Jan. 4, 1938. J. B. BRENNAN 2,104,019

ELECTROLYTIC CONDENSER

Filed July 20, 1935

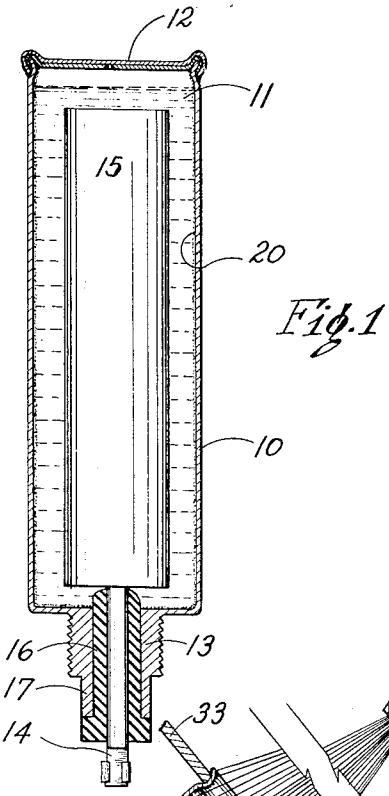


Fig. 1

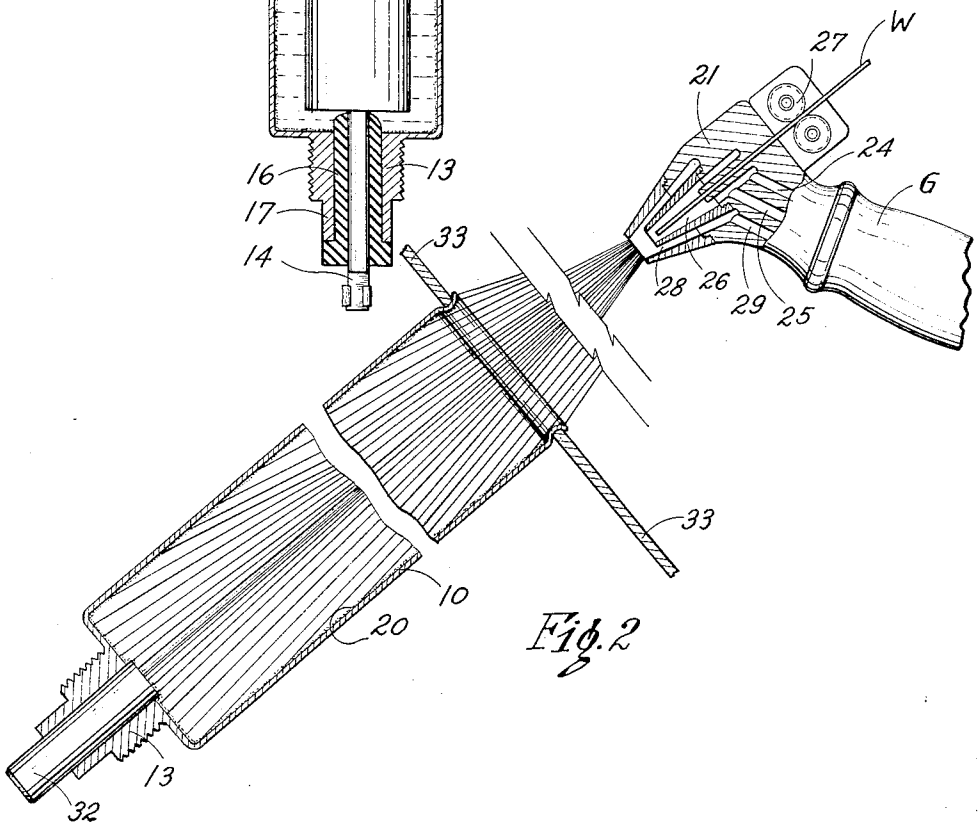


Fig. 2

Inventor

JOSEPH B. BRENNAN

By Ridley & Watts.

Attorneys

Patented Jan. 4, 1938

2,104,019

UNITED STATES PATENT OFFICE

2,104,019

ELECTROLYTIC CONDENSER

Joseph B. Brennan, Fort Wayne, Ind.

