from physical contact with each other by sheets or layers of mica or other non-porous dielectric material. In such case the use of a substance of dielectric constant greater than that of said sheets or layers to fill the spaces between said layers and the elements of the stack separated by said layers, is likewise in accordance with this invention, as is the use of such a substance in any structure where the capacitance device includes metallic electrodes separated by non-porous dielectric media, such as glass, mica, ceramic or the like.

The selection of a substance having a dielectric constant greater than that of the separating material employed will depend in many instances upon considerations of cost, eventual use of the capacitance device, manufacturing difficulties and the other electrical properties of the substance. Many such substances are, for one measurable reason or another, not particularly desirable for use in capacitance devices. The gist of this invention resides, however, in the provision of a capacitance device in which the exposed edges of the electrodes are insulated by a coating or mass of a substance of stated dielectric constant, and the advantages thereof flow from the combination of such a substance with a stack having separators made of non-porous dielectric material.

Use of the invention is somewhat limited by the limited choice of substances having such high dielectric constant in combination with such other electrical properties as will recommend their presence in the capacitor, but where electrical characteristics ultimately required in the capacitance device permit the use of these substances of stated dielectric constant for the purpose described, the advantages gained by way of reducing excessive heating of the device are considerable. For example, substances having a high dielectric constant which are useful in the practice of this invention include nitrobenzene, hydrogenated castor oils and liquid sulphur dioxide, the latter being useful where the capacitance device is capable of maintaining such pressures upon the sulphur dioxide that it does not pass into the gaseous state.

When the dielectric constant of the non-porous separating media used in the capacitance device is less than about 12, the hydrogenated castor oils of high hydroxyl number are particularly useful in the practice of this invention, since they have a dielectric constant of 12 or more and possess electrical and physical characteristics acceptable in most capacitor designs and methods of manufacture. Use of these castor oils to coat, surround or cover exposed areas of the electrodes allows obtainment of the advantages of this invention in mica capacitors of

many different types, thereby insuring superior performance of such capacitors over those of equivalent types not embodying the principles of this invention.

The invention has been specifically described with reference to capacitance devices in which the conducting elements or electrodes are sheets of metallic foil, but the invention is equally applicable to condensers in which the conducting elements are, in whole or in part, composed of metal coatings lying on the surface of the non-porous dielectric material. Metalized mica sheets or metalized ceramic sheets are examples of such use.

Having thus described my invention, I claim:

1. In a capacitance device, a plurality of electrodes separated by and in contact with a non-porous dielectric material, the surfaces of said electrodes which are free of contact with said material being in contact with a substance of dielectric constant greater than the dielectric constant of said non-porous dielectric material.

2. In a capacitance device, a plurality of electrodes and a plurality of layers of non-porous dielectric material, said layers and said electrodes being arranged to form a capacitor stack consisting of electrodes separated one from the other by said layers. said electrodes being in contact with said layers over a part of the electrode surfaces, the electrode surface free of contact with said layers and adjacent said stack being covered by a substance of dielectric constant greater than the dielectric constant of said non-porous dielectric material.

3. In a capacitance device, conducting electrodes separated by and in partial contact with mica, the electrode surfaces adjacent to and out of contact with said mica being in contact with a substance of dielectric constant of at least 9.

4. In a capacitance device, conducting elements separated by and in partial contact with a non-porous dielectric material, and a substance of dielectric constant greater than the dielectric constant of said material, positioned to cover the surfaces of the conducting elements which lie adjacent to and out of contact with said non-porous dielectric material.

5. In a capacitance device, conducting elements separated by and having surfaces in contact with and surfaces free of contact with a layer of mica, said free surfaces being covered by a substance of dielectric constant greater than the dielectric constant of said mica.

6. In a capacitance device, conducting elements separated by and having surfaces in contact with and surfaces free of contact with a layer of mica, said free surfaces being surrounded by and in contact with hydrogenated castor oil having a dielectric constant of at least 9.

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