E. A. ALLEN.

ELECTROLYTIC CELL.

APPLICATION FILED AUG. 24, 1907.

1,035,133. Patented Aug. 13, 1912.

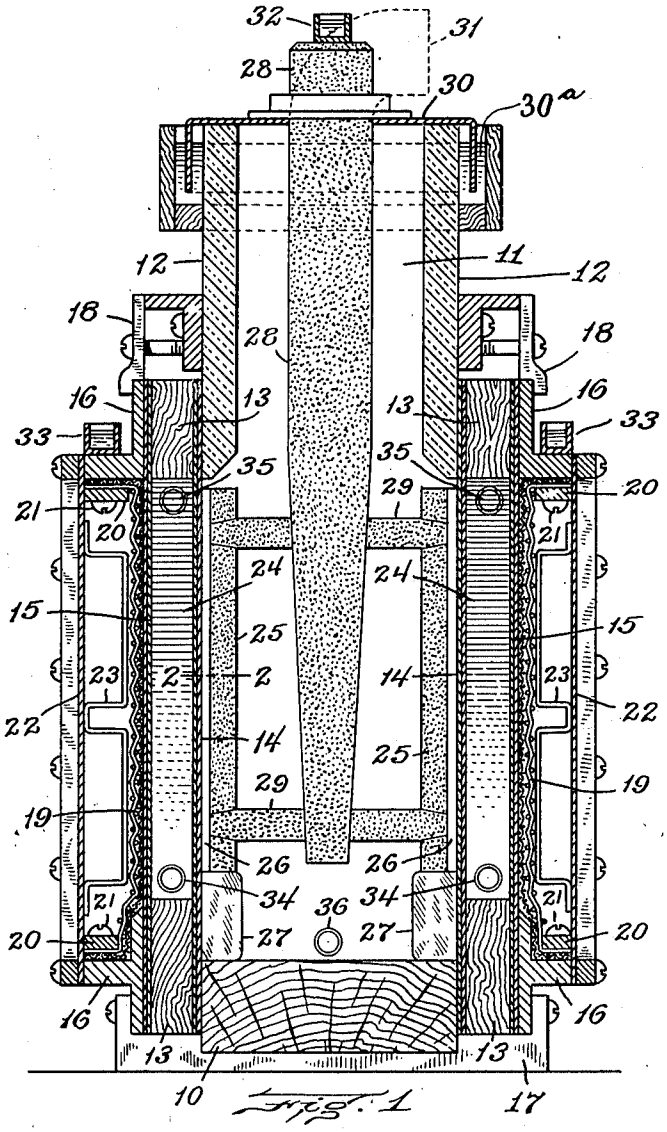

Fig. 1

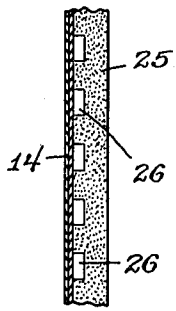

Fig. 2

Witnesses:
Walter P. Abell
Forest Rowlstone.

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UNITED STATES PATENT OFFICE.

EDWARD A. ALLEN, OF PORTLAND, MAINE, ASSIGNOR TO JAMES F. PRESTON, OF LOWELL, MASSACHUSETTS.

ELECTROLYTIC CELL.

1,035,133. Specification of Letters Patent. **Patented Aug. 13, 1912.**

Application filed August 24, 1907. Serial No. 390,018.

To all whom it may concern:

Be it known that I, EDWARD A. ALLEN, of Portland, in the county of Cumberland and State of Maine, have invented certain new and useful Improvements in Electrolytic Cells, of which the following is a specification.

This invention has relation to electrolytic cells such as are employed in the electrolysis of saline solutions, and more particularly to cells of the type in which the anode and the cathode are separated by a diaphragm. In such cells, it has universally been the practice to immerse the anode in the electrolyte and to place the cathode on the opposite side of the diaphragm from the anode. In such a cell, when a solution of sodium chlorid is being electrolyzed, the chlorin which is liberated at the anode bubbles up through the electrolyte, and the latter becomes charged with the gas. It has been universally recognized that this presence of the chlorin in the electrolyte is one of the most disadvantageous features of such cells and has proved the source of great annoyance, and unnecessary cost and labor, and has prevented the cells from being operated with the greatest efficiency.

I propose, in accordance with my invention, to eliminate the possibility of chlorin being liberated within the chamber which contains the electrolyte, or solution to be electrolyzed, by causing the chlorin to be liberated at an anode which is exterior to said chamber. This may be accomplished in different ways, although the best embodiment of the invention known to me consists in confining the electrolyte between two diaphragms and locating the cathode on the outer face of one diaphragm and the anode on the outer face of the other diaphragm. I preferably employ diaphragms of some relatively porous material which will permit a comparatively free percolation of the electrolyte therethrough into contact with the cathode and the anode. I prefer to employ a foraminous cathode, which is capable of retaining in its meshes a sufficient quantity of the electrolyte to permit the passage of the electric current therethrough. The anode I preferably form of carbon, such as Atchison graphite, the face of which is placed in close proximity with the face of one of the diaphragms. The cathode and the anode are preferably unimmersed in any liquor, although I may employ a suitable oil or other liquid, immiscible with water, in the cathode and anode compartments of the cell, without departing from the present invention. When the current is passed through the cell, the electrolysis takes place, as ordinarily, except that cations and anions are both liberated exteriorly to the chamber which contains the electrolyte.

Referring to the accompanying drawings,—Figure 1 represents a transverse vertical section of an electrolytic cell embodying the invention. Fig. 2 represents a section on the line 2—2 of Fig. 1 and illustrates the grooves in the face of the anode.

