

E. A. AND H. I. ALLEN.
ELECTROLYTIC CELL.
APPLICATION FILED DEC. 9, 1919.

1,373,394.

Patented Apr. 5, 1921.

2 SHEETS—SHEET 1.

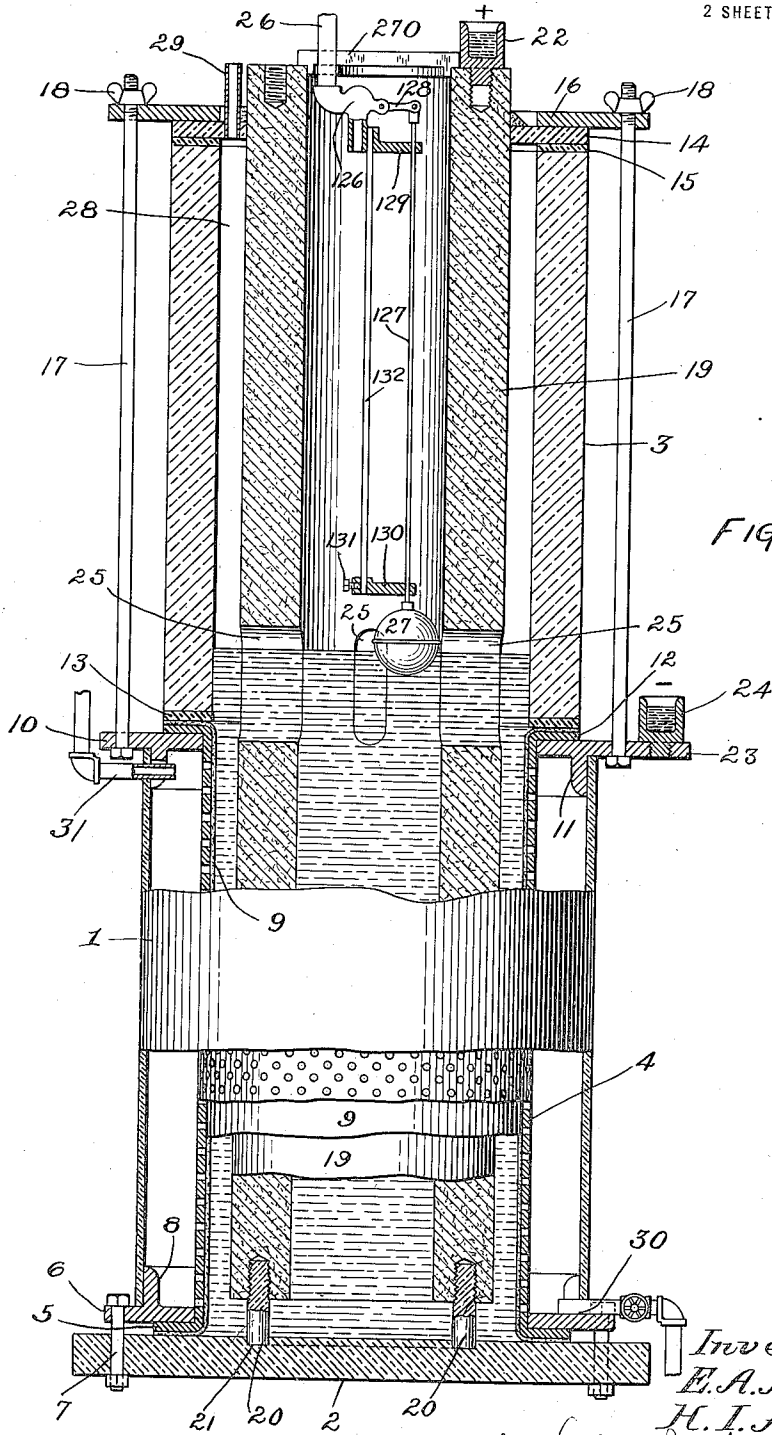


FIG. 1.

