May 13, 1952 G. T. MEIKLEJOHN 2,596,583

ELECTROLYTIC CELL

Filed April 12, 1948 2 SHEETS--SHEET 1

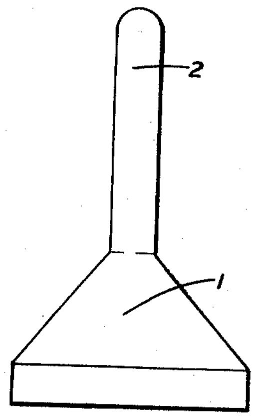


FIG. 1.

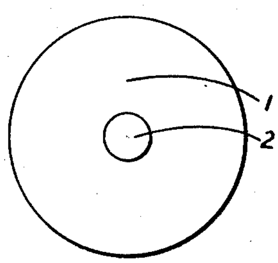
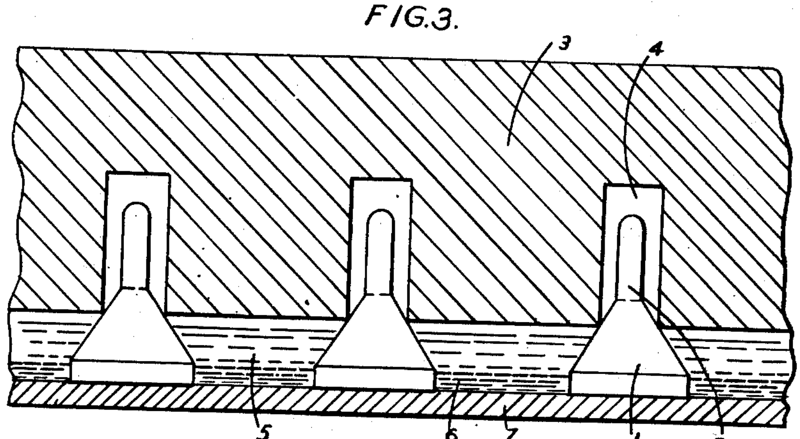


FIG. 2.

FIG. 3.



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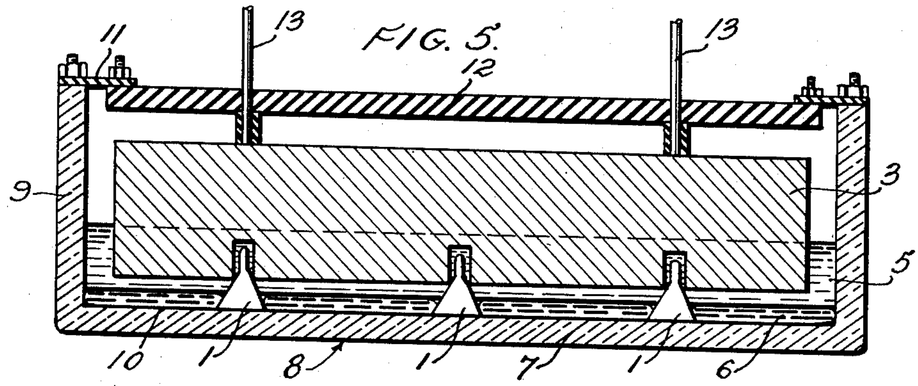

FIG. 5.

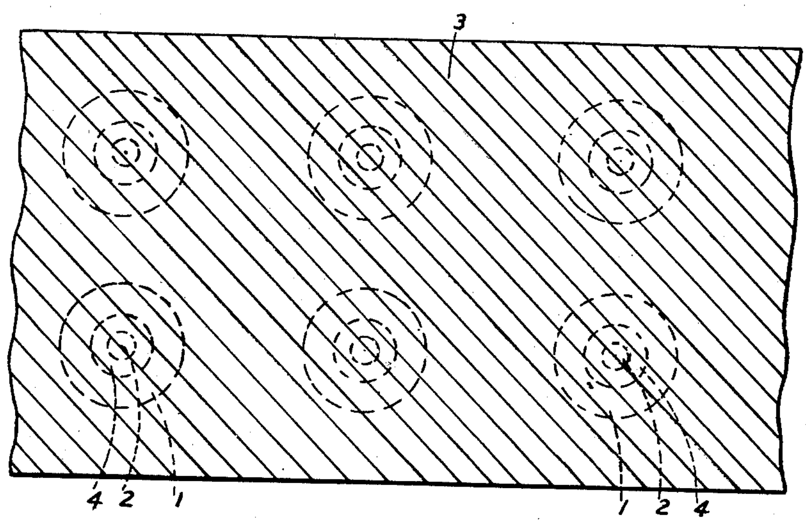

FIG. 4.