Application July 20, 1935, Serial No. 32,416

14 Claims. (Cl. 175—315)

This invention relates to electrolytic devices such as electrolytic condensers, rectifiers or lightning arresters of the type embodying an anode having an electro-formed dielectric film thereon, and a cathode on which no film is formed. This application is a continuation in part of my application Serial No. 707,148 filed January 18, 1934, which has resulted in Patent No. 2,060,022, issued on November 10, 1936, and a continuation in part of my application Serial No. 738,804 filed August 7, 1934.

In devices of this character, the cathode may also function as a container for holding and the cathode frequently comprises an aluminum can provided with means for connection into the electrical circuit. Aluminum cans are desirable from the standpoint of appearance, and also because they can be produced very cheaply by an extrusion method. However, when such cans are used as cathodes in electrolytic condensers, electrolytes ordinarily employed may have a corrosive effect on the aluminum and it has been necessary heretofore to protect the aluminum by chromium plating the inner surfaces of the cans. This process is not only expensive but also has the effect of increasing the resistance of the condenser. Furthermore, the chromium is apt to plate off when the condenser is used in a circuit having an alternating current ripple. Similar difficulties frequently occur in other types of condensers, such as paste type condensers, or condensers wherein the cathodes are made of materials other than aluminum.

It is among the objects of my invention to provide an improved electrolytic condenser wherein the resistance and power factor losses of the condenser are reduced. Another object is to provide an electrolytic condenser which will have a long life under severe operating conditions. Another object is to provide a cathode for electrolytic condensers which will have low resistance and which will stand up under severe operating conditions. A further object is to provide an electrolytic condenser and a cathode therefor which can be produced economically and easily. Another object is to provide a protective surface for the cathodes of electrolytic condensers. Another object is to provide a cathode for electrolytic condensers which also acts as a container for the electrolyte, and which has a protective coating applied to the inner surface thereof in contact with the electrolyte.

Further objects and advantageous features of my invention will become apparent from the following description of a preferred form thereof, reference being made to the accompanying drawing in which Figure 1 is a cross section through a condenser made according to my invention; and Figure 2 diagrammatically illustrates a method of spraying the inside of the containers.

Briefly, I attain the objects outlined above by providing condensers with cathodes having their surfaces exposed to the electrolyte coated with finely divided metallic particles. Various metals may be employed. In some instances I prefer to use copper, and in other instances I have found aluminum to be exceedingly satisfactory. I preferably produce the roughened metallic surface by spraying finely divided molten particles of metal on the material forming the base of the cathode, thus producing a roughened, somewhat porous surface of protecting metal. The surface so produced is conductive throughout its area, and has an extremely large effective or superficial area as compared with the plane or directly measurable area of the cathode.

Referring to the drawing, in which my invention is illustrated in conjunction with a well known type of electrolytic condenser, the reference character 10 indicates the container in general. This comprises the cathode of the condenser and also the container for the electrolyte 11, which may be any suitable film maintaining electrolyte, such as an aqueous solution of borax and boric acid. The container is closed by any suitable cap member 12, and if desired the cap may be provided with a vent to allow the escape of gases generated within the condenser. At its lower end, the container is provided with a threaded neck portion 13 which serves as an electrical terminal for the cathode and which is hollow to permit passage of the terminal 14 for the anode 15. The terminal is insulated from the neck portion by a rubber sleeve 16, and a fluid tight joint is produced by crimping in the projecting sleeve 17 to compress the rubber insulation against the terminal member 14. The anode 15 may comprise a cylinder or tube of film-forming material having a dielectric film suitably formed thereon, and preferably the anode is constructed according to the disclosure of my application Serial No. 662,107, filed March 22, 1933, in which I disclose an anode having a conductive surface of finely divided film-forming material sprayed thereon, whereby the capacity of the anode is greatly increased.

In order to protect the aluminum cathode and container 10 from the corrosive action of the electrolyte 11, I cover the internal surfaces thereof with a layer 20 of finely divided particles of

a suitable metal. I may employ a non-filming metal which is not readily corroded by the electrolyte and which will not contaminate the electrolyte, or I may employ aluminum, or other film-forming metal. The metal is sprayed into the container in a molten condition by an atomizing gun with the result that the minute particles of molten metal adhere to the interior surface of the aluminum can and effectively protect it against the corrosive action of the electrolyte. Furthermore, each particle apparently makes electrical contact with an adjacent particle or particles, so that the entire surface is conductive throughout. Because of the finely divided condition of the metal, the area of the cathode actually in contact with the electrolyte is increased greatly as compared to the area of the container itself. By reason of this great increase in area, the resistance to flow of current between the electrolyte and the cathode is greatly reduced, and likewise the current density per unit of area of the cathode actually in contact with the electrolyte is reduced and thus destructive arcing and heating up of the cathode and electrolyte is eliminated. The coating is preferably somewhat porous so that the electrolyte may permeate therethrough, but it nevertheless effectively protects the aluminum can against corrosion.