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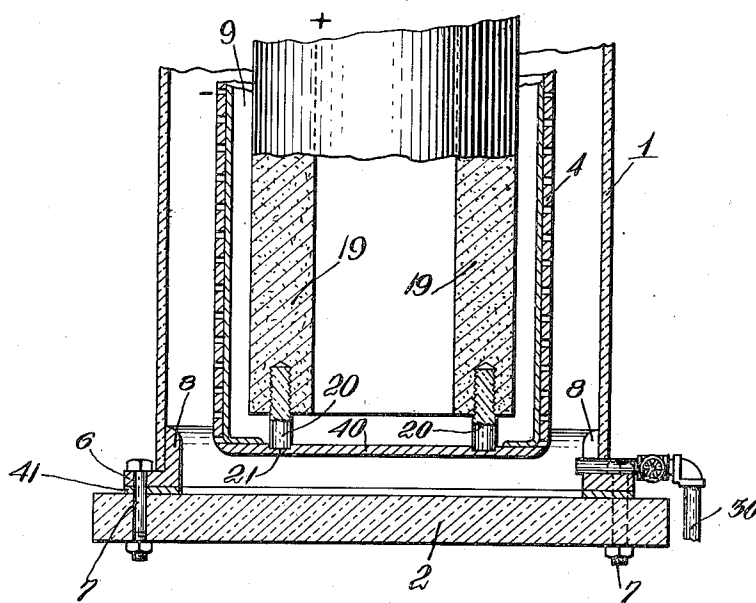


Fig. 2.

Inventors:
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By Wright Brown & Co. Inc.
Attys.

UNITED STATES PATENT OFFICE.

EDWARD A. ALLEN AND HERBERT I. ALLEN, OF PORTLAND, MAINE, ASSIGNORS TO
ELECTRON CHEMICAL COMPANY, OF PORTLAND, MAINE, A CORPORATION OF
MAINE.

ELECTROLYTIC CELL.

1,373,394.

Specification of Letters Patent.

Patented Apr. 5, 1921.

Application filed December 9, 1919. Serial No. 343,491.

To all whom it may concern:

Be it known that we, EDWARD A. ALLEN and HERBERT I. ALLEN, both citizens of the United States, residing at Portland, in the
5 county of Cumberland and State of Maine, have invented new and useful Improvements in Electrolytic Cells, of which the following is a specification.

This invention has relation to cells such as
10 are employed for the electrolysis of brine solutions in the production of chlorin and caustic soda, and it has for its object to provide certain improvements therein which we shall now proceed to describe.

15 Figure 1 of the drawing shows partially in section a cell which embodies our improvements but which may be varied in form and in many of its structural details without departing from the spirit and scope of
20 the invention as defined in the claims.

Fig. 2 illustrates in section the lower end of a cell in which the cathode is disconnected from the bottom of the tank.

As shown, the cell is cylindrical in form,
25 thereby affording features of advantage which will subsequently be explained. 1 indicates a cylindrical tank or container which with convenience may consist of a pipe of metal or glazed earthenware having a suitable
30 bottom. As shown, the container is made of earthenware or other inert material, and its bottom is formed by a slab 2 of slate, porcelain, cement or other suitable inert non-conducting material. Upon the container,
35 rests what may be termed the freeboard section 3 of the cell. This too is shown as cylindrical, and it is made of cement, glazed earthenware, porcelain or equivalent material. Within the container and spaced
40 from the vertical wall thereof, is a tubular cylindrical cathode 4 which is provided with numerous perforations to permit the passage of the effluent (undecomposed brine and caustic soda) and hydrogen. The lower end
45 of the cathode may rest upon the bottom of the container, as shown in Fig. 2, but, for some purposes, its lower end may have an outwardly-turned flange 5 to be clamped against the slab or bottom plate 2 by a
50 clamping ring 6 which is secured to the plate by bolts 7, as shown in Fig. 1. The ring is shown as provided with an upwardly projecting flange 8 on which the cylinder 1

