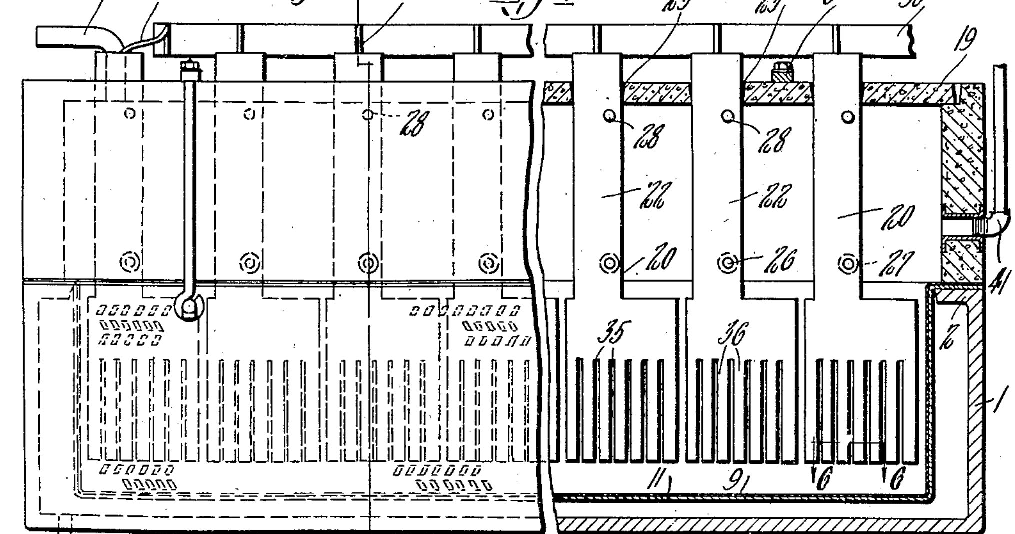
March 31, 1931. H. I. ALLEN ET AL 1,798,575

ELECTROLYTIC CELL

Filed July 3, 1926

Fig. 1.



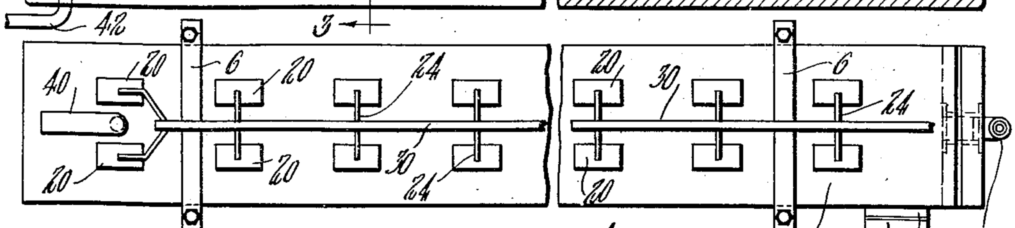


Fig. 2.

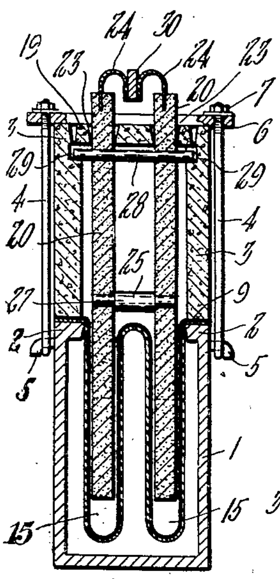


Fig. 3.

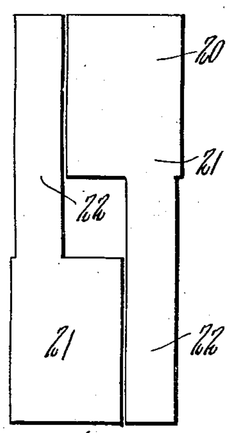


Fig. 4.

Fig. 6.

