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ELECTROLYTIC CELL

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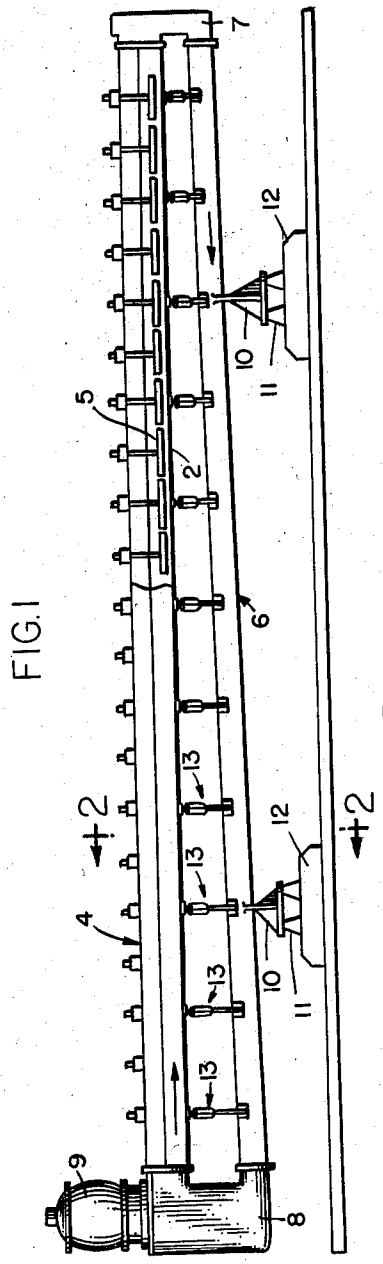


FIG. 1

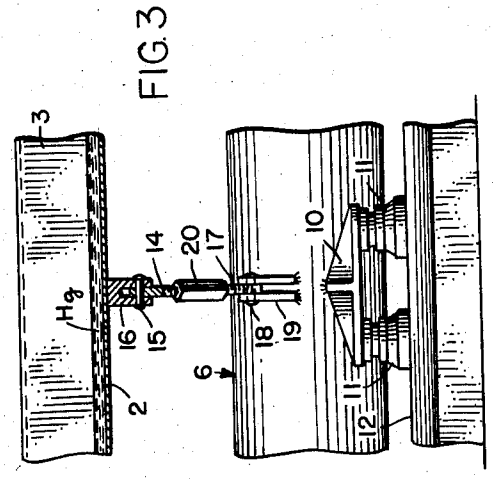


FIG. 3

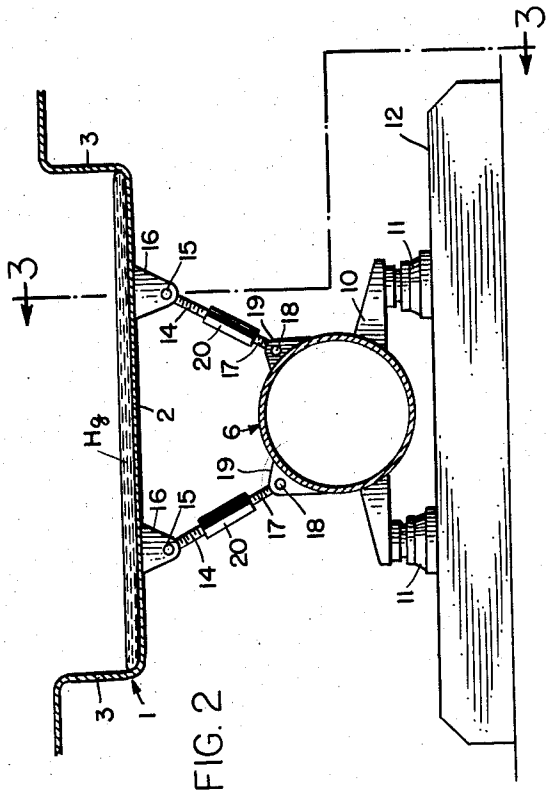


FIG. 2

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ELECTROLYTIC CELL

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5 Claims. (Cl. 204—220)

This invention relates to an electrolytic cell, and more particularly to the type of cell in which a fluid cathode is adapted to flow in an inclined trough receptacle.

