VERTICAL MERCURY CATHODE CELL

Filed Sept. 16, 1966

FIG. 1

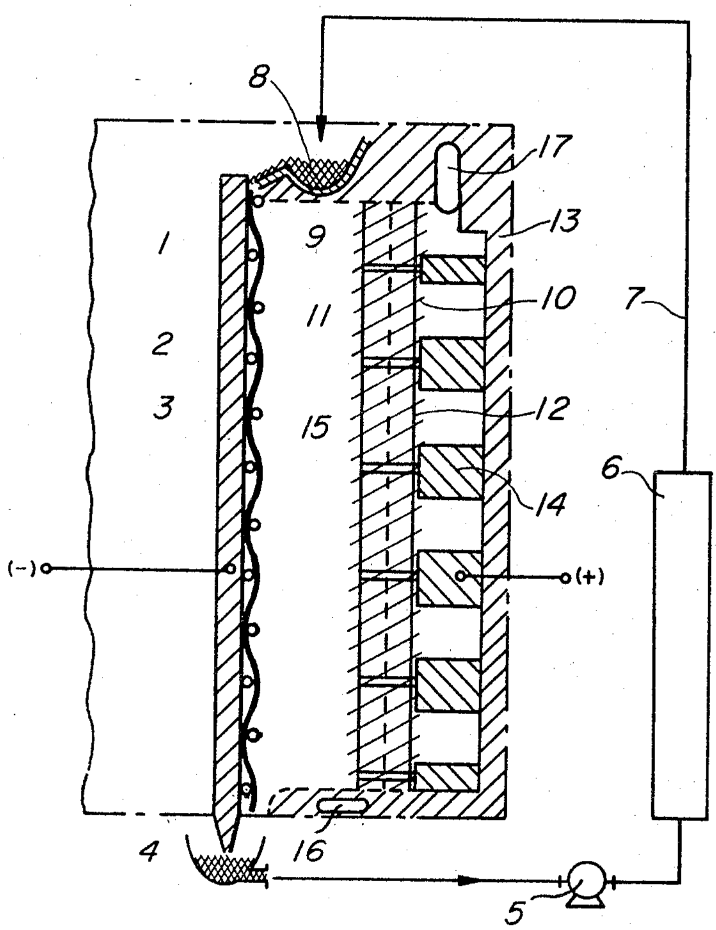


FIG. 2

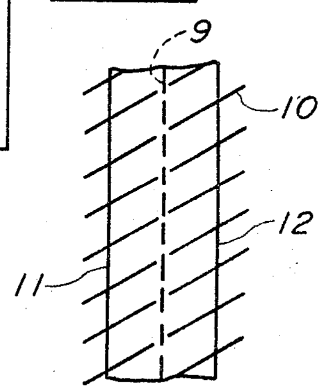
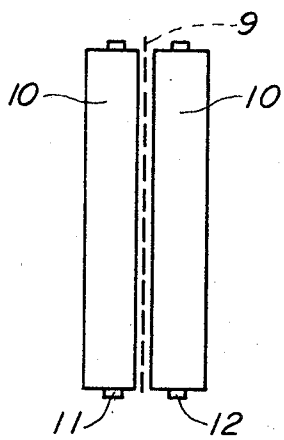


FIG. 3



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United States Patent Office 3,449,234
Patented June 10, 1969

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3,449,234
VERTICAL MERCURY CATHODE CELL

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Filed Sept. 16, 1966, Ser. No. 579,944
Claims priority, application Germany, Sept. 25, 1965, B 83,887
Int. Cl. C22d 1/04
U.S. Cl. 204—220 5 Claims

This invention relates to an electrolytic cell without diaphragms and having vertical mercury cathodes for the decomposition of alkali metal chlorides by the amalgam method and relates particularly to an anode for such an electrolytic cell.

Two types of cell for the electrolytic decomposition of alkali metal chlorides by the amalgam method using a mercury electrode as the cathode are known in which the mercury cathode is arranged either horizontally or vertically. In the development of these electrolytic cells, attention has hitherto been directed chiefly to cells having horizontal mercury cathodes. This is because a flat mercury surface having large dimensions is easier to make, readjustment of the graphite anode is easier and the mercury can be recycled by less elaborate means in this type of cell. Vertical cells have the advantage of requiring less space, but they have some other disadvantages which have hitherto prevented their use in practice. The mercury flows along the cathode too quickly so that it does not have sufficient time to react to form alkali metal amalgam of the desired concentration. Furthermore the mercury tends to become detached from the cathode walls in the form of drops instead of flowing down the cathode walls in a thin film. This mercury, which is present in the drops in depolarized form, is attacked by chlorine however so that loss of mercury is extremely high in this type of cell. Moreover the rate at which the mercury falls increases greatly with increasing height of the cell, so that cells having vertical electrodes can only be built to a certain height.

Cells having mercury cathodes have become known in which this disadvantage is partly avoided. In these cells a lamellar member serving as a cathode support is provided vertically. The surfaces of this member, down which the mercury is allowed to flow, are provided with a screen of electrically insulating material which retards the rate of flow of the mercury and also prevents the mercury from becoming detached from the wall in the form of doplets as it flows downward. The anode material, which is a packing in the form of lumps between the cathode support and the wall of the cell casing, is also separated from the cathode support by the said screen. The lumps of graphite, which wear away during operation of the cell, have to be replenished continually by the supply of fresh material. Another disadvantage of these cells is that the chlorine developed at the lumps of graphite rises along the lumps and is withdrawn from the cell together with the exhausted brine. The ascending gas decreases the free cross-section of the electrolyte and interrupts the flow of current between the cathode and the anode.