fits. A tubular porous diaphragm 9 of one or more layers of asbestos, paper or cloth is
55 arranged to cover the inner face of the cathode. The lower end of the tubular diaphragm may, if desired, be flared outwardly and clamped between the flange 5 of the cathode and the bottom plate 2 so as to form
60 a water-tight joint. The upper end of the cathode is clamped to the freeboard section 3. For this purpose, we employ an annular clamping plate 10 of metal which is provided
65 with a flange 11 to extend down into the container 1. The upper end of the cathode is provided with an outwardly flared flange 12, and the upper end of the diaphragm is likewise flared outwardly so as to lie between the
70 flange 12 and the lower end of the freeboard section 3. A gasket 13 of suitable material may be located at the joint between the diaphragm and the freeboard section. On top of the freeboard section there is a cover 14 of
75 inert material, such as slate, and between them is placed a gasket 15. A clamp plate 16 rests upon the cover 14, and it and the plate or annulus 10 are secured together by elongated bolts 17 and wing-nuts 18. By
80 means of this construction, the cathode is clamped to the lower end of the freeboard section so as to extend downwardly therefrom into the container 1. Preferably the
85 flanges 5 and 12 of the cathode are not perforated, and a liquid and gas-tight joint is formed between the cathode and the freeboard section 3. The container 1 and its
bottom plate 2 are integral, if desired. In Fig. 2 the cathode is shown as formed with
90 a lower end wall 40, either to rest upon the bottom of the tank or container, or else to be separated therefrom as illustrated, as may be desired. In this case, between the ring 6 and the slab 2 is located a gasket 41.

The space within the cathode is occupied
95 by an anode which is shown as a cylindrical tubular carbon bar 19, from the lower end of which projects glass or porcelain screw pins 20 to support the anode and maintain its lower end above the plate 2. This plate
100 may be grooved as at 21, so as to receive the insulating pins 20 and center the anode. The anode projects through an aperture in the cover 14 and is illustrated as provided with a mercury cup 22 into which may dip
105 the conductor by which current is supplied

to the anode. The annular clamping plate 10 is provided with a lug 23 having a similar mercury cup 24 into which a conductor may dip for conducting away the current from the cathode which is in electrical contact with the said clamping plate 10. The anode is provided with apertures 25 so that the electrolyte may circulate downwardly through the bore of the anode underneath the lower end thereof, up through the annular space between the anode and the cathode, and thence through the holes 25 back into the interior of the anode. The electrolyte, that is, saturated brine, is delivered to the cell through a valved pipe 26, the valve 126 of which is controlled by a float 27. The float 27 is connected by a link 127 to the valve lever 128, and the link is guided by guides 129, 130; the former of which may be formed on the valve casing, as shown. The guide 130 is adjustably fixed by a set screw 131 on a rod 132 which depends from the valve 126. In operation, the rise and fall of the float closes and opens the valve. These elements, for controlling the supply of electrolyte, are shown more or less conventionally, and are intended to permit adjustment of the float vertically, if desired. A cover plate of inert material, indicated at 27, may be placed upon the top of the anode. The chlorin, which is liberated on the exterior face of the anode, is conducted from the chlorin space 28 by a pipe 29. It is intended that the exterior face of the cathode should be unsubmerged in the cell effluent, and consequently a valved pipe 30 leads from the bottom of the container 1 so as to conduct away the mixture of undecomposed brine and caustic soda which flows down the face of the cathode. In the event that it be desired to conserve or recover the hydrogen, a pipe 31 may lead from the upper portion of the annular space in the container 1 surrounding the cathode.