Cells of this type are particularly suitable for the electrolysis of alkali chloride solutions wherein flowing mercury is used as the cathode. Such cells usually include a primary unit in which by decomposition of the electrolyte the mercury is laden with alkali metal by the formation of an amalgam, and a secondary unit, often termed the denuder, in which the alkali metal is separated from the mercury. The primary unit of such an alkali metal chloride cell with a horizontally disposed flowing mercury amalgam cathode usually consists of a lower part which is constructed as a trough to give the circulating mercury amalgam a definite guidance, and an upper part which serves as a cover for the lower part. On the bottom of the lower part or trough, which is usually provided with a slight longitudinal gradient amounting to about 2%, the mercury or amalgam flows as a thin band. This band should be spread out as thinly as possible in order to limit the amount of mercury required to a minimum, and, on the other hand, it should be spread out to the greatest possible width because the output of the electrolyzer depends on the width of the band. However, it is a prerequisite for an unobjectionable conduction of the electrolysis that the band should cover uninterruptedly the bottom of the trough, which is ordinarily constructed wholly or partly as an iron cathode, and is not disconnected or otherwise interrupted. For this reason the bottom should not exhibit any unevenness, should have a constant gradient throughout the whole length of the support viewed in the direction of flow, and should be horizontal at all points when viewed in a direction laterally perpendicular to the flow.

These conditions can be initially fulfilled without appreciable difficulty when the mercury band is not wider than about 80 centimeters and not longer than about 8 to 9 meters. A suitable cell trough for such a case consists in a known construction of a rolled iron beam having a U-shaped cross-section as in a channel beam or an I-shaped cross-section as in an I-beam, such that the web of the beam forms the bottom and the flanges form the sides of the trough. Since such rolled beams, which are mounted on two base support points, must be free from sagging and twisting and remain so, rolled sections of considerable thickness are necessary; for example, with a rolled iron beam of I-shaped cross-section having a width of 80 centimeters, the thickness of the flanges and web amounts to 30 millimeters. Apart from this, rolled beams having a width of more than 80 centimeters are not economical to produce.

For the construction of large cells, it has therefore been proposed to use flat sections welded together from sheet metal in a box-like or hollow construction. It is difficult, however, to prepare cell troughs of this type which are free from strain. The cells mounted at room temperature become distorted at the high operating temperatures, thereby seriously disrupting the uniform flow of the mercury band. Internal strains of the material caused by welding during preparation cannot subsequently be removed, particularly where the trough is lined with hard rubber. In order to avoid these difficulties which arise from the welding process during preparation, it has been proposed to make the cell trough by screwing together individual parts, for example, by screwing onto a sheet metal plate which serves as the bottom of the trough of the cell, while using rubber seals, a U-section iron frame which forms the walls of the trough. These rubber seals, which are under the pressure of the mercury, can only with difficulty be prevented from leaking at the varying temperatures at which the electrolyzer is operated.

One object of the present invention is to provide an electrolytic cell for a flowing fluid cathode in which unevenness in the surface over which the fluid is spread can be corrected.

Another object of the invention is to provide an electrolytic cell for a fluid cathode adapted to flow in an inclined trough receptacle in which unevenness in the bottom of the trough caused by stresses in the material the trough consists of, which stresses becoming effective at high operating temperatures, can be corrected even while the cell is in operation.

Another object of the invention is to provide an electrolytic cell for a fluid cathode adapted to flow in an inclined trough receptacle wherein the trough can be constructed of a single, continuous, integral sheet material which is relatively flat, thin and flexible.

Still another object of the invention is to provide an electrolytic cell for a flowing fluid cathode which is easily and economically constructed while overcoming the various disadvantages of prior cells set forth above.

These and other objects and advantages of the invention will be more clearly understood upon a consideration of the following description taken in conjunction with the accompanying drawings wherein similar reference figures are employed to designate similar parts in all of the figures, and in which:

Fig. 1 is a side elevational view, partly in cross-section, of an electrolytic cell constructed in accordance with the invention;

Fig. 2 is an enlarged cross-sectional view of the same taken on the line 2—2 of Fig. 1 with some parts omitted; and

Fig. 3 is a side view, partly in cross-section on the line 3—3 of Fig. 2.