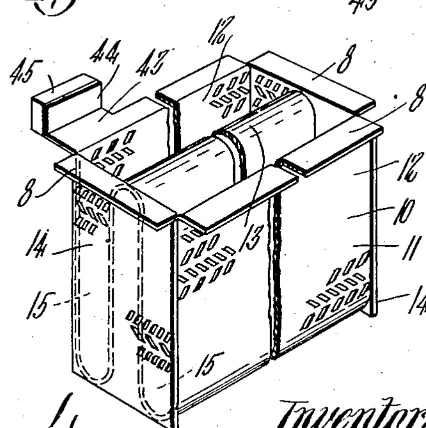


Fig. 5.

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UNITED STATES PATENT OFFICE

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ELECTROLYTIC CELL

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This invention relates to electrolytic cells, more particularly to the so-called non-submerged cathode and diaphragm type such as are used for the decomposition of brine in the formation of caustic soda.

One of the objects of this invention is to increase the efficiency and capacity of the cell. By increasing the capacity, less floor space is required for the same output, thus decreasing the cost of construction of the building for housing the cells and of the cell equipment for a given capacity.

The increase in efficiency and output capacity of the cell is produced to a large extent by so forming the cell that an increased proportion of total anode area is rendered effective, and by so forming the anode that flow of current is facilitated.

To provide increased active anode area, the cathode, formed as a box of foraminous metal such as iron, is so shaped as to present a plaited surface between adjacent stretches of which the anodes are positioned. Thus each anode has positioned portions of the cathode closely adjacent thereto on opposite sides so that both sides of the anode are active, and the plaiting of the cathode permits a larger active proportion of total anode area to be used for each cell.

To increase the effectiveness of the anodes to a further extent, they are so formed as to present a considerably increased length of edge portions.

For a more complete understanding of this invention, reference may be had to the accompanying drawings in which

Figure 1 is a somewhat diagrammatic view partly in side elevation and partly in vertical section through a cell embodying this invention.

Figure 2 is a top plan view.

Figure 3 is a transverse vertical section on line 3—3 of Figure 1.

Figure 4 is a diagrammatic view illustrating the manner of cutting a pair of anodes.

Figure 5 is a perspective of the cathode basket.

Figure 6 is a detail section on line 6—6 of Figure 1.

Referring to these drawings, at 1 is indicated a tank of suitable construction such as iron and having an inturned marginal flange 2 on its upper edge on which is supported the freeboard section 3. This freeboard section is preferably formed of concrete and is clamped to the tank by any suitable means, such, for example, as the tie bolts 4, having looped lower extremities engaging about hooks 5 extending from the outer face of the tank and having their upper ends threaded and extended through bars 6 resting on the upper face of the freeboard section, nuts 7 being shown as threaded on the upper ends of the tie bolts above the bars.

Interposed between the tank and the freeboard section at the joint are the out-turned flanges 8 of the cathode which are overlaid by the upper ends of a porous diaphragm 9 of asbestos paper or like material, the flange 8 and the diaphragm being so clamped between the freeboard section and the tank as to produce a liquid and gas tight joint therebetween.

As shown more particularly in Figure 5, the cathode 10 comprises a foraminous plate 11 bent into vertically plaited form having opposite sides 12 and a reentrant loop portion 13. Bridging the edges of the plate 11 are end plates 14, which are fixed to the edges of the plate 11, as by spot welding at intervals so as to produce a general box shaped foraminous tank having two compartments 15 separated from each other by the upwardly looped portion 13 formed by the plaiting of the sheet. The interior of each of these compartments is lined with an asbestos diaphragm overlying the plate 11 and the upper edges of the diaphragm being clamped between the cathode and the freeboard sections as previously described. The sides, ends and bottom are each electrically active.

Within each of the compartments 15, which contain electrolyte, are suspended anodes 20, there being two series of anodes as shown more particularly in Figures 1 and 3. Each of the anodes comprises a lower substantially rectangular portion 21 having integrally therewith and eccentrically or otherwise disposed relative thereto a lead member 22 which extends through the free-

board section and through openings 23 suitably spaced through the cover 19 which may if desired be formed of concrete similar to the side and end walls of the freeboard section.