In Figure 2, I have illustrated diagrammatically the method and apparatus which I preferably employ to form the porous layer on the inside of the container. This comprises a spray gun G having a head 21 to which oxygen and acetylene or other suitable gases may be supplied through passages 24 and 25 extending through the handle of the gun and terminating in a mixing chamber 26. The copper, aluminum or other suitable metal is supplied by a wire W which is fed into the center of the mixing chamber by feeding mechanism 27.

The metal is melted by the acetylene flame and atomized by a blast of compressed air or other suitable gas supplied to the annular chamber 28 through the passageway 29. The atomized metal is directed into the container 20 to deposit the protective film or layer thereon and the gun may be manipulated by hand to produce an even deposit of the desired thickness. In spraying copper or aluminum I have obtained good results by using an oxyacetylene flame to fuse the wire and by employing a blast of compressed air at about 60 lbs. pressure per square inch to atomize the molten metal. The gun is preferably held close to the entrance or opening of the container so that the metallic particles are quite hot when they impinge on the surface of the aluminum and thus a rather dense deposit is formed. If desired, the passageway in the neck 13 may be protected from the molten metal by a plug 32, and a shield 33 may be used to prevent particles from striking the outside of the container and marring its appearance.

This method causes the molten or plastic particles of metal to impinge upon the interior of the container with sufficient force to adhere thereto and to cohere to each other. The layer of deposited metal is apparently conductive throughout and seems to be somewhat porous and microscopically honey-combed, roughened, and reticulated throughout. The electrolyte is thus able to penetrate the surface and accordingly the area of contact between the electrolyte and the conductive cathode layer is very large. I prefer to coat the entire inner surface of the cathode, in which case I obtain a reduction in the resistance of the cathode of about 50%, but this is not essential, particularly when copper is employed, as corrosion will be substantially prevented by a relatively small area of copper, for the copper has a greater tendency to go into solution than aluminum.

Condensers embodying cathodes having surfaces of finely divided aluminum sprayed thereon are very effective as described in my application Serial No. 738,804 filed August 8, 1934. I have found that aluminum containers provided with interior surfaces of finely divided sprayed aluminum in contact with the electrolyte have only about half as great resistance as the ordinary type of aluminum container which is provided with a plating of chromium. Furthermore the finely divided aluminum stands up well when the condensers are used in circuits having high alternating current ripples, whereas the ordinary type of condenser embodying chromium plated aluminum cans is apt to be damaged by the plating off of the chromium under the influence of the alternating current.

The improved characteristics of condensers embodying my invention are apparently due, so far as I can determine, to the fact that the effective area of the cathode in contact with the electrolyte is greatly increased as compared to prior practices. Because of the increased effective area the resistance of the cathode is lowered and the current density at the surface of the cathode is reduced. The reduction of current density apparently results in the practical elimination of corrosion of the cathode by the electrolyte, even under severe operating conditions, and apparently prevents the formation of a dielectric film on the cathode even though an aluminum surface is employed, and even though there is an alternating current ripple present in the circuit to which the condenser is connected. I have been unable to determine precisely what takes place on the surface of the cathode, but I have found that the resistance of the cathode increases only slightly after the condenser has been in use, which leads me to believe that no dielectric film is formed on the cathode, or if a film is formed, it is of such great area and of such a character that it offers little resistance to the flow of current.

My cathodes are particularly adapted for use in conjunction with anodes having high capacity per unit of area, such as the sprayed or etched anodes described in my prior applications. Such anodes are very compact for a given capacity. By my present invention it is possible to employ correspondingly compact cathodes without sacrificing efficiency or durability.

In the foregoing description I have described preferred forms of my invention as applied to one type of electrolytic condenser. It will be obvious to those skilled in the art that my invention may be applied to various types of condensers, rectifiers and lightning arresters such as, for example, electrolytic condensers of the paste type. Furthermore, any suitable material, metallic or non-metallic can be employed as a base for my cathodes.

