Feb. 22, 1938. S. RUBEN 2,108,995

ELECTRICAL CONDENSER

Filed Aug. 26, 1933

FIG.1.

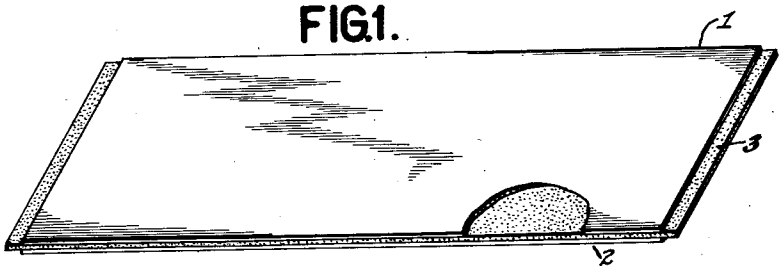


FIG.2.

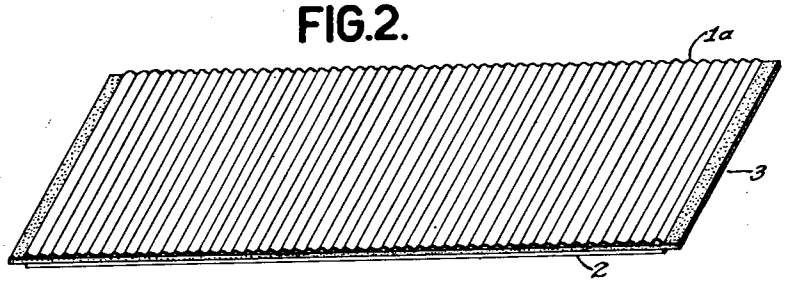


FIG.4.

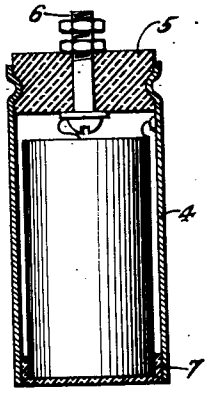
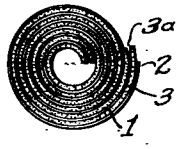


FIG.3.



INVENTOR

SAMUEL RUBEN

BY

ATTORNEY

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UNITED STATES PATENT OFFICE

2,108,995

ELECTRICAL CONDENSER

Samuel Ruben, New Rochelle, N. Y.

Application August 26, 1933, Serial No. 686,887

10 Claims. (Cl. 175—315)

This invention relates to electrical condensers and to a method of making such devices and more particularly to such condensers which have a current blocking film on at least one electrode and a film-maintaining composition interposed between the electrodes and in physical contact with the current-blocking film.

The general object of the invention is to provide such a condenser which is compact in form and which is electrically of high efficiency.

A specific object is the provision of a condenser of this type having a low power factor.

A further object is to provide a condenser of this type having uniform characteristics and capable of being produced at a low cost.

An additional object is the provision of a condenser of this type having a fibreless spacer medium which has been rendered electrolytically conductive.

Still a further object is to provide an improved condenser of the "dry" or plastic electrolytic type as exemplified in my United States Letters Patent Number 1,710,073 of April 23, 1929; Number 1,714,191 of May 21, 1929, and Number 1,891,207 of December 13, 1932, which employ filmed electrodes separated by a fibrous cloth spacer impregnated with a viscous glycol or glycerol borate material, serving as the electrolyte, and as further exemplified in my United States Letters Patent Number 1,918,716 of July 18, 1933, and application bearing Serial Number 680,688 filed July 17, 1933.

The condenser may also be of the type described in my application for United States Letters Patent bearing Serial Number 676,943, filed June 15, 1933.

Other objects will be apparent from the disclosure and from the drawing in which

Fig. 1 is a perspective view, partly broken away, of one embodiment of the invention showing a flat plate condenser;

Fig. 2 is a view similar to Fig. 1 showing a corrugated electrode;

Fig. 3 is a perspective view of a modification showing the arrangement of the invention in coiled form and

Fig. 4 is a vertical sectional view of an arrangement somewhat similar to Fig. 3, enclosed within a protective casing.

The "dry" electrolytic type of condenser as described in my aforementioned patents, offers several advantages and improvements over the wet types, in relation to fundamental considerations as capacitance, electrical, chemical and physical aspects.

