April 11, 1939. R. N. JONES ET AL 2,153,569

ELECTROLYTIC CELL

Filed May 2, 1935 3 Sheets-Sheet 1

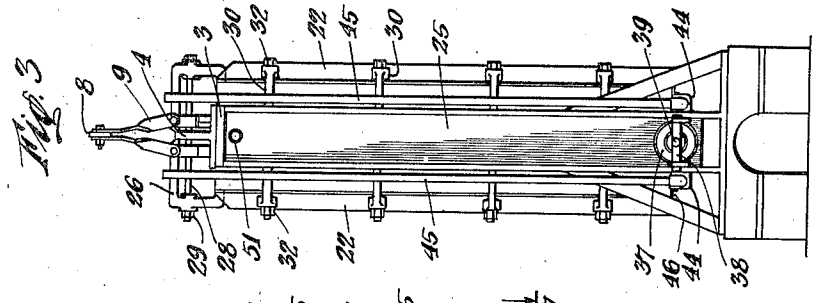


Fig. 3

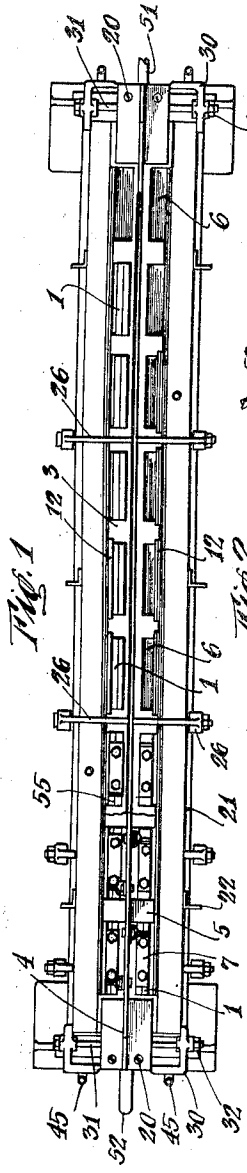


