Dec. 31, 1963 E. L. TALBOTT 3,116,228

DIAPHRAGM TYPE ELECTROLYTIC CELL

Filed May 9, 1960 2 Sheets-Sheet 1

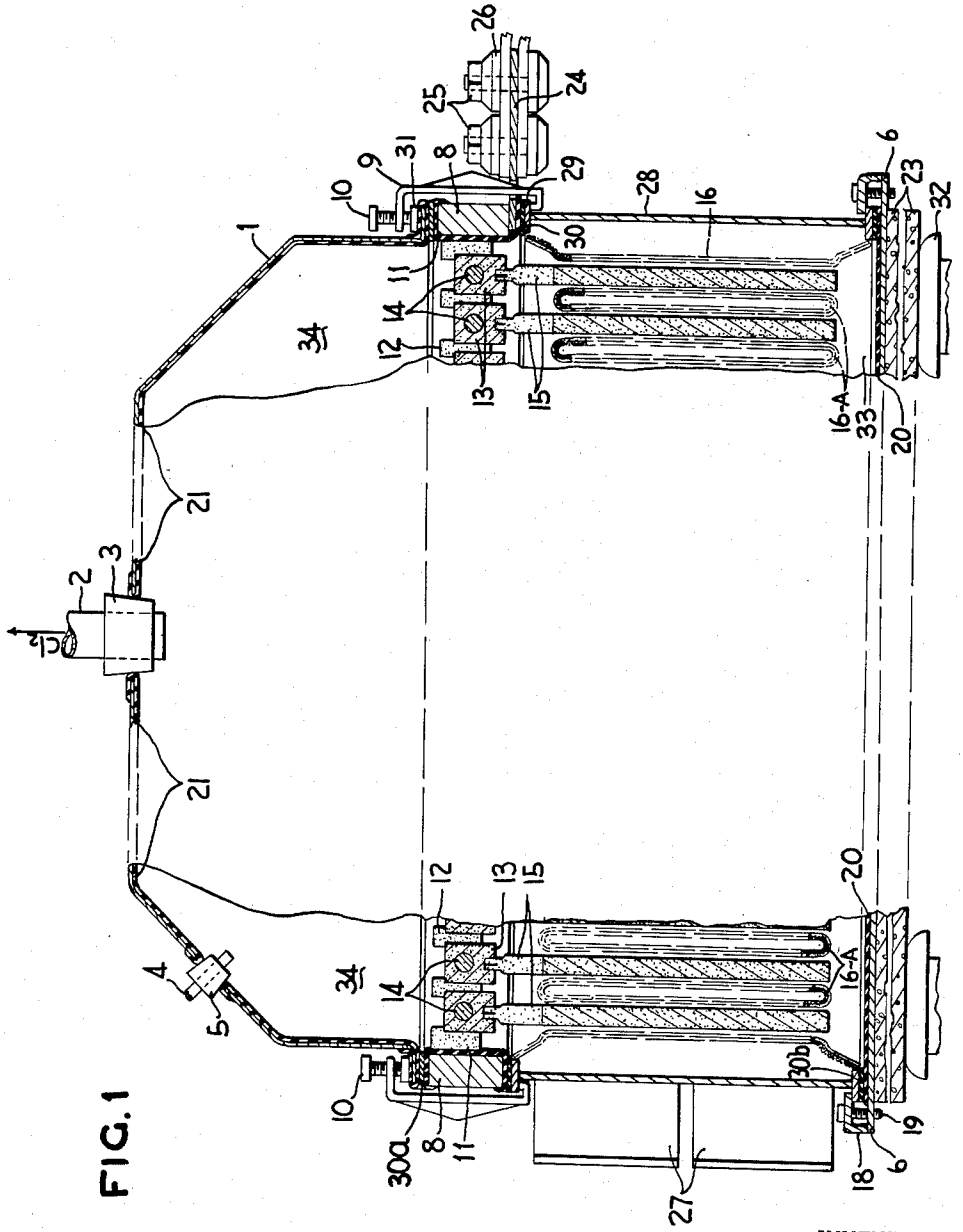


FIG. 1

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2 Sheets-Sheet 2

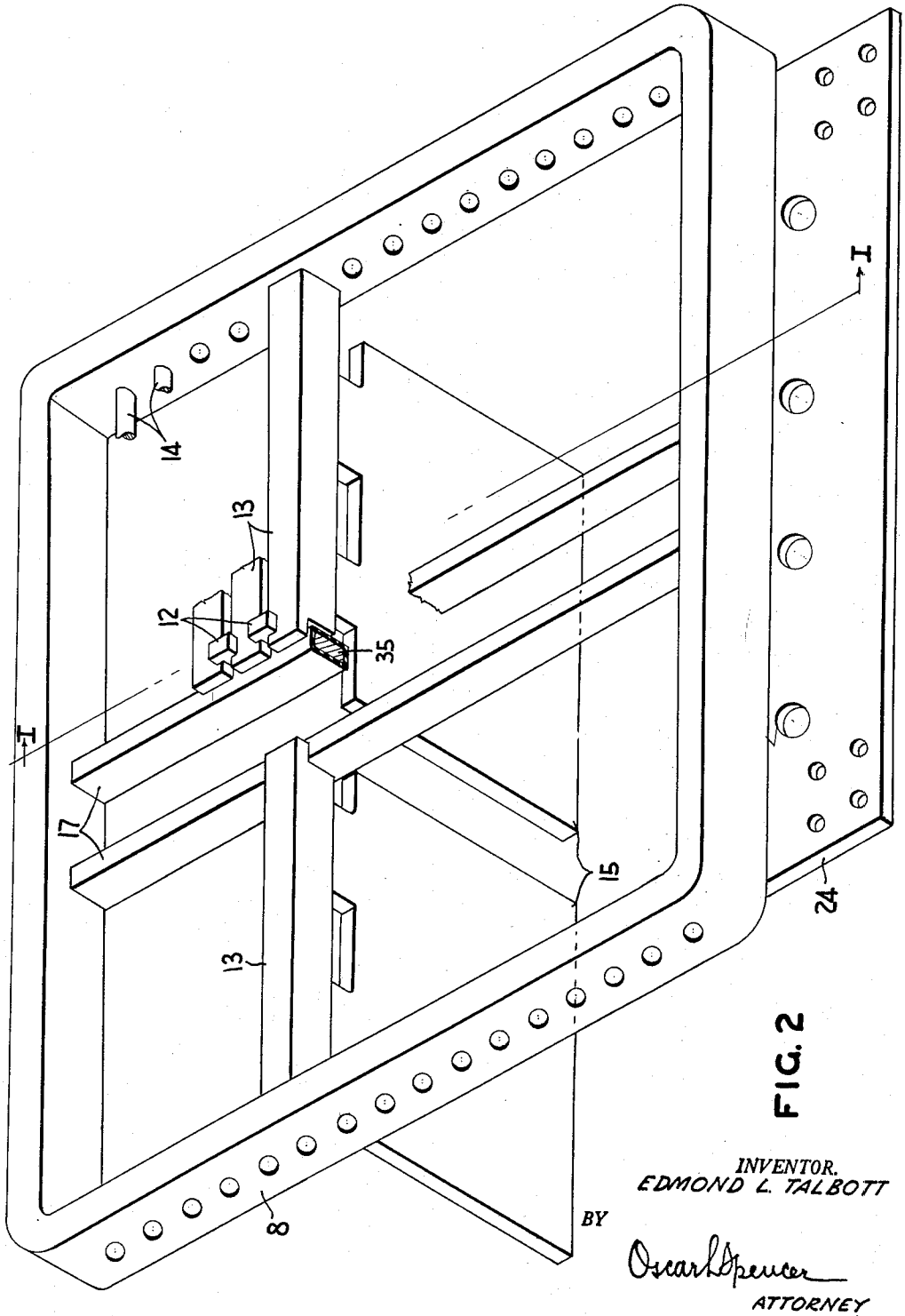


FIG. 2

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DIAPHRAGM TYPE ELECTROLYTIC CELL

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5 Claims. (Cl. 204—266)

The present invention relates to electrolytic cells. More particularly, the present invention relates to improvements in electrolytic alkali-chlorine cells of the diaphragm type.

