July 30, 1940. F. EVERS ET AL 2,209,770

ELECTROLYTIC CONDENSER

Filed July 3, 1936

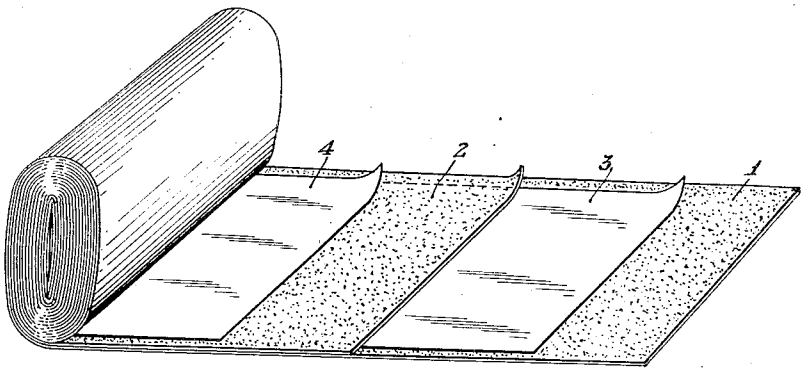


Fig. 1

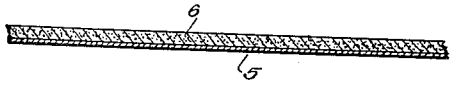


Fig. 2

Fritz Evers
Werner Herrmann
Paul Werner
INVENTORS

BY Josef Oppenheimer
ATTORNEY.

Patented July 30, 1940 2,209,770

UNITED STATES PATENT OFFICE

2,209,770

ELECTROLYTIC CONDENSER

Fritz Evers, Berlin-Wilmersdorf, Werner Herrmann, Berlin - Charlottenburg, and Paul Werner, Berlin-Neulichtenberg, Germany, assignors, by mesne assignments, to Radio Patents Corporation, a corporation of New York

Application July 3, 1936, Serial No. 88,700
In Germany July 12, 1935

6 Claims. (Cl. 175—315)

Our invention relates to electrolytic devices, such as condensers, and to a method of making such condensers.

Electrolytic devices, such as condensers, are provided with electrodes contacting an electrolyte. At least one electrode is provided with a dielectric film formed on it. A spacer containing or permeated by the electrolyte is arranged between the electrodes.

It is an object of the invention to improve the manufacture of condensers of this type and to render it more compact.

Another object is to secure a complete and homogeneous impregnation of this separator.

Another object of the invention is to provide an electrolytic condenser having a unitary fibreless spacer and electrolyte.

A further object is to provide a unitary electrode and separator comprising a non-fibrous spacer adhering to the electrode.

A specific object is to provide a unitary electrode and spacer element ready for assembly in a condenser structure.

These and further objects of the invention will become more apparent from the following description with reference to the accompanying drawing in which Fig. 1 illustrates diagrammatically an electrolytic condenser of the rolled type with the ends of the electrode and spacer strips partly unrolled, while Fig. 2 is a cross-section on an enlarged scale of a unitary electrode and conductive spacer according to the invention.

In the construction of electrolytic condensers, it has been customary to use a fibrous material such as cotton or paper as a spacer separating the electrodes. Such separators require considerable space. It has also been proposed to use a fibreless spacer of cellulose derivative known under the trade-name "Cellophane." When using a material of this character as a spacer in electrolytic condensers, care must be taken that the electrolyte completely impregnates the Cellophane. The manufacture of porous Cellophane is quite difficult. The Cellophane contains also side products incidentally produced in the manufacture of the Cellophane. Thus, the Cellophane usually contains sulphuretted hydrogen or sulphates or other reducing substances. These and other side products contained in the Cellophane are liable to impair the proper functioning of the condenser.

The above mentioned and other disadvantages are substantially overcome by the invention which uses preshaped gelatin, preferably in the form of sheets or strips as a spacer and carrier of the electrolyte in electrolytic condensers.

The gelatine as a spacer material may be provided in different forms, some of which will be described hereafter. In accordance with one method, gelatine sheets or foils are used produced by casting gelatin upon a glass or metal base. Such processes are well known in the art and described for instance in a publication by Dr. M. Halama, Chemisch-technischer Verlag Dr. Bodenbacker, entitled "Transparentfolien." The gelatine foils or plates are then soaked in the electrolyte which causes the foils to swell and become thoroughly impregnated with the electrolyte.

The gelatine can be mixed, however, with the electrolyte and the mixture then cast into foils, strips or plates. Thereby a unitary or composite gelatin-electrolyte sheet is obtained. This gelatin-electrolyte sheet of proper size can be used as such in the assembly of a condenser, or wound into a roll for storage and used later on when desired. If the sheet has been dried, any suitable liquid solvent in proper amount can be added before assembly of the condenser.

The gelatin-electrolytic composition, or liquid or plastic mixture thereof, can also be applied to the metallic elements, or electrodes, of the condenser in such a way as to obtain a unitary electrode and conductive spacer element. To this end, a coating of a gelatin-electrolyte composition is applied to the electrode such as a metal strip, by casting or similar process. The electrode may be either a plain metal electrode or formed i. e. covered on one or two sides with a dielectric film.

The following is an example for producing a suitable mixture of a gelatin-electrolyte for use according to the invention.

Electrolytes for use in electrolytic condensers should have a proper pH value or degree of ion concentration which remains substantially constant, and the value of which amounts in general to about 4–6, i. e. is coming within the range of weak acids. A suitable acid constituent such as boric acid or a mixture of boric acid and a borate, is preferably admixed to the gelatin before admixing the electrolyte or other constituents of it. Moreover, so-called buffer materials may be added such as acetates, or mixtures of acetic acid and alkali acetates, citrates or mixtures of citrates and alkali citrates. The latter have the effect of preventing substantial variations of the pH value of the electrolyte.

