

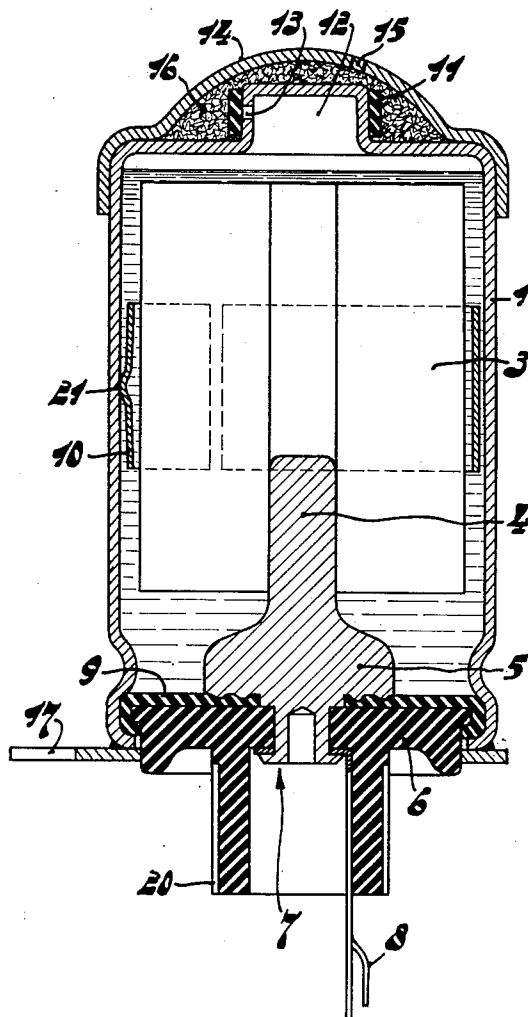
Dec. 12, 1939.

A. F. P. J. CLAASSEN ET AL

2,183,091

ELECTROLYTIC CELL

Filed June 26, 1937



INVENTORS
A. F. P. J. Claassen and
Cornelis de Lange

BY

E. F. Wendt

ATTORNEY

UNITED STATES PATENT OFFICE

2,183,091

ELECTROLYTIC CELL

Anthony Frederik Peter Johannes Claassen and
Cornelis de Lange, Eindhoven, Netherlands, as-
signors to N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Netherlands

Application June 26, 1937, Serial No. 150,622
In Germany July 20, 1936

6 Claims. (Cl. 175—315)

Our invention relates to electrolytic cells having liquid electrolytes.

We shall describe our invention in connection with wet electrolytic condenser, however it is not limited thereto but is equally applicable to other types of electrolytic cells having liquid electrolytes.

Electrolytic condensers of the above type are generally made with a container, i. e. cathode-container, of a conductive material which also acts as a current supply conductor for the electrolyte, and with an anode, i. e., the formed electrode, disposed in the center of the container and insulated therefrom. To obtain the highest possible capacity per unit volume, the anode is given a large active surface area per unit volume, for instance by giving it a profiled surface and/or by chemically or electrochemically roughening or etching the surface. If such a condenser is used as a smoothing condenser, there is generally superposed upon the direct-current voltage, a rather high alternating voltage which, for example, may vary from 30 to 50 volts at 50 cycles per second (half-wave rectification), or at 100 cycles per second (full-wave rectification), and which results in the passage of a rather high capacitative alternating current. Furthermore, because of the very small size of the anode, the cathode-container may be, and generally is, made very small, which results in a large current density at the surface of the cathode-container.

With such condensers, however, difficulties arise, particularly when the cathode-container is made of a material, such as aluminum, zinc, aluminum alloys, magnesium alloys, etc., which meets the usual requirements, for example, low cost and easy workability even in mass production.

More particularly, when using cathode-containers of such materials the surface thereof in contact with the electrolyte becomes chemically transformed under the influence of the above-mentioned high alternating current load and the cathode-container during part of one cycle becomes positive with respect to the electrolyte. As a result of this, a capacity connected in series with that of the anode is produced at the surface of the cathode-container and the total capacity of the condenser is decreased. Furthermore, the series resistance, i. e. loss resistance of the condenser, is increased by the presence of this oxide film.