Before proceeding to describe in detail the cell which I have illustrated upon the drawings, I desire to have it understood that the invention is not limited to that particular embodiment thereof, that a wide range of equivalents may be employed for parts shown, and that the phraseology which I have adopted in the specification and in the appended claims is for the purpose of description and not of limitation.

The cell illustrated is duplex, in that it is provided with two chambers for the electrolyte and a cathode and an anode for each body of electrolyte.

10 indicates the base or bottom plate of the cell, to which are attached end walls of which one is shown at 11. Connecting the upper ends of the end walls are the side walls 12 12. These parts may be formed of any suitable material such as slate.

To the sides of the structure are secured rectangular frames 13 13, which for convenience may be made of wood, hard rubber, slate or any other suitable material. On the exterior faces of the frame are the diaphragms 14 15, which may be made of asbestos paper, asbestos cloth, or other material suitable for the purpose. I prefer to have the diaphragms sufficiently porous to permit a comparatively free flow of the electrolyte therethrough. The diaphragms, however, may be substantially impermeable, as in the cells of the Hargreaves type, without departing from the spirit of the invention. Placed against the margins of the diaphragms 15 are metallic frames 16, and these frames, together with the frame 13, are clamped against the bottom, side and end walls by suitable clamps, such as are illustrated and described in the application of myself and Herbert I. Allen, Serial No. 389,824, filed Aug. 23, 1907. The bottom

clamps are indicated at 17 and the upper clamps at 18. The cathodes, which are indicated at 19, are placed against the outer faces of the diaphragms 15 and the margins or edges of said cathodes are bent outwardly and are clamped against outwardly projecting flanges on the frames 16 by clamping bars 20 and screws 21. To the flanges of the frame are secured plates 22, which, together with the diaphragms 15, form as it were cathode compartments. Braces 23, attached to said plates, may be employed to prevent the diaphragms 15 and the cathodes 19 from being bent outwardly under the pressure of the electrolyte contained in the compartments 24 between the diaphragms. As previously indicated, the cathodes may be made of foraminous metal, such as one or more layers of wire gauze.

The anodes are indicated at 25. They consist of plates of carbon, the inner faces of which are grooved as at 26, to permit the easy escape of chlorin. These grooved faces are placed against the outer faces of the diaphragms 14 and they rest upon suitable blocks or supports 27 resting on the base 10. These anodes may, with convenience, be constructed substantially as shown and described in the said co-pending application of myself and Herbert I. Allen, hereinbefore referred to, although I prefer that the faces be practically continuous from top to bottom. These anodes are connected with a central stem 28 by connections 29, said connections and said stem being preferably made of carbon or other material which will not be attacked by the chlorin. The space between the diaphragms 14, the end walls 11, and the base 10 constitute what I may term an "anode compartment." This compartment is closed at the top by a cover 30, the edges of which are inserted in a lute 30ª. Through the cover extends a conduit 31, as shown in dotted lines, to carry away the chlorin. The stem 28 is illustrated as being provided with the mercury cup 32 to receive one terminal of the electric circuit, and the metallic frames 16 are provided with similar cups 33 to receive the other terminals.

It will be understood, that near the bottom of the cathode compartments, there are ports for discharging the cationic product and ports near the top to carry away the hydrogen which is liberated therein. The compartments 24 for the electrolyte are provided with inlet and outlet ducts which are indicated at 34 and 35, so that I am enabled to keep a constant circulation of saturated solution in said compartments.

By any suitable means I provide for increasing the hydrostatic pressure of the electrolyte in the compartment 24 so that I am able to secure the proper passage of the electrolyte through the diaphragms where I employ a permeable diaphragm.

Assuming that the electrolyte compartment 24 has its proper supply of saturated solution of sodium chlorid, the passage of the current from the anode to the cathode electrolyzes said solution, caustic soda being formed at the cathode, and chlorin being liberated on the surface of the anode. The anions and the cations are both liberated exteriorly of the compartment 24, so that there is always a body of neutral liquor in the compartment 24 which is free from chlorin and from the caustic solution, thus preventing the formation of hypochlorites. The caustic solution flows down the face of the cathode and is discharged, and the chlorin is conducted from the anode compartment as usual. The electrolyte, which percolates through the diaphragm 14, flows down the faces thereof and down the faces of the anodes to the bottom of the anode compartment and is discharged through a port 36. This liquor may be treated to remove whatever chlorin remains in it and may be reused.

Having thus explained the nature of my said invention, and described a way of constructing and using the same, although without having attempted to set forth all of the forms in which it may be made, or all of the modes of its use, what I claim is:

1. An electrolytic cell comprising an open sided main body having end walls, a base and upper side walls, and constituting an anode chamber, frames having spaced opposing porous diaphragms affixed to the open sides of said body, the walls of each said frame and the diaphragms thereon constituting an electrolyte compartment, a casing outside the outer diaphragm on each frame forming a cathode compartment, a cathode in each cathode compartment confronting the outer diaphragm, and an anode in said cathode chamber having active surfaces confronting and in contact with the inner diaphragms.

2. A duplex electrolytic cell, comprising a cell structure having on each side two confronting diaphragms forming compartments for the electrolyte, an intermediate anode compartment, a cathode outside of the outer diaphragm on each side, an anode outside of the inner diaphragm on each side in said anode compartment, and a stem connecting said anodes, substantially as set forth.

In testimony whereof I have affixed my signature, in the presence of two witnesses.

EDWARD A. ALLEN.

Witnesses:
MARCUS B. MAY,
ARTHUR H. BROWN.