In order to render the condenser suited for operating temperature above the softening tem-

perature of gelatin, the gelatin may be subjected to well known hardening processes.

It has furthermore been found advantageous to add substances to the gelatin rendering the foils sufficiently flexible and pliable. There may be added ingredients increasing or decreasing the hydroscopity of the foil. To this end, a suitable oil, such as castor oil, beeswax, carnauba wax, Vaseline, formaline, boric acid, may be added to the gelatine. Adding such as boric acid and formaline have the further effect of counteracting possible decomposition of the gelatine which is an organic substance caused by bacteria.

It was found that condensers made in accordance with the improvements and method described require less space and possess high breakdown voltage compared with condensers made according to heretofore known methods.

Referring to the drawing, we have illustrated therein diagrammatically an electrolytic condenser of the rolled type suitable for practicing the invention. Referring to Fig. 1, the condenser shown comprises a pair of composite gelatine and electrolyte strips 1 and 2 serving as separators interleaved with a pair of metal foils 3 and 4, and wound into a roll. At least one of the foils has a dielectric film formed thereon, such as by an electrochemical process well known in the art. The dielectric film can be formed prior to the assembly of the metal foils with the spacer elements into the condenser body or roll, or the film may be formed, or aged, after completion of the condenser assemblage by applying a forming, or aging potential to the electrodes in a known manner.

The forming of the electrodes can be carried out according to any process known in the art, and the electrodes may be subjected to preparatory treatment such as an etching operation either chemical or mechanical to improve the electrical characteristics of the condenser in a known manner.

Figure 2 is an enlarged cross-section of a foil 5 coated with a gelatin spacer 6 such as described above. A unitary structure of this type is of particular advantage if used for foils having minute surface elevations and depressions, such as an etched foil, or foil having a roughened surface. In these cases the spacer soaked in an electrolyte is applied, enters into all craters or depressions, thus preventing voids between the electrode surface and the electrolyte, and insuring good physical contact between them. Thereby desirable improvements of the characteristic of the condenser, including a substantial reduction of its internal resistance and increase of its capacity are obtained.

It is evident from the above that many changes may be made in the manufacture and structure of the condenser described and materials used, coming within the broadest scope and spirit of the invention as defined in the appended claims.

What we claim is:

1. In a method of manufacturing an electrolytic device, such as a condenser, composed of metal-foil electrodes separated by a sheet-like spacer containing an absorbed electrolyte, the steps of applying plastic or liquid gelatine to at least one side of a metal-foil electrode to form a thin layer thereon substantially covering said electrode side, solidifying said layer on said electrode so as to form a coherent unit therewith, soaking said layer of the unit with an electrolyte, and assembling a number, one as a minimum, of said units into an electrolytic body.

2. In a method of manufacturing an electrolytic device, such as a condenser, composed of metal-foil electrodes separated by a sheet-like spacer containing an absorbed electrolyte, the steps of applying plastic or liquid gelatine to at least one side of a metal-foil electrode to form a thin layer thereon substantially covering said electrode side, solidifying said layer on said electrode so as to form a coherent unit therewith, soaking said layer of the unit with an electrolyte, interleaving a number, two as a minimum, of said units and rolling them into an electrolytic body.

3. In a method of manufacturing an electrolytic device, such as a condenser, composed of metal-foil electrodes separated by a sheet-like spacer containing an absorbed electrolyte, the steps of applying plastic or liquid gelatine to at least one side of a metal-foil electrode to form a thin layer thereon substantially covering said electrode side, solidifying said layer on said electrode so as to form a coherent unit therewith, soaking said layer of the unit with an electrolyte, treating said layer united with said electrode so as to render it indifferent to changes of temperature, and assembling a number, one as a minimum, of said units into an electrolytic body.

4. In a method of manufacturing an electrolytic device, such as a condenser, composed of metal-foil electrodes separated by a sheet-like spacer containing an absorbed electrolyte, the steps of applying plastic or liquid gelatine containing a softening medium to at least one side of said electrode to form a thin layer thereon substantially covering said electrode side, solidifying said layer on said electrode so as to form a coherent unit therewith, soaking said layer of the unit with an electrolyte, and assembling a number, one as a minimum, of said units into an electrolytic body.

5. In a method of manufacturing an electrolytic device, such as a condenser, composed of metal-foil electrodes separated by a sheet-like spacer containing an absorbed electrolyte, the steps of applying to at least one side of said electrode a mixture of liquid or plastic gelatine and means capable of affecting the hygroscopicity of said mixture selected from a group consisting of oil, castor oil, bees-wax, carnauba wax and Vaseline, to form a thin layer thereon substantially covering said electrode side, solidifying said layer on said electrode so as to form a coherent unit therewith, soaking said layer of the unit with an electrolyte, and assembling a number, one as a minimum, of said units into an electrolytic body.

6. In a method of manufacturing an electrolytic device, such as a condenser, composed of metal-foil electrodes separated by a sheet-like spacer containing an absorbed electrolyte, the steps of applying a liquid or plastic mixture of gelatine and some constituents of an electrolyte to at least one side of a metal-foil electrode to form a thin layer thereon substantially covering said electrode side, solidifying said layer on said electrode so as to form a coherent unit therewith, soaking said layer of the unit with a liquid remainder of the electrolyte, and assembling a number, one as a minimum, of said units into an electrolytic body.

FRITZ EVERS.
WERNER HERRMANN.
PAUL WERNER.