Basically, an electrolytic condenser must maintain a dielectric film on the anode. This requires an expenditure of energy at the anode as represented by the energy required to form and maintain the aluminum oxide film and gas layer. This maintenance of the oxide and gas layer is dependent upon the drop of potential between the anode and electrolyte and the current density.

When the electrolyte is in a dry or plastic form, complete maintenance of the oxide film and gas layer on the anode obtains, as due to the high specific resistance of the electrolyte, (in the case of a typical glycol borate electrolyte, about 1100 ohms per cm. cube with a pH (hydrogen ion) concentration of 2.5) a limited ionization is had which allows adequate energy drop at the anode to form and maintain the capacitance film without the use of high currents. This prevents localization and affords a uniform distribution of current over the entire anode surface. Due to the organic nature of the electrolyte suspension medium, any tendency toward local forming and corrosion is minimized.

The close spacing between the electrodes provides a low internal resistance and a better average power factor is obtained than with the low resistance liquid type.

The reaction product obtained by the combination of the glycol or glycerol with the borate salts affords a stable compound which allows higher and lower temperatures to be applied, due to the low vapor pressure of the compound. Another factor assisting in the mechanical maintenance of the film is the low ionic mobility of the plastic electrolyte.

The invention comprises an anode of film-forming metal and a cooperating cathode spaced by a sheet of a flexible non-fibrous albuminous sheet material such as gelatine which has been impregnated and made electrically conductive by the addition of a conductive electrolyte which may be in the form of a plasticizer such as a glycol or glycerol compound. If the condenser is to be used for alternating current work, both electrodes are composed of film-forming metals.

In accordance with the present invention, a metallic electrode is formed from a sheet of film-forming material, such as aluminum, tantalum, magnesium and alloys including one of these metals, aluminum being preferred. This electrode sheet is provided with a current-blocking film, such as, for example, by the well known electrolytic method with the use of a suitable electrolyte, such as a borax solution. The current blocking film may then be washed, if desired, in a suitable cleansing solution, such as by passing

the sheet successively through a bath of alcohol and a bath of distilled water. In some cases, it is also desirable to pass the cleansed sheet through a viscous bonding liquid to provide a thin coating which becomes closely allied with the electrolyte spacer. This affords complete coverage of the anode area and prevents separation of the anode from the film-maintaining electrolyte. This viscous bonding liquid may consist of or include one or more of the polyhydric alcohols or products thereof having two or more hydroxyl radicals, such as for example, glycerine or ethylene glycol.

The anode material is preferably aluminum or an aluminum alloy. I have found that the addition of a slight amount of tantalum to aluminum provides an alloy especially suitable for use in condensers of this type. A much denser oxide film can be formed with consequent reduction in power factor. The percentage of tantalum added to the aluminum should range from one-tenth of one per cent to five per cent. For alternating current uses the cathode should be of a film-forming metal preferably a duplicate of the anode.

The electrolyte carrying spacer is prepared by immersing the gelatine in a bath of the electrolyte so as to thoroughly impregnate and plasticize it. This plasticizing may be accomplished through the use of aqueous salt electrolytes, glycol or glycerol borates, glycol or glycerine, etc. It is also possible to introduce the conductive salts into the gelatine prior to its rolling in sheet form.

I have also found that if gum tragacanth is added to the plasticizing or impregnating electrolyte, that a more adhesive conductive spacer material is obtained.

In the spacer of the present invention which is relatively nonporous in comparison with reticular gauze spacers, conduction occurs through impregnation of the minute intercellular spacers or pores of the sheet gelatine, not visible to the naked eye. There may also be conduction through intercellular chemical transference. There is no conduction through fibres as the gelatine is non-fibrous.

In the construction of the condenser the conductive gelatine sheet is placed between the two electrodes and compressed to insure good physical contact. If the condenser is to be rolled, another layer of the impregnated gelatine is placed over the cathode and the rolling carried out in the usual manner.

Such a condenser has a very uniform distribution of current over the entire contacting area and localization is prevented. Should sparking occur, due to an over voltage, carbonization does not readily occur, because there are no conductive fibres in contact with the anode, as would be the case of a fibrous spacer such as gauze or paper were used. Furthermore, separation of the fibres and non-uniform conduction, which would occur through the use of an impregnated paper spacer, are avoided.