It is also known that corrosion-resistant metals which are not attacked by chlorine, for example platinum, titanium, niobium, tantalum, zirconium and their alloys, may be used instead of graphite for the anode in horizontal cells.

The object of the present invention is to provide chlorine and corrosion-resistant anodes of metals or alloys of the same for use in electrolytic cells without diaphragms and having vertical mercury cathodes for the decomposition of alkali metal chlorides by the amalgam method which are free from the said disadvantages.

Anodes in accordance with this invention consist of a fine-mesh wire cloth provided between the cathode and the cell casing and running parallel to the cathode, and baffles on both sides of the cloth extending over the whole width of the cloth, the baffles being parallel to each other and having horizontal longitudinal axes arranged one above the other so that the baffles contact the cloth with their longitudinal edges, and each two opposite baffles form a surface which is interrupted by the cloth, which surface rises toward the cell wall from the side facing the cathode.

The wire cloth and the baffles consist of a metal which is resistant to chlorine and to corrosion, particularly titanium. To increase its activity, a cloth consisting of titanium may be provided with a coating of noble metal, for example iridium or particularly platinum or an alloy thereof with other noble metals. The cloth should advantageously be of small mesh and may for example have 20 to 50 meshes per square centimeter with a wire diameter of 0.2 to 0.3 mm.

The baffles which are arranged on both sides of the wire cloth may be secured for example to the cell wall. To permit easy exchange, they are advantageously arranged in a frame inserted into the cell. There is a frame on each side of the cloth at such a distance therefrom that the baffles contact the cloth over their entire longitudinal edge and press against a corresponding baffle on the other side of the cloth, so that each pair of baffles forms a practically coherent surface through which the cloth is passed. The width of the baffles may be about 0.3 to 1.0 cm., especially 0.5 cm. The spacing of the baffles arranged one above another may be 0.3 to 2.0 cm. and is advantageously about 0.5 to 1 cm. According to another feature of the invention the baffles are so arranged that each surface formed by two baffles slopes up from the cathode to the cell wall, the angle from the horizontal being about 30° to 60°.

The alkali metal chloride solution is introduced into the lower part of a cell provided with the anode in accordance with this invention, the point of introduction being between the cathode and the wire cloth, and flows upward. Chlorine is developed at the cloth forming the anode and is forced through the cloth together with the exhausted salt solution by the entering fresh salt solution. Gas and salt solution flow upward between the cloth and the cell wall and are withdrawn at the top of the cell.

With the anodes according to this invention, the free electrolyte cross-section between the cathode and anode is not decreased anywhere by the gas formed and interruption of the flow of current between the two electrodes is therefore avoided.

A cell provided with an anode in accordance with this invention is shown diagrammatically in the accompanying drawings in which FIGURE 1 is a longitudinal section through such a cell, FIGURE 2 is a longitudinal section of a part of the anode on an enlarged scale, and FIGURE 3 is a transverse section through the anode. The same parts are indicated in the figures by the same reference numerals.

1 is the cathode support (which may be made for example of iron), **2** is mercury flowing down over the face of the cathode support facing the anode, **3** is a wire cloth of electrically insulating material, for example polyvinyl chloride, by which the rate at which the mercury flows down on the cathode is retarded. The mercury collects at the lower end of the cathode support in a channel **4** from which it is supplied by means of a pump **5** to a decomposer **6** in which the amalgam formed is decomposed by means of water to form caustic soda solution and hydrogen. The mercury leaving at **7** is supplied to a channel **8** formed as an overflow in the upper portion of the cell and is distributed over the cathode support. **9** is a fine-mesh wire cloth of material which is resistant to chlorine and to corrosion and on both sides of which pairs of contacting baffles **10** are provided. The baffles are secured to two frames **11** and **12**. A number of connections **14** arranged side by side and one above another are provided on the cell wall **13**, and the frames **11** and **12** and the wire cloth **9** are secured thereto by screws **15**. The connections **14** serve at the same time to supply current to the anode. The salt solution is supplied to the lower part of the cell through an opening **16** arranged between the anode and the cathode and flows upwardly. The chlorine developed at the anode and the exhausted salt solution is forced through the cloth by the fresh salt solution, flows up in the space between the cell wall and the cloth and is withdrawn through an opening **17** provided in the upper part of the cell.

The cell may be constructed for example so that the cathode is in the middle of the cell and an anode is provided on each side of the cathode.

I claim:

1. An electrolytic cell without diaphragms having a vertical mercury cathode for the decomposition of alkali metal chlorides by the amalgam method, and having an anode of metal resistant to chlorine and corrosion which comprises a fine-mesh wire cloth arranged between the cathode and the wall of the cell and running parallel to the cathode, baffles on both sides of the wire cloth extending over the whole width of the wire cloth, the baffles being parallel to each other and having horizontal longitudinal axes arranged one above another so that the baffles contact the wire cloth with their longitudinal edges and each two opposite baffles form a surface which is

interrupted by the wire cloth and which rises toward the cell wall from the side facing the cathode.

2. A cell as claimed in claim **1** wherein the wire cloth consists of titanium and is provided with a coating of a noble metal.

3. A cell as claimed in claim **1** wherein the wire cloth consists of titanium and is provided with a coating of a metal selected from the class consisting of platinum and its alloys with other noble metals.

4. A cell as claimed in claim **1** wherein the wire cloth has 20 to 50 meshes per square centimeter with a wire diameter of 0.2 to 0.3 millimeter.

5. A cell as claimed in claim **1** wherein said surfaces formed by two opposite baffles include an angle from the horizontal of from 30° to 60°.

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U.S. Cl. X.R.

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