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UNITED STATES PATENT OFFICE

2,596,583

ELECTROLYTIC CELL

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Application April 12, 1948, Serial No. 20,564
In Great Britain April 21, 1947

5 Claims. (Cl. 204—219)

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This invention relates to means of obtaining automatic and continuous adjustment of the inter-electrode space in electrolytic cells and includes electrolytic cells of the flowing mercury cathode type comprising the said adjustment means.

It is well-known that the graphite anodes in flowing mercury cathode cells for the electrolysis of solutions of alkali metal salts undergo a progressive disintegration or wear during the electrolytic process, this wear being due to several physical and chemical causes the nature of which is imperfectly understood. The progressive disintegration of the anode, occurring principally at the surface of that electrode which faces the mercury cathode, has the important consequence that the space between the electrodes of the cell is enlarged with the result that, the path to be traversed by the current being increased, the efficiency of the cell is decreased. In order to maintain the cell in efficient operation, the inter-electrode space must be constantly adjusted to a practical minimum size. A considerable number of devices have been proposed for effecting the periodic adjustment of the inter-electrode space in electrolytic cells. In an early form of cell, not of the flowing mercury cathode type, which is described in United States Patent No. 468,880, the inter-electrode space is periodically adjustable, to compensate for anode disintegration, by a screw and pillar arrangement which enables manual adjustment of the position of the anode relative to the cathode to be made while the gas-tightness of the cell is maintained by means of a liquid lute. Again, in United States Patent No. 2,104,678 there is described a means of adjusting anode height in a flowing mercury cathode cell, which means comprise a series of layers of fibrous material, located between the cover, to which the anodes are fixed, and the upper edges of the sides of the lower part of the cell; progressive periodic removal of layers of this fibrous material permitting the lowering of the anode. In United States Patent No. 2,323,665 a means of adjustment is described which comprises a vertically adjustable clamp on the supporting rod of the anode above the cell cover and an open-sided laterally removable spacer or shim located between the cover and a clamp supporting the said clamp, gas-tightness of the cell being maintained by a vertically adjustable sealing means between the cell cover and the anode supporting rod. French Patent No. 899,026 describes yet another means by which the anode height above the mercury cathode is adjusted, the said means comprising a framework carrying the anodes within the cell, the framework having its position determined by the manipulation of screws above the cell cover. In a type of cell briefly noticed at pages eleven and fourteen of Report No. 816 of Field Information Agency Technical United States Group Control Council for Germany entitled "Horizontal Mercury Chlorine Cell, I. C. Farbenindustrie, A. G." and reported to have been in use at Gendorf, the position of the anodes in a flowing cathode mercury cell is adjustable by means of the supporting conductor rods carrying the anodes, the said rods passing through resilient sleeves in apertures in the cell cover. Further, in the beforementioned Gendorf cell, the clearance between the mercury cathode and the graphite anode is prevented from becoming less than a predetermined minimum by means of a series of flat-heated glass pegs resting on the cell bottom and having stems which protrude into vertical holes cut in the anode. The flat-headed spacer pegs aforesaid do not carry the weight of the cell anodes, but are limited in function solely to ensuring that the anode-cathode gap is not inadvertently closed during anode height adjustment and that the gap is readily restored to its predetermined size after the periodic alterations of anode height necessitated as a result of anode wear. All the foregoing means of anode adjustment have the associated disadvantage that the adjustment is made periodically and not continuously so that the electrolytic cell operates with an average inter-electrode space greater than the minimum practical one, with the consequence that the maximum practical efficiency of the cell cannot be realised. Further, except in the case of the German cell last mentioned, no precision of adjustment is possible. Finally, in none of the devices referred to in the foregoing is the adjusting means automatic in its operation.

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Objects of the present invention are to overcome the disadvantages of intermittent adjustment of the inter-electrode space and lack of precision in the said adjustment, and to effect continuously and automatically the regulation of the height of the anode above the mercury cathode.

I have found that the adjustment of the inter-electrode space in a flowing cathode type mercury cell may be effected automatically and in a very convenient manner, without interfering in any way with the continuity of the electrolytic process, by making use of an electrode assembly comprising a mass of electrically conducting material, normally graphite, substantially supported within the cell by means of a series of relatively small bodies made of insulating material and resting on the bottom of the cell and so shaped as to make edge-surface contact only with the masses constituting the supporting electrode, which masses are modified in shape so that such edge-surface contact may be effected. The small supporting bodies aforesaid are made of a material selected from the class consisting of ebonite, glass, glazed porcelain, granite and synthetic resin.