Where electrolytic cells are made in units, each having a relatively large area of diaphragm surface, the cost of renewing the cells is disproportionately large, because of the necessity of throwing the entire cell out of operation. A part of the present invention comprehends the construction of each unit in the form of a cylinder with the cathode, the diaphragm and the anode concentrically arranged, each unit being relatively small so that in a given area of floor space there can be secured a maximum area of active electrode surface. Furthermore, by reason of this construction, the cell structure may be made lighter because of the fact that the pressure on the parts is equal circumferentially, about the cell. In a long flat cell, braces or struts must be provided to prevent the bulging of the cathode and the diaphragm. On the other hand, where the cathode is made in the form of a cylinder, with the diaphragm inserted in place, it may be made relatively thin and yet successfully resist the pressure of the electrolyte. Another advantage that is gained by this construction is that the anode, which is necessarily cylindrical, may be made in one piece; in fact, being tubular, so that, after having been used for some time, it may be reversed end for end. By making the anode of one integral piece, its active life is materially increased, since there are no cracks and crevices facilitating disintegration and its cost of construction is materially reduced. In construction, the anode may be approximately 44 inches long, 9 inches in external diameter, and 5 inches in internal diameter. The cathode may be approximately 21 inches in height and 11 inches in diameter. As stated, an earthenware or metal tank or container may be used for receiving the cathode and to provide the cathode chamber in which the hydrogen is liberated. This container may have an internal diameter of approximately 13 inches. With a cell of these dimensions, a current may be employed of approximately 600 amperes and the voltage would range from 3.8 to 4.5 according to the condition of the diaphragm. The cell, as herein disclosed, is cheap in construction, and practically all of the parts are standard and may be purchased in the open market.

To facilitate the flaring of the diaphragm, it may be treated with paraffin or other non-conducting impregnating material. In the event that the cathode is provided with a lower end spaced from the bottom of the container, the anode will rest thereon, as shown in Fig. 2, and, in such event, the freeboard section, the cathode and the anode may be bodily removed from the container.

The freeboard section, above the joint connecting it with the cathode, affords space for receiving a column of the electrolyte to increase the hydrostatic head when the diaphragm becomes more or less clogged with impurities, the remainder of the space above the level of the electrolyte being filled with chlorin.

Having thus explained the nature of our said invention and described a way of making and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, what we claim is:—

1. An electrolytic cell comprising a cylindrical cathode, a cylindrical diaphragm covering the inner active face of the cathode, and a cylindrical tubular anode occupying the space within the cathode and diaphragm.
2. An electrolytic cell comprising a tank or container, a freeboard section resting thereon, a cathode connected at its upper end by a liquid-tight joint to the lower end of the freeboard section and located within the

container, an anode within said cathode, and a porous diaphragm covering the inner active face of the cathode.

3. An electrolytic cell comprising a tank or container, a cylindrical freeboard section resting on the top of the tank or container, and having a perforated cathode connected to the lower end thereof to extend down into the tank or container, an anode occupying the space within the cathode, and a porous diaphragm covering the active face of the cathode.

4. An electrolytic cell comprising a tank or container, a cylindrical freeboard section resting on the top of the tank or container, and having a cylindrical perforated cathode connected to its lower end by a liquid-tight joint and extending down into the container, a cylindrical anode occupying the space within the cathode, and a diaphragm covering the active face of the cathode.

5. An electrolytic cell comprising a tank or container, a cylindrical freeboard section resting on the top of the tank or container, and having a cylindrical perforated cathode connected to its lower end by a liquid-tight joint and extending down into the container, a cylindrical anode occupying the space within the cathode, a diaphragm covering the active face of the cathode, and insulators supporting the lower end of the anode.

6. An electrolytic cell comprising a cylindrical cathode, a cylindrical diaphragm covering the inner active face of the cathode, and a cylindrical tubular anode occupying the space within the cathode and diaphragm, and having apertures extending transversely therethrough.

7. An electrolytic cell comprising a tank or container, a freeboard section supported thereon, a perforated metal cathode within the container and having an out-turned flange at its upper end, and clamping means securing the flange to the lower end of the freeboard section.