While this conductive gelatine spacer may have its largest application in condensers of the "dry" or plastic type, I have found that it can be used to advantage in electrolytic condensers of the wet type. As thus used, it would allow a much closer spacing of the electrodes than has been heretofore practicable, the spacer being wound between the two electrodes and immersed into the electrolyte solution, such as the aqueous boric acid or acidified ammonium borate solutions or other electrolytic solutions commonly used in electrolytic condensers. When used in a wet condenser, the gelatine may first be treated with glycerine or ethylene glycol or glycerol or glycol borate to render it conductive.

The preferred electrolyte is that described in my United States Letters Patent Number 1,891,207, comprising a viscous syrupy glycol-borate paste which is preferably made by dissolving ammonium borate and boric acid in hot ethylene glycol. For a more detailed description of the composition and manufacture of the paste, reference may be had to the patent. However, other viscous conductive electrolytes, including those formed by the reaction between one of the weak acids, such as citric, malic, lactic, tartaric, formic, phosphoric, and/or their salts and one of the polyhydric alcohols of the classes glycols and glycerols, may be used.

In the manufacture of a condenser of the type described in my aforesaid co-pending application bearing Serial Number 676,943, sheet gelatine would be substituted for the cellulose sheet.

In order to afford a detailed description of some forms of the invention, reference is made to the accompanying drawing in which like numbers indicate like parts.

In the flat type condenser of Fig. 1, the anode (1) composed of aluminum having a pre-formed oxide film or layer, is spaced from aluminum cathode (2) by gelatine sheet (3) which has been rendered electrolytically conductive and tacky in the manner hereinabove described. For best results, the gelatine itself, independent of the impregnating electrolyte, should have a thickness of approximately .002" or less.

In Fig. 2, the anode (1_a) is similar to the anode (1) of Fig. 1, except that it is corrugated.

In the rolled condenser of Fig. 3, an additional conductive gelatine spacer (3_a) has been provided.

In the housed condenser of Fig. 4, the metal can (4) acts as one terminal, being insulated from the other terminal (6) by insulator member (5). Insulation at the bottom of the can is provided by insulator (7).

It is obvious that the construction shown in Fig. 4 may be used for "dry" or wet type condensers.

Since certain changes in carrying out the construction of the condenser and its components and obvious substitutions can be made in the materials used without departing from the scope of the invention, it is intended that all matters contained in the above description or shown in the accompanying drawing shall be interpreted as illustrated and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A plasticized non-rigid conductive sheet spacer for electrolytic condensers comprising a flexible non-fibrous gelatine sheet of a thickness substantially not greater than .002", impregnated with a conductive electrolyte so as to afford a conductive path therethrough.

2. The method of making a flexible non-rigid conductive sheet spacer material for electrolytic condensers which comprises immersing a preformed sheet of non-fibrous gelatine in a conductive plasticizing electrolyte and impregnating said sheet with said electrolyte so as to afford a conductive path therethrough.

3. A dry electrolytic condenser of the rolled type comprising two electrodes at least one of which is film-formed and two conductive spacer members rolled between and with said electrodes; said

spacer members comprising preformed thin flexible non-rigid plasticized gelatine sheets of thickness substantially not greater than .002 inch, said sheets having incorporated therewithin an electrolyte so as to afford a conductive path between the electrodes.

4. A dry electrolytic condenser as described in claim 3 in which the electrolyte is composed of a glycol compound.

5. A dry electrolytic condenser as described in claim 3 in which the electrolyte is composed of a glycerine compound.

6. A dry electrolytic condenser as described in claim 3 in which the electrolyte is composed of a polyhydric alcohol of the class consisting of glycols and glycerols, one of the weak acids—boric, citric, malic, lactic, tartaric, formic and phosphoric, with a salt of one of said acids suspended therein.

7. A dry electrolytic condenser as described in claim 3 in which the electrolyte is composed of ethylene glycol and a boron compound.

8. A dry electrolytic condenser as described in claim 3 in which the electrolyte is composed of glycol, boric acid and ammonium borate.

9. A dry electrolytic condenser as described in claim 3 in which the electrolyte is composed of glycerine and a boron compound.

10. The method of making a conductive spacer material for dry electrolytic condensers of the rolled type which comprises the immersing of a pre-formed gelatine sheet in a plasticizing solution so as to make said sheet flexible and non-rigid and impregnating said sheet with a conductive electrolyte so as to afford a conductive path therethrough.

SAMUEL RUBEN.