In a preferred form of my invention cylindrical holes penetrate the anodes vertically and the small supporting bodies are pegs having upwardly directed central stems of circular section two-fifths of the diameter of the said holes into which they penetrate and bases in the form of truncated cones the sloping sides of which make an angle of not less than 30° at their edge of contact with the under-surface of the anode masses at the peripheries of the holes therein. The axes of the supporting bodies are perpendicular to the plane undersurface of the electrode. Further, the dimensions of the peg bases are so chosen that the apical angle of the entire cone is approximately 120°. Preferably the apical angle of the conical bodies is not less than 40° and not greater than 140°. The peg base in this preferred form of my invention may be modified so that its walls are vertical for a height of, say, one eighth of an inch from the bottom. Other modifications of supporting body bases will be described in what follows. The anode assembly just described may be used in a cell of the flowing mercury cathode type suitable for the electrolysis of solutions of alkali metal chlorides and in which anodes of graphite are rigidly fixed to the cover, a flexible jointing or a lute of any convenient type between the cover and the lower part of the cell ensuring the gas-tightness of the apparatus and permitting the cell cover together with the anodes to move downwards under gravity, at such a rate that, as anode wear proceeds, the inter-electrode space is maintained approximately constant. After extensive experiments I have found that, when contact other than edge-surface contact exists between the supporting bodies and the anodes, e. g. if the pegs have cylindrical heads making surface-surface contacts with the anodes, irregular anode wear takes place. The angle between the sloping side of the supporting body and the under-surface of the anode in the form of the invention just mentioned and in the form about to be described, is not sharply critical; I have found, however, that any wide departure from a value of 30° for the contact angle results in the appearance of irregular anode wear near the edge of contact between the anode and the supporting body.

In another form of the invention the small supporting bodies are in the form of wedges of triangular section and long in relation to their width upon one edge of which wedges the plane under-face of the anode rests; alternatively, the anode masses may be provided with rectangular slots into each of which a portion of a supporting wedge protrudes in such a way that the perimeter of the slot makes edge-surface contact with the sloping sides of the wedge.

In yet another realisation of the invention the anode masses are not rigidly fixed to the cell cover but are connected by means of flexible conductors to conductor rods passing through the cell cover, which cover is rigidly secured to the lower part of the cell.

I have observed that when I employ my invention using cones, truncated cones or truncated cones with upwardly extending central stems (pegs), in all of which a circular base rests on the cell bottom, there is a slight tendency, especially when the said cell bottom is ebonite lined, for the mercury to break on the downstream side of the circular bases of the anode-supporting bodies, with consequent exposure of the lining to the action of the chlorine dissolved in the electrolyte. When the cell bottom is of steel the foregoing effect is practically absent. In order to prevent exposure of the cell bottom by the streaming of the mercury round the bases of the anode-supporting bodies, the base of each supporting body may be modified either by shaping it to conform with the convergent streaming lines of the flowing mercury cathode round it, or by providing a channel or channels under it so that the mercury may flow through the base which is maintained circular in form. In the latter modification of the supporting body base the channel or channels under the said base are set in the direction of flow of the mercury cathode.

In the case of wedge-shaped bodies the bases thereof may be boat-shaped in order to permit the smooth unbroken flow of the cathodic mercury round them.

The accompanying drawings illustrate diagrammatically and by way of example embodiments of the invention.

In the said drawings:

Fig. 1 is a side elevation of one form of anode-supporting body.

Figure 2 is a top view of the supporting body shown in Figure 1.

Figure 3 is a vertical section showing the anode-supporting bodies of the form shown in Fig. 1 in situ in the anode holes and resting on a cell bottom.

Fig. 4 is a view from above of the assembly shown in Fig. 3.

Figure 5 is a side sectional view showing an electrolytic cell incorporating the anode supporting members of this invention.

In the figures similar parts bear similar reference numbers.

Referring now to the drawings, in Fig. 1 the base 1 of the supporting body is surmounted by the central circular stem 2 which is conveniently of the order of four times the height of the base 1.