By forming the leads 22 eccentric to the longitudinal axis of portion 21 the anodes can be cut from plates of graphite or other suitable material in a manner shown in Figure 4, the plates being of combined widths no greater than the width of the portions 21 and 22. By this means there is little waste in cutting the anodes from the material. The upper edge of the rectangular portion 21 is positioned slightly below the joint between the tank and freeboard section in order that during the normal operation of the cell the level of the electrolyte is above it. This permits circulation of the electrolyte beneath the lower edge of each anode and over the upper edge adjacent to the lead member 22. As shown, oppositely positioned anodes extending into the two compartments 15 are fixed together in suitably spaced relation by spacing elements 25, each having reduced extremities extending into perforations in the lead members as at 26 and a central enlarged portion 27 which acts to space the anodes apart. The anodes are supported from opposite side walls of the freeboard section by means of pins 28 extending through each anode of each opposed pair and resting in suitable recesses 29 in the inner face of the freeboard wall 3. These anode lead portions extend through the openings 23 of the cover and are connected to a bus bar 30 extending along the top of the cell as by means of the conductors 24. It will be noted that the pins 28 pass eccentrically through the anode lead portions, this being for the purpose of permitting a proper balance of the anodes so that they tend to take a substantially vertical position, the pins 28 passing through the anodes substantially above their gravity axes when they are vertical.

To further facilitate the passage of current from the anodes they are preferably formed to present a multiplicity of corners, it being well known that an edge or a point facilitates the discharge of current from a conductor. For this purpose the body portions 21 of the anodes are shown as cut upwardly as by means of a saw to form a series of closely spaced kerfs 35 to divide the major portion of the active anode into a series of relatively narrow bars 36 as shown more particularly in Figure 6. In operation the edges 37 defined by the kerfs 35 are subject to active current emission and gradually become wasted away so that the portions 36 take a general oval form as shown in the dotted lines at 38 in Figure 6. These oval portions however are still more efficient in permitting the discharge of current than a flat plate would be. While anodes might be made in small slabs to obtain an extensive edge length, this would require fabrication and would be more expensive than forming kerfs in anodes of substantial size. At 40 is shown a gas escape and at 41 is shown a supply pipe through which brine may be passed into the cell. The central compartment formed within the looped portion 15 and the side compartments between the compartments 15 and the tank 1 are free from electrolyte, but receive the effluent from the anode compartments and the gas liberated at the cathode. The effluent may be led off from the cell after passing through the diaphragm and the cathode through the pipe 42.

Particularly when this cell is used for electrolysis of brine to form caustic soda, hydrogen and chlorine, the top of the central compartment formed between the sides of the central plait and looped portion 13 and covered by the diaphragm should be below the out-turned cathode flanges 8, as shown in Figure 3, so that the hydrogen accumulating in the central compartment may flow freely through the foraminous end walls thereof and be taken off from the cell outwardly of the cathode. Thus the cathode compartment in which the hydrogen accumulates has its highest part along the exterior wall in direct communication with the exit (not shown) always provided at the top of the tank just below the cathode flanges in cells of the freeboard type. Hydrogen being a very light, tenuous gas, is difficult to confine and handle and if, for example, the top of the central cathode compartment formed by the plating of the cathode were higher than the side compartments, hydrogen would tend to accumulate from the outer compartment in this inner compartment and exert an upward pressure, which would result in hydrogen passing through the diaphragm and through the superimposed electrolyte into the anode chamber where it might mix in explosive proportions with the chlorine. The increased hydrostatic head over the top of the middle cathode compartment also aids to prevent the escape of hydrogen into the freeboard section. Moreover, it is exceedingly important inasmuch as substantially half of the hydrogen produced by the cell is collected in this central compartment that there be absolutely free communication between this central cathode compartment and the two outer cathode compartments to prevent the trapping of hydrogen. It is also important that the central compartment between the anode compartments be open at its lower end or bottom so as to permit free escape therefrom of the effluent from the anode compartments. This prevents the return of the effluent to the anode compartments which would contaminate the electrolyte and cause side reactions with resultant loss in cell efficiency, im-

purity of reaction products, and shortened life of the anodes.

While as shown the cathode is plaited to provide a pair of compartments 15 which are positioned so as to extend lengthwise of the cell, it should be evident that if desired there might be a sufficient number of plaits to produce more compartments and also that they might be positioned laterally rather than longitudinally of the cell. Current connections may be made to the cathode by any suitable means, but as shown in Figure 5 a portion of one of the flanges 8 has been extended as at 43, its outer end being upwardly turned as at 44 and fixed to the bus bar 45.