According to the present invention, the bottom of the trough is constructed of a flat, flexible material, for example, such as can be pressed from sheet metal or made from plastic. Suitable materials for the construction of the trough include sheet iron, sheet aluminium and plastics such as polyvinylchloride and other polymers which are resistant to attacks of elevated temperatures and chemicals under the operating conditions. The thickness of the material can vary from as small as a few millimeters, where sheet iron is employed, to any desired thickness depending upon the relative flexibility of the material employed.

The bottom of the trough is arranged on a plurality of supports spaced intermediately the ends of the trough. The height of each support is individually adjustable so as to remove unevenness in the bottom which may occur, for example, during erection or in operation of the cell. The trough may therefore be formed from a unitary thin sheet of any desired size, and it is no longer necessary to have to resort to a welding method for the assembly of the trough from several individual parts, so that internal straining of the sheet and the other difficulties mentioned above cannot occur.

The variability in the height of the supports can easily be ensured by subdividing cylindrical supports, providing the two parts with screwthreads and connecting them by a threaded sleeve, thereby providing a turnbuckle supporting means. Then, by rotation of the threaded sleeve, a lengthening or shortening of the support can readily be effected at will and local unevenness, i. e. depressions or protuberances in the bottom of the trough which impair the uniform flow of the mercury band, thereby removed. These corrections can readily be carried out during operation of the cell. Instead of a turnbuckle, any other means can be used which make possible an adjustment of the height of the supports.

It is advantageous to mount all the supports on a common bearing member, e. g., a rod which is arranged in about the same vertical plane as the longitudinal axis of the trough and which is separated from the base by insulators. Also, a tube has been found to be suitable as the bearing member with the lower ends of the supports secured to the wall of the tube.

A tubular bearing member can serve at the same time with advantage as the denuder, i. e. the vessel for the regeneration of the mercury leaving the cell. In the electrolysis of alkali chloride solutions by the mercury-amalgam method, the tube would therefore be constructed as the secondary cell for the decomposition of the mercury amalgam.

Referring now to the drawings, a mercury cell for the electrolysis of an alkali chloride solution is illustrated in which a primary unit for the decomposition of the electrolyte includes a trough 1 pressed from a single sheet of iron to form a bottom 2 and sides 3. The trough bottom 2 measures about 150 centimeters in width and 1500 centimeters in length, with a thickness of 0.4 centimeter. The bottom of the trough is inclined downwardly from left to right with a gradient of about 2%. A cover 4 is provided to enclose the trough, a plurality of graphite electrodes 5 being inserted through the cover to act as the anode in the electrolytic solution contained in the trough. The cathode for the cell is mercury (Hg) which flows as a thin band on the trough bottom 2 in the direction of the arrow, i. e. from left to right in the primary unit. Current is carried from the flowing mercury cathode by the trough itself when constructed of a conducting material such as sheet iron and in the case of a non-conducting material such as a plastic or the like, by contact plates consisting of a conducting material which are local constituents of the bottom.

The secondary unit or denuder is formed as a tube 6, its axis falling in the same vertical plane as the axis of the primary unit or trough. The tube 6 is inclined from right to left so that the mercury amalgam formed in the primary unit is caused to flow in the direction of the arrow as shown. Thus, mercury flows down the trough 1 into a collecting member 7, then flows in the opposite direction through the tube 6 where the amalgam is decomposed, and the regenerated mercury is returned to the primary unit or trough by means of a pump 8 driven by a motor 9. The tube 6 is supported by brackets 10 mounted upon insulators 11 which separates the apparatus from the base pedestal 12 in order to prevent grounding of electrical current.

In order to correct unevenness in the trough bottom 2 caused by the construction or erection of the trough or by higher operating temperatures, a plurality of paired support assemblies 13 are shown in Fig. 1 to be spaced intermediately the ends of the trough. The distance between each pair of support assemblies is governed to a certain extent by the weight and flexibility of the material used in constructing the trough. In the continuous beam structure shown, a distance of about 40 centimeters was provided between each pair of supports to prevent excessive longitudinal deflection.