Fig. 1

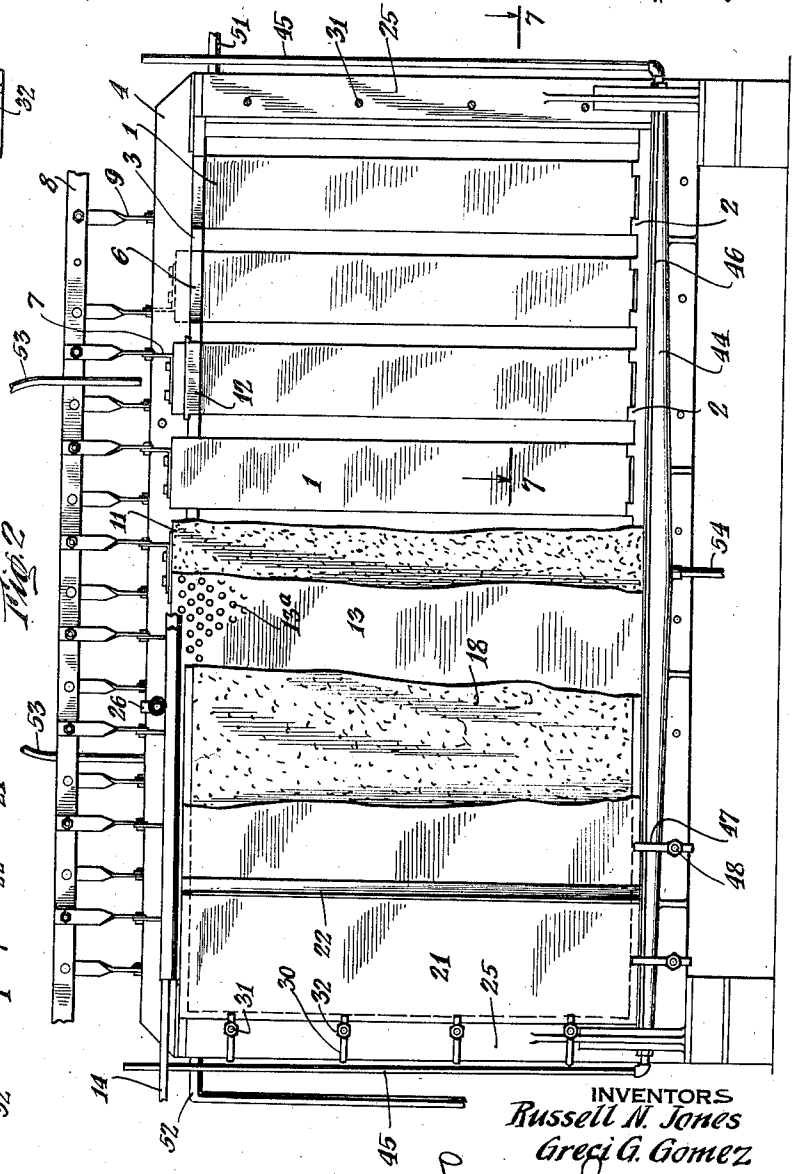


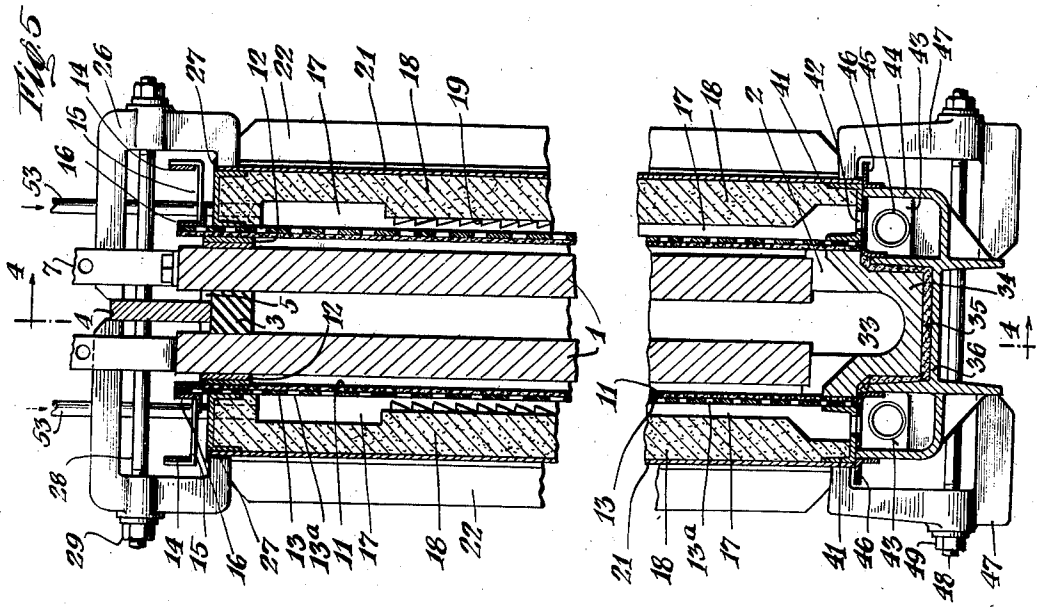
Fig. 2

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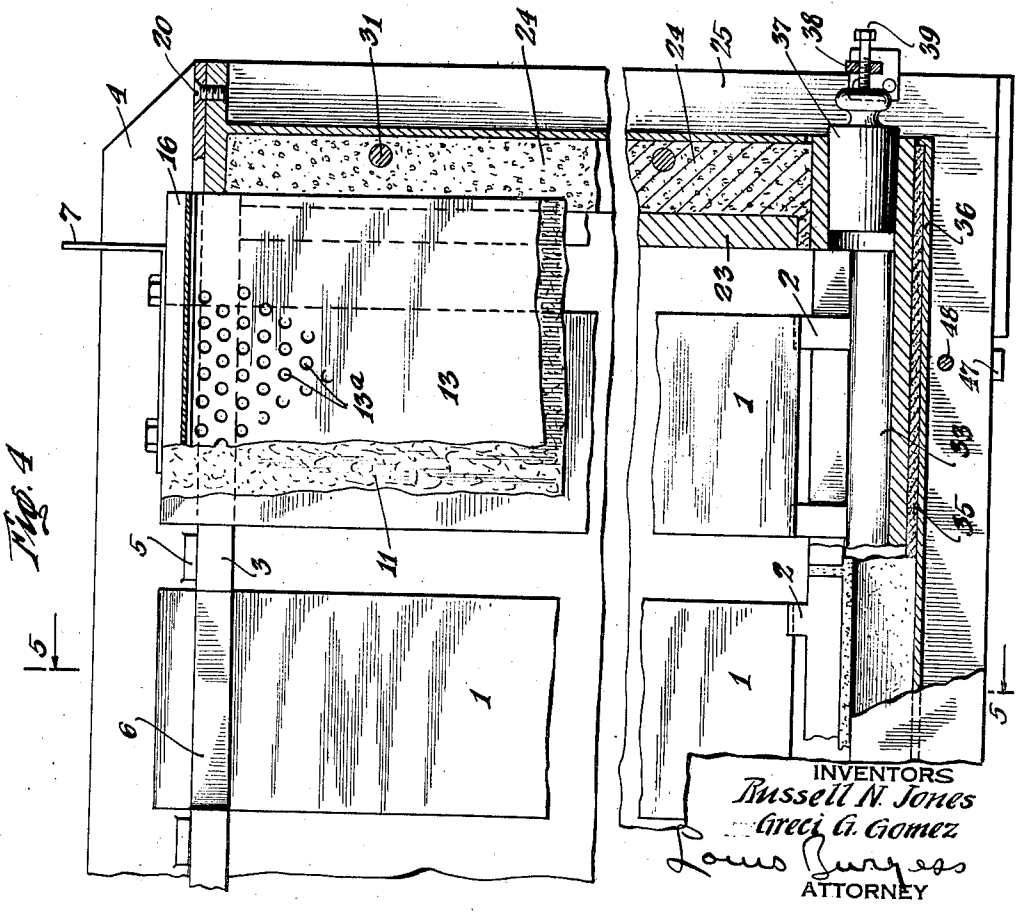