The above condition deleteriously affects the electrical properties of the condenser, and due

particularly to the high current density resulting from the compact construction of such condensers, this forming process proceeds very rapidly and consequently the harmful oxide film is produced after the condenser has been in operation only a very short time. This oxide film is also produced on the cathode-container by repeated switching on and off, i. e. by the so-called switching effect.

The main object of our invention is to prevent the production of such an oxide film or at least suppress the harmful effect thereof, while at the same time retaining all the advantages of an inexpensive cathode-container.

According to the invention, we form the container, which is in contact with the electrolyte, of a cheap and easily-workable metal, and provide in contact with the electrolyte and electrically connected to the container, a metallic member of a material which is more precious than that of the container.

The expression "more precious" as used herein and in the claims, is to be understood to mean a material which is anodically polarized, i. e. formed less strongly than the material of the cathode-container.

In a condenser according to the invention, the current does not flow directly from the electrolyte to the container, but flows from the electrolyte to the metallic member, and then through the container to an external circuit. Thus the connections for the external circuit are maintained in the usual manner, and the container can be made of a material which is most suitable for this purpose, whereas the metallic member or cathode body as regards its shape and material may be exactly adapted to its particular function, and may be made, for instance, of a very thin sheet of a more precious metal.

According to a preferred embodiment of the invention, we form the cathode body of metals which are novel for this purpose and which entirely meet all the requirements, i. e. chromium-iron or chromium-nickel alloys.

The use of ferrochromium is particularly advantageous as it is not attacked by the electrolyte solutions usually employed in this technique, and consequently the cell can be stored for a long time without deterioration.

According to a further embodiment of the invention, the cathode body, which will be referred to as the cathode, is secured to the container by spot-welding or riveted thereto with a closed eyelet, whereby at the same time the electric connection is established.

In a particularly advantageous construction of a condenser according to the invention, we arrange the anode in the center of the container and insulated therefrom, and form the cathode body of a cylindrical sheet of more precious metal secured to the container by spot-welding, and surrounding the anode symmetrically with respect to the active surface thereof. This construction has the great advantage that the path of current between the anode and the cathode body is very short and consequently the series resistance is reduced to a minimum.

We are aware that it has been proposed to form the cathode of an electrolytic cell of a material which is unattacked by the electrolyte, for instance gold or graphite, or to form the inner surface of the container itself of a material which is unattacked by the electrolyte, such as chromed aluminum. Such constructions, however, have the disadvantage that the selection of the material for the container is governed by other factors than cheapness and easy workability. On the other hand, if a cathode insulated from the container is used, the container cannot be used as a current-supply conductor.

Furthermore, chromed aluminium has the disadvantage that it can only be used when the alternating current density is very low, for instance below 5 milli-amp. (50 cycles per second) per sq. cm. Compared with the use of chromed aluminum, the present invention has the advantage that the function of electrical contact with the electrolyte and the function of the contact with the supply conductor are entirely separate with the result that both the container and the cathode body can be made with the most favorable shape and of the most suitable material.

In order that the invention may be clearly understood and readily carried into effect, we shall describe the same in more detail with reference to the accompanying drawing, in which the single figure is a sectionized side view of an electrolytic condenser embodying the invention.

The condenser shown in the drawing comprises a cup-shaped container 1, for instance of aluminum, provided on its closed end with a protuberance 12 having a venthole 13. Within the container is an anode 3 in the form of a star-shaped sheet of film-forming metal, such as aluminum, tantalum or the like, supported from a stem 4 and provided with an electrolytically-formed oxide film. Stem 4 is supported from a member 6 of hard insulating material, for instance "Bakelite", by riveting over its end at 7, whereas a gasket 9 of insulating material is provided between member 6 and the corrugated surface of a flanged portion 5 of stem 4 to provide a liquid-tight seal. The ends of container 1 are spun over the edge of member 6 with the interposition of gasket 9 to form a liquid-tight seal, whereas a lug 17 soldered to container 1 serves as a cathode terminal, and a lug 8 riveted to stem 4 at 7 serves as an anode terminal.