In Fig. 2 the stem 1 of each of the supporting bodies protrudes into a cylindrical hole 4 in the anode mass 3, the bases of the supporting bodies resting on the cell bottom 7 which carries the mercury cathode 6, between which and the anode 3 flows the electrolyte 5. Fig. 3 shows one of many permissible arrangements of the cylindrical holes 4, 4 in the anode mass 3.

In Figure 5, one form of cell in which the new anode supporting bodies of this invention are used is illustrated. The cell 8 consists of a trough-shaped base 9 having a bottom 7 provided with a plane upper surface 10 which supports the flowing mercury cathode 6. Within the base 9 is the anode mass 3 supported above the mercury cathode 6 by the conical-shaped bodies 1. A flexible sealing diaphragm 11 extends between the cell cover 12 and the base 9 sealing the cell and anode conducting rods 13 extend through the cover 12 to the anode 3.

While in the foregoing I have described several embodiments of my invention, it is to be understood that various modifications falling within the scope of the appended claims will be evident to those skilled in the art.

I claim:

1. In an electrolytic cell for the electrolysis of solutions of alkali metal chlorides, having a plane bottom for supporting a flowing mercury cathode and flexible sealing means between its cover and lower part, an anode assembly comprising blocks of graphite having a plane undersurface fixed to the cell cover and together therewith supported from below a short distance above said bottom by a plurality of small bodies of conical shape having an apical angle greater than 40° and less than 140° made of rigid insulating material the vertices of which protrude into cylindrical holes in the anode blocks in such a way that the peripheries of the said holes make edge-surface contact only with the sloping sides of the conically-shaped bodies.

2. In an electrolytic cell of the flowing mercury cathode type for eletrolysis of alkali metal salt solutions, having a plane surface bottom to support a base a flowing mercury cathode, a cover, flexible sealing means between the cover and the base, an anode assembly of graphite masses having a plane undersurface fixed to the cell cover and together therewith supported from beneath a short distance above said bottom by a plurality of relatively small bodies of electrically insulating material which rest on the bottom of the cell, said small bodies being in the form of truncated cones having an apical angle greater than 40° and less than 140° provided with upwardly extending central stems which extend into cylindrical holes drilled into the undersurface of said graphite masses, the peripheries of said holes resting through edge-surface contact upon the sloping sides of said cones.

3. In an electrode assembly within an electrolytic cell, a cell bottom having a plane upper surface, an electrode of an electrically conducting material having a plane under surface substantially parallel to said upper surface, a plurality of small bodies resting on the cell bottom and having the form of truncated cones having an apical angle greater than 40° and less than 140°, each cone having an upwardly directed central stem of circular section protruding into a cylindrical hole cut in said electrode, the diameter of the said stem being about two-fifths that of the diameter of the hole into which it protrudes and the longitudinal axis of said stem being in substantial alignment with the longitudinal axis of said cylindrical hole, the periphery of said holes making edge-surface contact with the sloping sides of the truncated cones in such a way that the weight of said electrode is substantially borne by the plurality of truncated conical bodies.

4. In an electrolytic cell for the electrolysis of solutions of alkali metal chlorides, a cell base having a bottom with a substantially plane upper surface, a movable cover and an anode assembly comprising blocks of graphite having plane under surfaces substantially parallel to said bottom surface rigidly fixed to said cover, said anode assembly being supported a short distance above said bottom by a plurality of small conical-shaped bodies each having one axis perpendicular to the plane of said anode under surface, said bodies being made of electrically insulating material and having an apical angle greater than 40° and less than 140° with central circular upwardly extending stems, the upper parts of said small bodies protruding into cylindrical holes in said anode blocks in such a way that the peripheries of said holes make edge-surface contact only with the sloping sides of said small bodies, said bodies resting upon said cell bottom.

5. An electrolytic cell comprising a cell base having a bottom with a plane upper surface, a plurality of small conical-shaped bodies of rigid insulating material in which the sloping sides of the bodies make an angle of between 40 and 140° with one another at their point of convergence and an electrode of electrically conducting material having a plane under surface perpendicular to the axes of said small bodies, cylindrical holes extending into said electrode from the under surface thereof, the upper part of said small bodies protruding into said cylindrical holes with the peripheries of the holes in edge-surface contact with the sloping sides of said bodies, said bodies resting on the bottom of the cell so that these bodies bear substantially the entire weight of the electrode and support the electrode with the under surface thereof substantially parallel to the upper surface of said cell bottom.

GEORGE TURNER MEIKLEJOHN.

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The following references are of record in the file of this patent:

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