8. An electrolytic cell comprising a tank or container, a freeboard section supported thereon, a perforated metal cathode within the container and having an out-turned flange at its upper end, a clamping member resting on the tank to receive the freeboard section, said flange being located between said clamping member and the lower end of the freeboard section, and bolts for clamping said member, said flange and said freeboard section together.

9. An electrolytic cell comprising a tank or container, a freeboard section supported thereon, a perforated metal cathode within the container and having an out-turned flange at its upper end, a porous diaphragm lining the perforated cathode, and having a flaring upper end overlapping the said flange, and a clamping member interposed

between the tank and the freeboard section and clamping the said flange and the overlapping diaphragm to the freeboard section to form a liquid-tight joint between the cathode and the freeboard section.

10. An electrolytic cell comprising a tank or container, a freeboard section supported thereon, a perforated metal cathode within the container and having an out-turned flange at its upper end, a porous diaphragm lining the cathode and having its upper end out-turned to overlap the said flange, clamping members at the upper and lower ends of the freeboard section and bolts connecting said members, the lower member clamping said flange and the overlapping diaphragm to the lower end of the freeboard section to form a liquid-tight joint.

11. An electrolytic cell comprising a container consisting of a vertical wall and a bottom, a member resting upon the upper end of the container, a tubular freeboard section superposed on said member, a tubular perforated metal cathode having a flange clamped between said freeboard section and said member, a porous diaphragm lining the active face of said cathode, and an anode occupying the space within the cathode and projecting upwardly into the interior of the freeboard section.

12. An electrolytic cell comprising a cylindrical tubular perforated sheet-metal cathode, a porous diaphragm lining the cathode, a tubular cylindrical anode occupying the space in the anode, a tubular cylindrical freeboard section extending above the cathode, and a container surrounding the cathode and forming a cathode chamber.

13. An electrolytic cell comprising a cylindrical tubular perforated sheet-metal cathode, a porous diaphragm lining the cathode, a tubular cylindrical freeboard section extending above the cathode, a tubular cylindrical anode occupying the space in the cathode and extending through the freeboard section, and a container on which the freeboard section is supported and which incloses the cathode to form a cathode chamber.

14. An electrolytic cell comprising a cylindrical tubular perforated sheet-metal cathode, a porous diaphragm lining the cathode, a tubular cylindrical freeboard section extending above the cathode, and a tubular cylindrical anode within the cathode, having its lower end elevated and having means for the passage of electrolyte to the bore thereof.

15. An electrolytic cell comprising a tubular freeboard section adapted to contain a column of electrolyte and to receive the gas liberated at the active surface of the anode, a cover for said section, a tubular perforated sheet-metal cathode having an out-turned flange at its upper end, a porous diaphragm

covering the inner active face of the cathode, a member on which the freeboard section rests and by which the out-turned flange of the cathode is clamped to the freeboard section, an anode within the cathode, and a container on which the said member rests and forming a chamber around the cathode.

16. An electrolytic cell comprising a tubular freeboard section adapted to contain a column of electrolyte and to receive the gas liberated at the active surface of the anode, a cover for said section, a tubular perforated sheet-metal cathode below said freeboard section, a porous diaphragm covering the inner active face of the cathode, a container inclosing the cathode and constituting a cathode chamber, an anode extending through the freeboard section into the cathode, and insulators supporting the lower end of the cathode.

17. An electrolytic cell comprising a tubular freeboard section adapted to contain a column of electrolyte and to receive the gas liberated at the active surface of the anode, a cover for said section, a tubular perforated sheet-metal cathode below said freeboard section, a porous diaphragm covering the inner active face of the cathode, a container inclosing the cathode and constituting a cathode chamber, an anode extending through the freeboard section into the cathode, and insulators supporting the lower end of the cathode, said anode being tubular and having transverse openings therethrough for the circulation of the electrolyte.

In testimony whereof we have affixed our signatures.

EDWARD A. ALLEN.
HERBERT I. ALLEN.