The trend in industry today among alkali-chlorine manufacturers utilizing electrolytic cells of the diaphragm type is towards increased circuit amperages and cell size. Many problems are introduced in diaphragm cell operation when increased operating currents are employed. Thus, increasing operating current on existing or modified electrolytic cells of the diaphragm type results in increased operating temperatures within the cells which gives rise quite frequently to serious difficulties. Conventional diaphragm type electrolytic cells with anodes placed in the bottom quite frequently leak giving rise to serious current losses. In addition, cell leakage presents a hazard to the safety of personnel working in the cell areas. Diaphragm cells operating at higher circuit amperages have their onstream time substantially reduced due to the more rapid deterioration of the graphite anode blades employed. Thus, considerable periods of time are required to replace cell anodes which seriously impairs the overall efficiency of an electrolytic cell operation in conventional diaphragm cells. In addition, standard electrolytic cells do not lend themselves to positive alignment of anodes and cathodes. This is an extremely important consideration from the standpoint of overall cell efficiency since misalignment of anodes and cathodes effects the efficiency of any given cell due to the fact that non-uniform anode-cathode gaps occur across the entire cell. Increased cell size to accommodate high amperage operations is often necessitated and renders alignment even more difficult.

According to the present invention, a novel cell construction is provided which eliminates many of these problems faced in modern electrolytic, high amperage, diaphragm cell operation. Thus, by virtue of the instant invention, positive alignment of anodes and cathodes in a diaphragm type electrolytic cell becomes a reality. In addition, means are provided for cooling the cell as it is operated at higher circuit amperages. The cell is easily adapted to operation at circuit amperages considerably in excess of those normally encountered in a conventional diaphragm cell. The rating of a given diaphragm cell may be increased without affecting the main cell construction. Considerable savings are also realized in the assembly and disassembly of diaphragm cells constructed in accordance with this invention. Still further, the cell of the present invention in the preferred embodiment provides short proof anode blades.

For a more complete understanding of the present invention, reference is made to the accompanying drawing in which:

FIGURE 1 is a longitudinal fragmentary vertical section, taken substantially along line I—I of FIGURE 2, and

FIGURE 2 is a perspective view of the principal features of the anode assembly shown in the cell of FIGURE 1, with certain elements being omitted for the sake of clarity.

Referring to FIGURES 1 and 2, 1 is a gas collecting cover member constructed of halogen resistant, non-conducting materials such as concrete or rubber-covered steel. Provided on the cover member 1 is a gas exit or conduit 2 for escaping halogen gas. The conduit 2 is conveniently secured to the cover member by means of a

gasket or plug 3 constructed of acid-resistant material such as rubber, plastic, and the like. Located on one side of the cell is a brine inlet 4 also suitably gasketed by an acid resistant stopper or plug 5.

Located beneath the cover member is a frame member 8 which is peripherally positioned on the side walls of the cell. Frame member 8 also functions as a conductor of electricity and is preferably constructed of a material of high conductivity such as copper. The interior surface of the frame and its upper and lower surfaces are covered with an insulatory, non-corrosive material such as rubber lining 11. In communication with the copper frame 8, are a plurality of electrically conductive members or rods 14 preferably constructed of copper which are positioned at right angles to the frame 8 and in electrical communication therewith. These members or rods extend into the cell horizontally. The copper rods or members 14 are conveniently encapsulated in a backing plate or support member 13 constructed of an electrically conductive material such as graphite and may be conveniently sealed therein with solder. A gasket (not shown) of corrosion resistant material such as rubber is positioned between number 13 and lining 11 to protect the rods 14. On the under side of the graphite, support member 13 is provided a groove or a plurality of grooves or slots in which anode blades 15 are inserted and depend downwardly therefrom. While backing plate 13 forms a preferred mode of connecting anode blades 15 to the electrically conductive rods or members 14 other means may be employed. As an example, the blades can be attached directly to the member 14 and the member suitably encased or covered by a corrosion resistant nonconductor such as rubber.

Located immediately below the frame member 8 are the cell side walls 28 which have on their upper surfaces a shoulder 29 on which the framing member 8 rests above a gasket 30. Side walls 28 of the cell have affixed or welded thereto a foraminous cathode screen 16 which is fashioned with a plurality of finger-like projections 16–A which extend outwardly into the cell from the side walls. The arrangements of anodes 15 and cathode fingers 16–A are such that the anode and cathodes alternate from one side of the cell to the other.

Located on the sides of the cell are clamping members 9 which communicate with the shoulder 29 of the cathode containing side walls and an inverted lip fashioned on the bottom of the cover member 1. The clamp has a U-bend on the bottom portion thereof which is inserted under the shoulder 29 of the side wall and extends upwardly and inwardly toward the cell cover 1. A suitable bolt is passed through the clamp member 9 and is affixed on its lower surface with a flat washer or disc 31. Rotation of the nut or bolt 10 effectively maintains a fluid tight seal between the cover member and the side walls and the frame member located therebetween. In placing the frame member upon the cell, the anodes and the cathodes are aligned and the alignment is made steadfast or fixed by virtue of the clamp.