An embodiment of this invention having thus been described, it should be evident to those skilled in the art that many other changes and modifications might be made therein without departing from the spirit or scope of the invention as defined by the appended claims.

We claim:

1. An electrolytic cell comprising a tank, a cathode comprising a foraminous sheet formed vertically in plaits and having end flanges resting on the walls of said tank, plates of foraminous material bridging the ends of said plaits and fixed thereto, a freeboard section supported on said tank, and rows of anodes supported by said freeboard section and depending between the plaits of said sheet, said plaits forming a chamber between said anodes open at its bottom.

2. In a divice of the class described, a cathode comprising a box having electrically active foraminous sides, ends, and bottom, said sides and ends forming a substantially rectangular frame, and said bottom being plaited to form with said sides and ends a plurality of compartments open alternately at top and bottom, the edges of said bottom between said sides being fixed to the inner faces of said ends.

3. In a device of the class described, a cathode comprising a box having electrically active foraminous sides, ends, and bottom, each of said ends being rectangular and said sides and bottom being formed of a single sheet plaited to form with said ends a plurality of compartments open alternately at top and bottom, the edges of said sheet engaging and being fixed to the inner faces of said ends, and an anode between adjacent faces of each plait in each of said compartments open at its top, said anodes being in operative relation to said sides, ends and cathode bottom.

4. In a device of the class described, a cathode comprising electrically active foraminous sides, ends and a bottom, said bottom being plaited and having its edges secured to the inner faces of said ends and forming with said ends and sides a plurality of compartments open alternately at top and bottom.

5. In a device of the class described, a cathode comprising a box having electrically active foraminous sides, ends and bottom, said bottom being plaited to form with said sides and ends a pair of side compartments having open tops and a central compartment having a closed top, said central compartment being open through said ends for the free passage of gaseous products of electrolysis.

6. In a device of the class described, a cathode comprising a box having electrically active foraminous sides, ends and bottom, said bottom being plaited to form with said sides and ends a pair of side compartments having open tops and a central compartment having a closed top, said central compartment having perforations distributed over substantially its entire end areas for the free passage of gaseous products of electrolysis.

7. A device of the class described comprising a container, a cathode suspended in said container and comprising two spaced apart parallel electrolyte containing chambers, a diaphragm lining each chamber, the four sides and bottom of each chamber being active, a chamber free from electrolyte located between the electrolyte chambers, and anodes extending into said electrolyte chambers, said chamber free from electrolyte having end openings for the free escape of gaseous products of electrolysis therefrom.

8. An electrolytic cell comprising a container, a cathode suspended therein, said cathode comprising two spaced apart electrolyte-containing chambers, anodes in said chambers, and chambers free from electrolyte outwardly of said cathode and between said electrolyte-containing chambers, said last mentioned chambers being closed at their tops, the top end of said chamber between said electrolyte-containing chambers being below the tops of said outwardly positioned chambers, and said chambers free from electrolyte being in free communication with each other for the passage of products of electrolysis.

9. In a device of the class described, a cathode comprisng a box having electrically active foraminous sides, ends and bottom, said sides and ends forming a substantially rectangular frame, said bottom being plaited to form with said sides and ends a pair of anode compartments for the reception of electrolyte spaced by a compartment free from electrolyte, said bottom being fixed to said end walls which provide free exit from said spacing compartment through the openings in said end walls for the products of electrolysis entering said spacing compartment, and a diaphragm lining said anode compartments, and extending over said spacing compartment.

10. In a device of the class described, a cathode comprising a box having electrically

active foraminous sides, ends and bottom, said sides and ends forming a substantially rectangular frame, said bottom being plaited to form with said sides and ends a pair of anode compartments for the reception of electrolyte spaced by a compartment free from electrolyte, said bottom being fixed to said end walls which provide free exit from said spacing compartment through the openings in said end walls for the products of electrolysis entering said spacing compartment, and a diaphragm lining said anode compartments, and extending over said spacing compartment, said spacing compartment having an open bottom and its top being below the top of said cathode.

In testimony whereof we have affixed our signatures.

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