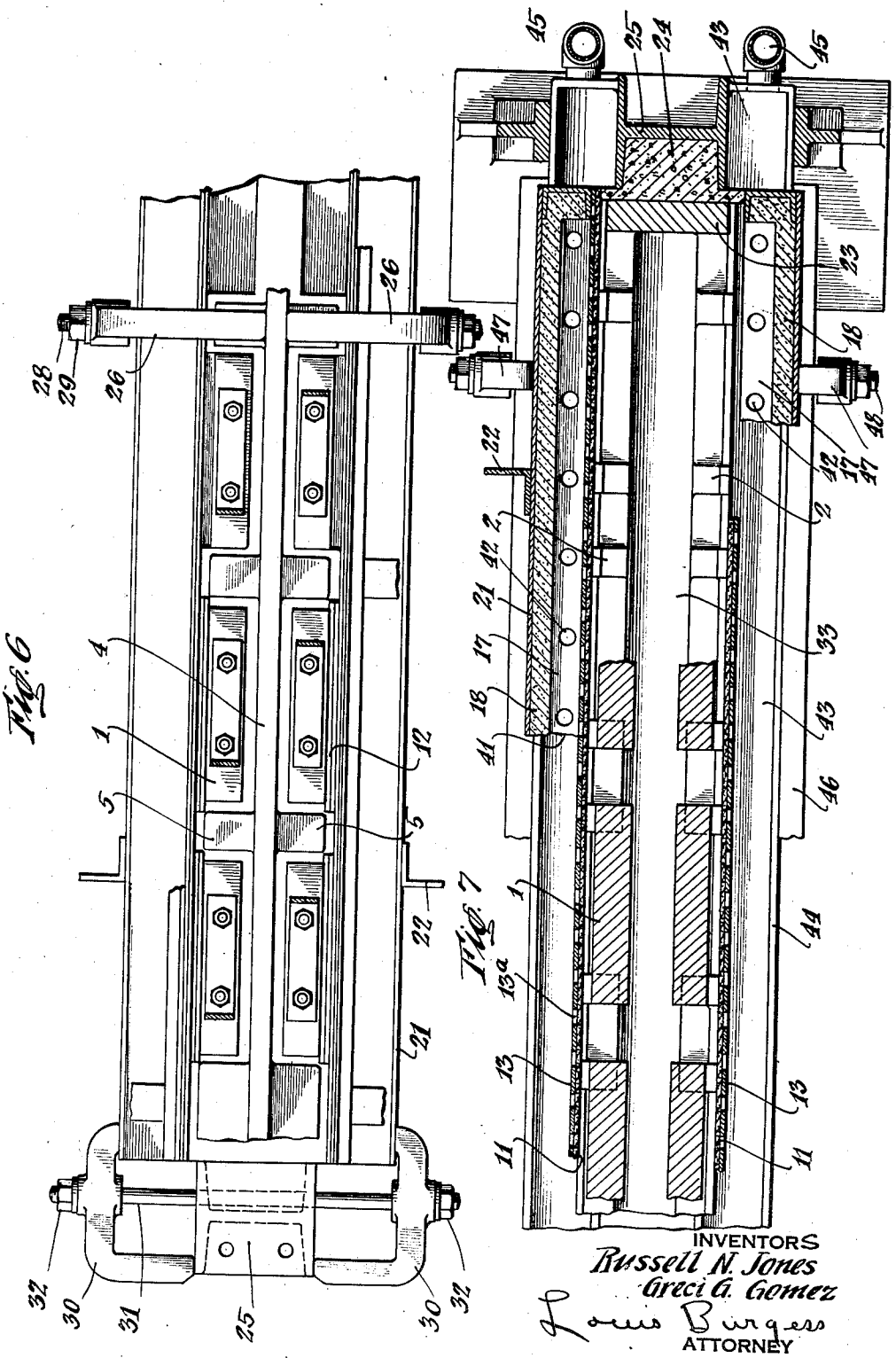
Fig. 4

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ELECTROLYTIC CELL

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ELECTROLYTIC CELL

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Application May 2, 1935, Serial No. 19,342

15 Claims. (Cl. 204—58)

This invention relates to an electrolytic cell, and more particularly to an electrolytic cell for the electrolysis of a brine solution.

An object of the invention is to provide a cell of simplified construction and efficient operation.

Another object of the invention is to provide a cell substantially free of internal current carrying joints.

A still further object is to provide a simple anode supporting structure with the elimination of complications found in present commercial cells.

Another object is to provide optimum electrode spacing and to permit reversal of the anode plates at various times during the life of the cell.

Still another object is to provide for more complete utilization and consumption of the anode, thus reducing waste anode losses, and contributing to a reduction in one of the principal expenses of cell operation, viz. anode cost.

Another object is to provide a sediment collecting zone in the bottom of the cell for collecting an appreciable amount of sediment without interfering with the operation of the cell and adapted for flushing out such sediment without dismantling the cell.

Many electrolytic cells in commercial use today have a plurality of concrete posts, through which posts extend copper cores so shaped or formed to receive graphite spindles which extend through the concrete posts and have tapered terminals. Graphite plates drilled to the same taper are fitted on the graphite spindles so that two plates are located on opposite sides of the concrete posts. The concrete posts usually rest upon a tile bottom of the cell chamber with a copper core extending out through the roof of the cell to a bus bar, which roof is commonly referred to as an arch. A porous diaphragm and a cathode are positioned around the anode plates.