Electrical connection of the bus bar 24 to the cell is made through a plurality of nuts 25 and plates 26 which are fixed to the bus bar or connector 24. Bus bar or connector 24 is affixed to the copper frame or conductor 8 by welding or other suitable mechanical connection.

The sides 28 of the cell rest upon a bottom member 6 preferably constructed of steel over which a rubber lining 20 is placed. Clamping members 18 are provided on all sides of the cell and suitably attached to the bottom 6 such by a bolt 19. Between the cell side and the bottom 6 of the cell is a rubber gasket 30*b* which provides a fluid tight seal between the side member 28 and the rubber covering (20) of bottom 6 of the cell. Similar gaskets 30 and 30*a* are provided between the

frame 8 and cell side 28 and the frame 8 and cell top 1. The bottom is preferably rested upon a concrete slab 23 and the slab, in turn, placed upon pedestals 32 constructed of suitable structural and insulatory material such as glass or porcelain. Current is removed from the cell by cathode bus connectors 27 which are affixed to a side wall of the cell.

In operation of the cell, the brine is introduced through inlet 4 to provide a liquid level in the cell which is several inches above the frame member 8. Current is introduced into the cell through bus connector 24. The current is conducted from frame 8 through rods 14, support members 13, to the anodes 15 of the cell. The current passes through the electrolyte to the cathode fingers 16–A and the cathode screen 16 and is removed from the cell by way of bus connector 27. The products of electrolysis are removed through the gas outlet 2 shown on the cover of the cell. Hydrogen and caustic are removed from the hollow cathode of the cell by means of conduits in a manner well understood by the art.

Referring in more specific detail to FIGURE 2, there is also provided between the support members 13 a plurality of T-shaped spacing members 12 preferably made of graphite which serve to align the support members 13 at their ends. Support beams 17 are shown connected between the framing member at right angles to the support members 13. These support beams are preferably constructed of a rigid structural material such as steel and are rubber covered on all sides to provide protection from corrosion. Support plate 13 is preferably constructed of a wax impregnated graphite material so as to be substantially non-consumable during cell operation. The blades 15 are comprised of consumable graphite such as linseed oil treated graphite blades or other conventional anode graphite. If desired, blades 15 may be constructed of a suitable electrically conductive metal having a low chlorine over-voltage such as platinum plated titanium or other noble metal plated base metal.

Cathode 16 is preferably constructed of steel or Monel screen though any electrically conductive screen material which will provide adequate structural strength for the cathode members and fingers 16–A may be employed. Affixed to the cathode screen 16 and the fingers 16–A is an asbestos diaphragm which may be pulled on in a conventional manner or may comprise asbestos paper.

While in the drawings, the cell top 1 and the bottom member 6 have been shown to contain rubber linings 21 and 20, respectively, it is of course understood that concrete or other corrosion resistant covers and bottoms may be employed if desired. The anode blade 15 depending downwardly from the support member 13 and in electrical communication with the rod member 14 terminate at a point above the bottom 6 of the cell so that there is provided between the anodes and cathodes at the bottom of the cell a space 33 which permits brine circulation through the cell during cell operation.

The provision of the spacing 33 at the bottom of the cell and a space 34 provided above the frame member 8 enhances cell operation and provides in this cell design very desirable features. Thus, by providing for circulation of the brine through space 33 and across the conductive framing members 8 to the space 34 located above the frame members, the entire anode structure of the cell is capable of being cooled by the liquid brine circulating within the cell. Thus, heat may be removed from the cell by vaporizing water contained therein thus permitting cell operation at higher current densities. The anode blades depending downwardly from the support member 13 provide an additional advantage in the cell by virtue of the fact that should an anode blade separate from the support member from any causes such as by erosion of the anode at the insertion point of the blade in the support member the blade will simply fall into the cell and rest upon the bottom thereby becoming inactive

electrically. In conventional cell operation, a failure of this type would result in the shorting out of an adjacent cathode finger since the blade would merely tip and fall against an adjacent finger. The clamping member 9 provides the cell with a fixed positive alignment of anodes and cathodes across the cell. Thus, once the framing member 8 and its associated electrically conductive members 13 and 14 and the associated anodes 15 are put in place and the anodes and cathodes aligned across the cell, the clamping member 9 is tightened and the alignment is positive and permanent.