The pair of support assemblies 13 are connected at their top end to the trough bottom 2 and converge downwardly to be mounted upon the tube bearing member 6. Figs. 2 and 3 more clearly illustrate the construction of each pair of supports. Thus, the trough bottom 2 is attached to an upper threaded rod 14 by a free pin connection 15 in a trough connecting plate 16. A lower threaded rod 17 is secured by a free pin connection 18 in a tube connecting plate 19 on the wall of the tube bearing member 6. A threaded sleeve 20 is threadably connected to the upper and lower rods 14 and 17 to provide a turnbuckle supporting means so that rotation of the sleeve in one direction causes the supporting assembly to elongate while rotation in the opposite direction causes the supporting assembly to shorten. The trough connecting plates 16 are securely attached to the trough bottom by pins. Welding of the trough connecting plates to a sheet metal is not advisable since the deformation caused by welding would be difficult to correct. The trough connecting plates 16 are spaced inwardly from the edges of the trough and a distance provided between each plate such that excessive horizontal deflection caused by the weight and flexibility of the sheet material itself is prevented.

Prior to operation of the cell, local areas of unevenness in the bottom of the trough can be readily observed and corrected by adjusting the height of the individual supports. During operation of the cell, unevenness in the bottom of the trough can be detected by means of openings in the cover 4 (not shown in the drawings) and of periscope-like observing devices inserted in said openings, and correspondingly corrected by adjusting the height of the supports. By maintaining the even distribution of mercury over the trough bottom throughout the continuous operation of the cell, a more efficient output is provided while eliminating costly shutdowns.

What I claim is:

1. In an electrolytic cell in which a fluid cathode flows in a thin band covering the bottom surface of an elongated, inclined trough receptacle, the improvement which comprises: an elongated trough consisting essentially of a unitary, flat, thin, flexible bottom and side walls integral with said bottom, the weight exerted by and the relative flexibility of said bottom resulting in a normally excessive deflection thereof over an unsupported length corresponding to less than one-third of the total length of said trough, means secured at either end of said trough to hold said trough in an inclined plane; a plurality of individual adjustable supports spaced intermediately the ends of said trough and means at the top end of each support to secure the support to the flexible bottom of said trough, the distance between each of said supports being sufficiently small to prevent normal excessive deflection of said flexible bottom; and means to individually longitudinally adjust the height of each of said supports cooperating with said means securing each support to the bottom of said flexible trough for local reciprocal movement of the bottom of the trough corresponding to the longitudinally adjustable movement of the support, in order to correct local unevenness in the bottom of the trough.

2. An electrolytic cell as defined in claim 1 wherein the trough having a flat, flexible bottom is constructed from a single thin sheet of conducting material.

3. An electrolytic cell as defined in claim 1 wherein the trough having a flat, flexible bottom is constructed from a single thin sheet of iron.

4. An improved electrolytic cell as defined in claim 1 wherein the length of said trough is greater than 9 meters.

5. In an electrolytic cell for the electrolysis of an alkali metal chloride solution in which a liquid mercury cathode flows in a thin band covering the bottom surface of an elongated, inclined trough receptacle, the improvement which comprises: an elongated trough consisting essentially of a unitary, flat, thin, flexible bottom and side walls integral with said bottom, the weight exerted by

and the relative flexibility of said bottom resulting in a normally excessive longitudinal deflection thereof over an unsupported length corresponding to less than one-third of the total length of said trough and a normally excessive horizontal deflection thereof over an unsupported width corresponding to less than one-half of the total width of said trough, means secured at either end of said trough to hold said trough in an inclined plane; a plurality of paired, individually adjustable supports spaced intermediately the ends of said troughs and means at the top end of each support to secure the support to the flexible bottom of said trough, the distance between each of said individual supports being sufficiently small to prevent normal excessive longitudinal and horizontal deflection of said flexible bottom; and means to individually longitudinally adjust the height of each of said supports cooperating with said means securing each support to the

bottom of said flexible trough for local reciprocal movement of the bottom of the trough corresponding to the longitudinally adjustable movement of the support, in order to correct local unevenness in the bottom of the trough.

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