Such a construction requires a large number of current carrying joints, and such joints result in greater electrical losses and consequently lower efficiency than if such joints were not present. Furthermore the construction of the anode does not permit suitable strengthening or reinforcing, especially where the copper core extends through the arch of the cell, and the danger of chlorine leakage is increased.

According to our invention the anode is composed of a plurality of conducting slabs such as graphite, which extend the working height of the cell and a short distance above the arch. The slabs are suitably attached to a bus bar by any desired means. The diaphragm and cathode are relatively closely spaced from the anode, and the cell is provided with a sediment collecting zone at the bottom thereof, and of such porportion as to provide accumulation of an appreciable amount of sediment without interfering with the operation of the cell. The construction of the sediment collecting zone is such that the sediment can be easily removed and the zone flushed without dismantling the cell. This is superior to other constructions which necessitate dismantling the cell to remove the sediment, resulting in the destruction of the diaphragm with each such dismantling.

Also cells in common use have brine inlets and chlorine outlets built into the walls of the cells. The repair of such inlets and outlets is difficult because of their inaccessibility. The inlets and outlets of our improved cell are substantially external to the cell, and such accessibility permits easy repair or change in the same.

The cell according to this invention is provided with a continuous arch through which the slabs extend, and the arch assists in maintaining such slabs in their proper position and reinforces and strengthens the same.

Our cell is compact and less massive than other cells, and can be easily assembled or dismantled.

Referring to the drawings, Fig. 1 is a top plan view of an electrolytic cell according to our invention.