The cell further is easily adaptive to higher circuit amperages. Current increases may be made by enlarging the copper frame 8 to the desired cross sectional area. The circulation of the brine throughout the cell will remove heat in a satisfactory manner so that the higher current density will not have any deleterious effect on the internal operation of the cell.

It is, of course, understood that many modifications of this arrangement may be made without departing from the spirit of the invention. For example, the electrical connection to the cell could be made directly to the individual conductive members if desired from the current carrying means 24.

Many other modifications may be made in the construction of a cell in accordance with this invention without departing from the spirit and scope of the invention and while the cell has been defined with reference to certain specific embodiments it is not intended to be limited thereby except insofar as appears in the accompanying claims.

I claim:

1. An electrolytic cell of the diaphragm type comprising a bottom, a cover and side walls enclosing a chamber, an electrically conductive frame peripherally positioned on the side walls and below the cover, said frame being open in the center thereby forming part of said chamber, a plurality of elongated electrically conductive members extending horizontally into said chamber from said frame, means connected to said frame for passing current thereto, anodes electrically connected to said members and depending downwardly therefrom to a point above the cell bottom, a foraminous metal cathode attached to the side walls and having a plurality of horizontally disposed fingers projecting inwardly of the side walls and positioned between the downwardly depending anodes, a diaphragm affixed to said cathode and a gas collection chamber located beneath the cell cover and above the frame and associated electrically conductive members.

2. An electrolytic cell of the diaphragm type comprising a bottom, a cover and side walls enclosing a chamber, an electrically conductive frame peripherally positioned on the side walls and below the cover, said frame being open in the center thereby forming part of said chamber, a plurality of elongated electrically conductive members extending horizontally into said chamber from said frame, means connected to said frame for passing current thereto, anodes electrically connected to said members and depending downwardly therefrom to a point above the cell bottom and supported by said members, a foraminous metal cathode attached to the cell side walls and having a plurality of horizontally disposed fingers projecting inwardly of said walls and positioned between the downwardly depending anodes, a diaphragm positioned on said cathode, a gas collection chamber located beneath the cell cover and above the frame and associated electrically conductive members and a clamping member attached to said cell cover and cell side walls for providing a fluid tight seal between said cover, side walls and frame and the interior of the cell.

3. An electrolytic cell of the diaphragm type comprising a bottom, a cover and side walls enclosing a chamber, an electrically conductive frame peripherally positioned on the side wall and below the cover and electrically insulated from the side walls, said frame being open in

the center thereby forming part of said chamber, a plurality of elongated electrically conductive members extending horizontally into said chamber from said frame, means connected to said frame to pass current thereto, anodes electrically connected to said members and depending downwardly therefrom a point above the cell bottom and being supported by said members, a foraminous metal cathode attached to the cell side walls and having a plurality of horizontally disposed fingers projecting inwardly of said walls and positioned between the downwardly depending anodes, a diaphragm positioned on said cathode and a gas collection chamber located beneath the cell cover and above the frame and electrically conductive members.

4. An electrolytic cell of the diaphragm type comprising a bottom, a cover and side walls enclosing a chamber, an electrically conductive frame peripherally positioned on the side walls and below the cover, said frame being open in the center thereby forming part of said chamber and being electrically insulated from said side walls and cover, a plurality of electrically conductive members extending horizontally into said chamber from said frame, means connected to said frame to pass current thereto, anodes electrically connected to said members and depending downwardly therefrom to a point above the bottom and being supported by said members, a foraminous metal cathode attached to said side walls and having a plurality of horizontally disposed fingers projecting inwardly of said walls and positioned between the downwardly depending anodes, a diaphragm positioned on said cathode and a gas collection chamber located beneath the cell cover and above the frame and electrically conductive members.

5. An electrolytic cell of the diaphragm type comprising a bottom, a cover and side walls enclosing a chamber, an electrically conductive frame peripherally positioned on the side walls and below the cover, said frame being open in the center thereby forming part of said chamber, a plurality of elongated electrically conductive members extending horizontally into said chamber from said frame, supporting means for said members, means connected to said frame to pass current thereto, anodes electrically connected to said members and depending downwardly therefrom to a point above the bottom and being supported by said members, a foraminous metal cathode attached to said side walls and having a plurality of horizontally disposed fingers projecting inwardly of said walls and positioned between the downwardly depending anodes, a diaphragm positioned on said cathode and a gas collection chamber located beneath the cell cover and above the frame and electrically conductive members.

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