Member 6 is provided with an externally-threaded projecting portion 20, which serves in the usual manner to secure the condenser to a panel.

Container 1 is filled to a level above the top of anode 3 with a suitable electrolyte 2, for instance an aqueous solution of borax and boric acid.

To provide for the escape of gases developed within the container during operation, venting means are provided which consist of a band 11 of elastic material, such as rubber, which nor-

mally closes vent hole 13. A metal cap 14 provided with a vent hole 15 is secured to the top of container 1 and forms a space within which is disposed a suitable absorbent material 16, such as sawdust, which serves to absorb any of the electrolyte which may be carried out through vent hole 13 by the vented gases.

It will be noted that up to this point the condenser is of a more or less standard construction. However, if further means are not provided an oxide film will be formed upon the inner surface of container 1, which will deleteriously affect the operation of the condenser.

In accordance with the invention, we provide within the electrolyte a cathode body 10 in the form of a partial cylinder of a thin strip of a "more precious" metal fixed to container 1 at 21 by means of spot-welding. It is advantageous to use a partial cylinder as shown in the drawing, as we can start from a flat strip which we bend to the desired curvature. Body 10 may be made of materials such as rust proof steel, gold or platinum in foil-form. However, as has been stated, we prefer to make this body of a chromium-iron or chromium-nickel alloy. For example, very good results are obtained when using an alloy consisting substantially of 20% chromium and 80% nickel, or an alloy comprising 24% to 26% chromium, 0.10%–0.20% carbon, 0.25% silicon, 0.20% manganese, and the remainder iron.

While we have described our invention with reference to specific examples and specific applications, we do not wish to be limited thereto, but desire the appended claims to be construed as broadly as permissible in view of the prior art.

What we claim is:

1. An electrolytic cell comprising a container of an easily-worked film-forming metal, an anode within said container, an electrolyte, said container serving as a current-supply conductor for the electrolyte, and a strip-shaped contact member of a more precious metal than the container metal and electrically connected to the container, said member substantially completely encircling the anode and extending laterally at least over the middle portion thereof.

2. An electrolytic cell comprising a cup-shaped container of an easily-worked film-forming metal, an anode within said container, a liquid electrolyte within said container, said container serving as a current-supply conductor for the electrolyte, and a cylindrical-shaped strip of a more precious metal than the container metal and electrically connected to the container, said strip substantially completely encircling the anode and extending laterally at least over the middle portion thereof.

3. An electrolytic cell comprising a container of an easily-worked film-forming metal, an anode within said container, an electrolyte within said container, said container serving as a current-supply conductor for the electrolyte, and a strip-shaped contact member of ferro-chromium alloy electrically connected to the container, said member substantially completely encircling the anode and extending laterally at least over the middle portion thereof.

4. An electrolytic cell comprising a container of an easily-worked film-forming metal, an anode arranged within said container, an electrolyte within said container, said container serving as a current-supply conductor for the electrolyte, and a strip-shaped contact member of a more precious metal than the container metal and spot-

welded to the container, said member substantially completely encircling the anode and extending laterally at least over the middle portion thereof.

5 5. An electrolytic cell comprising a container of an easily-worked film-forming metal, an anode arranged within said container, an electrolyte within said container, said container serving as a current-supply conductor for the electrolyte, 10 and a strip-shaped contact member of a chromium-nickel alloy connected to the container, said member substantially completely encircling the anode and extending laterally at least over the middle portion thereof.

6. An electrolytic cell comprising a container of an easily-worked film-forming metal, an anode arranged within said container, an electrolyte within said container, said container serving as a current-supply conductor for the electrolyte, 5 and a strip-shaped contact member electrically connected to the container and consisting of an alloy of chromium, carbon, silicon, manganese and iron, said member substantially completely encircling the anode and extending laterally at least over the middle portion thereof. 10

ANTHONY FREDERIK PETER
JOHANNES CLAASSEN.
CORNELIS DE LANGE.