Fig. 2 is a side elevation with a portion removed;

Fig. 3 is an end elevation of the cell;

Fig. 4 is a vertical sectional view taken on the line 4—4 of Fig. 5;

Fig. 5 is a vertical sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is an enlarged fragmentary top plan view of the cell; and

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 2.

In the drawings, the anode is composed of a plurality of conducting slabs 1, such as graphite, which rest on supports 2 of insulating and brine resistant material, for example tile. A continuous arch 3 of insulating material extends substantially the length of the cell and may be of any suitable shape, such as arched, square, rectangular, etc., and the expression "arch" in the specification and claims denotes the roof of the cell, according to well-known usage. The arch 3 has a longitudinal rib 4 which is secured to the arch in any suitable manner. For example the rib 4 may be welded to a member 5, which may be blocks or a continuous strip, and member 5 may be screwed to the arch 3. The arch 3

has openings 6 in the form of recesses, notches, or holes, through which the slabs 1 extend for a short distance. Any desired number of slabs may be used, and in practical operation we have found that two rows, each containing nine slabs give good results. Copper angles 7 are screwed to slabs 1 and the copper angles and slabs are electrically connected to a common bus bar 8 by means of fork leads 9.

Diaphragms 11, such as mats of asbestos, on the outer sides of the anode rows extend substantially the length and height of the cell and are separated from graphite slabs 1 by means of shims 12. The shims, graphite plates, arch and diaphragms at their points of contact are packed with suitable material to prevent loss of chlorine. Cathodes 13 having openings 13a are in contact with the outer side of diaphragms 12, and the diaphragm and cathode on each side of the cell are closely spaced from the graphite slabs. For example, the diaphragm and cathode may be spaced two inches from the slabs, or even one inch or less. The cathodes 13 are connected to a common bus bar 14 by means of brackets 15 and 16. On the outer sides of the cathodes 13 are cathode chambers 17 formed by concrete strips or walls 18 provided with serrated baffles 19. Side metal walls 21, preferably integral with concrete strips 18, are suitably clamped in position, as will be hereinafter described. Side walls 21 may be provided with reinforcing angle irons 22.

The ends of the cell are closed by means of a tile strip 23 which extends substantially the working height of the cell, and on the outer side of tile strip 23 is a concrete strip 24. The tile and concrete strips are held in position by a metal I beam end wall 25 which extends substantially the height of the cell. The side and end walls may be clamped or otherwise held in position. For example top clamps 26 at their lower ends press against side walls 21 and flanges 27 of said side walls, and at their upper ends against longitudinal rib 4. Threaded bolts 28 and nuts 29 hold the clamp in proper position. Side clamps 30 at their inner ends press against side walls 21 and at their outer ends against I beams 25, and are held in position by means of threaded bolts 31, which pass through openings in I beams 25, and nuts 32. The end portions of longitudinal rib 4 are flanged at 10 and are screwed at 20 to side walls 21.

The bottom of the cell is provided with a sediment collecting zone 33 of sufficient depth to permit accumulation of a substantial amount of sediment without interfering with the proper operation of the cell. Sediment collecting zone 33 extends substantialy the working length of the cell and may be of any desired shape. As shown in the drawings it is formed by a tile member 34, having curved upper face, and the tile member rests on a U-shaped concerete member 35. The concrete member 35 rests on metal I beam 36. The sediment collecting zone may be provided at one or both ends with a removable member 37, which may be an ordinary plug as shown, a hinged cover, or other suitable means. An internally threaded bracket 38 is mounted on I beam and threaded bolt 39 passes through the threaded opening of bracket 38 and presses against the plug 37.

The bottoms of the cathode chambers 17 are provided with U-shaped members 41 which extend substantially the working length of the cell, and are provided with openings 42 to permit discharge of liquor into collecting zones 43. Zones 43 are formed by troughs 44 which extend substantially the working length of the cell, and are welded to I beam 36. Vent pipes 45 permit vapors to escape from troughs 44. Troughs 44 are provided at their upper outer external ends with angle irons 46, and bottom clamps 47 at their upper ends press against side walls 21 above the flanges 46, and at their lower ends against the bottom parts of I beam 36. Threaded bolts 48, which pass through openings in I beam 36, and nuts 49 maintain the clamps in proper position. The cell is provided with a charge inlet pipe 51 and with a gas outlet pipe 52, both of which extend through the walls of the cell and into the anode chamber. Pipes 51 and 52 are substantially external to the cell, that is they are external to the cell except for the short distance that they extend through the walls of the cell, in contradistinction to other inlet and outlet pipes, a substantial portion of which are built into the walls of the cell.