From the foregoing description of preferred forms of my invention it will be seen that I have provided an improved type of electrolytic condenser which can be manufactured economically and rapidly. Condensers made according to my invention and embodying my containers or cathodes have lower resistance and lower power factor losses than prior types of condensers. Because of the reduction in current density on my

cathodes, my condensers do not heat up to as great an extent as prior types of condensers, and are free from troubles caused by corrosion of the cathodes, arcing between the electrolyte and cathode, and contamination of the electrolyte by the cathode. Thus my condensers are durable and reliable and retain their efficiency during long periods of use under severe conditions.

Various modifications and changes within the spirit and scope of my invention will be apparent to those skilled in the art. It is therefore to be understood that my patent is not limited to the preferred embodiments of my invention described herein or in any manner other than by the appended claims when given the range of equivalents to which my patent may be entitled.

I claim:—

1. A cathode for electrolytic condensers and the like comprising a can of material which is corrodable by the electrolyte employed therein, and a protective coating of copper deposited on the internal surface thereof, the copper having a rough surface and comprising a great number of minute particles making electrical contact with each other and with the can.

2. A cathode for electrolytic condensers and the like comprising an aluminum can having a protective, conductive layer of finely divided copper deposited on the internal surface thereof.

3. A container for electrolytic condensers and the like comprising a can adapted to form the cathode and having a protective coating of finely divided copper deposited on at least a portion of the internal surface thereof.

4. A container and cathode for electrolytic condensers and the like of the type embodying film maintaining electrolyte comprising an aluminum can and a protective coating of aluminum deposited on the internal surface thereof, the aluminum having a rough surface adapted to be directly in contact with the electrolyte and comprising a great number of minute particles making electrical contact with each other and with the can.

5. A container and cathode for electrolytic condensers and the like of the type embodying a film maintaining electrolyte comprising an aluminum can having a protective, conductive layer of finely divided aluminum deposited on the internal surface thereof and adapted to be directly in contact with the electrolyte.

6. A cathode for electrolytic condensers and the like of the type embodying a film maintaining electrolyte comprising a base of filming material having a layer of finely divided cohering particles of non-filming material adhering thereto and adapted to be directly in contact with the electrolyte.

7. A cathode for electrolytic condensers and the like comprising a base of aluminum having a layer of finely divided cohering particles of copper adhering thereto.

8. A cathode for electrolytic condensers and the like of the type embodying a film maintaining electrolyte comprising a base formed of a metal which is corrodable by the electrolyte and having a protecting layer adhering thereto and exposed to the electrolyte and comprising finely divided particles of a metal which is adapted to prevent corrosion of the base by the electrolyte.

9. A cathode for electrolytic condensers and the like of the type embodying a film maintaining electrolyte, comprising a base of aluminum having a layer of finely divided cohering particles of aluminum adhering thereto and adapted to be directly in contact with the electrolyte.

10. A cathode for electrolytic condensers and the like of the type embodying a film maintaining electrolyte comprising a suitable base having a conductive layer of finely divided metallic particles deposited thereon and adapted to be exposed to the electrolyte.

11. In an electrolytic condenser, the combination of a film-maintaining electrolyte, a pair of spaced electrodes of film-forming metal immersed in said electrolyte, said electrodes having surfaces comprising finely divided cohering particles of film-forming metal deposited thereon, and an electro-formed dielectric film overlying the surface of one of said electrodes, the surface of the other of said electrodes being directly in contact with the electrolyte.

12. An electrolytic condenser comprising an electrolyte, an anode having a porous surface of film-forming metal and a dielectric film overlying said surface and in contact with said electrolyte, and a cathode having a porous roughened surface of finely divided cohering metallic particles, the roughened surface of the cathode being directly in contact with the electrolyte.

13. An electrolytic condenser comprising in combination, an electrolyte, an anode having a dielectric film thereon, and a cathode comprising a base having a surface comprising a conductive layer of finely divided metallic particles, said conductive layer being in contact with the electrolyte.

14. An electrolytic condenser comprising in combination, an electrolyte, an anode having a dielectric film formed thereon, and an unfilmed cathode comprising a base having a conductive layer of finely divided particles of aluminum deposited thereon, said conductive layer being in contact with the electrolyte.

JOSEPH B. BRENNAN.