The operation of the cell will be described with respect to the electrolysis of a brine solution followed by carbonation, but it is understood that the invention is not limited to any particular type of electrolysis, and electrolysis of solutions other than brine may be carried out with good results in our cell. The brine is introduced through inlet pipe 51 into the anode chamber and a current is passed through the cell. The chlorine formed is removed through outlet pipe 52, and if desired a suction pump may be used to facilitate withdrawal. Sodium hydroxide is formed in the cathode chamber, and carbon dioxide and steam are introduced into this chamber through pipes 53. As the sodium hydroxide trickles down the serrated baffles 19, it reacts with the carbon dioxide to form sodium carbonate, and the solution of the same passes through openings 42 in the bottom of cathode chambers 17 into troughs 44 and is removed through a common outlet pipe 54. During operation of the cell sediment will collect in the sediment collecting zone 33, and to remove such sediment it is only necessary, when the cell is not in use, to remove the plug 37 and introduce water through inlet pipe 51. Or the cell may be provided with a plug on each end of the zone 33 in which case both plugs are removed and water is forced in one end of the cone and passes out of the other.

During the operation of the cell the sides of the graphite slabs adjacent the diaphragm and cathode will be reduced in size, resulting in decreased efficiency of the cell. When one side of the slab has been so attacked, the arch of the cell is removed and the graphite plates are reversed, presenting an unattacked face to the cathode. After one or both sides of the graphite slabs have been worn away, for example to one-half of their original thickness, the upper unattacked portions of the slabs which are external to the cell may be planed to a thickness uniform with the attacked portions, and two of these slabs can be joined to form a composite slab of approximately the original dimensions, as shown at 55. This anode reclamation permits more complete utilization and consumption of the anode thus reducing waste anode losses and anode cost, which is the principal expense of cell operation. Such reclamation also permits operation at substantially the original optimum anode spacing and high efficiency.

The cell according to our invention is substantially free of all internal current carrying joints

permitting a greater efficiency of operation. The initial operating voltages are lower than in other cells, and continue lower during the life of the cell. The power savings of such cells may amount to as high as 35 kilowatt hours per day over an initial period of operation of approximately a year, with respect to other cells now in commercial operation. There is no sagging of the arch, and it assists in supporting and maintaining the slabs in their proper position. Moreover, it is not necessary to dismantle the cell, with the attendant loss of the diaphragm, to remove the sediment, and the external inlets and outlets provide easy access to the same in case of damage or replacement.

We are not to be limited to any particular charging materials, to any size of cell, anode, cathode, or diaphragm, nor to any number of graphite slabs forming the anode, nor to any other limitations, except as expressly provided in the claims.

When we speak in the specification and claims of "a cell being substantially free of internal current carrying joints," or use words of similar import we means an electrolytic cell in which the anode or a plurality of anodes extends substantially the working height of the cell and through a continuous arch extending substantially the length of the cell and in which the anode or anodes are substantially free from any seams or joints or similar electric contact means within the interior of the cell.

We claim:

1. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of graphite slabs extending substantially the working height of the cell and through said openings, supports for said slabs, a cathode, and a diaphragm between said cathode and said graphite slabs, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

2. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of reversible graphite slabs extending substantially the working height of the cell and through said openings, supports for said slabs, a cathode, and a diaphragm between said cathode and said graphite slabs, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

3. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of graphite slabs extending substantially the working height of the cell and through said openings, at least one of said slabs being a composite of two previously used and worn slabs, supports for said slabs, a cathode and a diaphragm between said cathode and said graphite slabs, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

4. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of reversible graphite slabs extending substantially the working height of the cell and through said openings, supports for said slabs, a cathode, and a diaphragm between said cathode and said graphite slabs, said slabs being capable of substantially optimum spacing from said diaphragm during the life of the cell, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

5. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of graphite slabs extending substantially the working height of the cell and through said openings, at least one of said slabs being a composite of two previously used and worn slabs, supports for said slabs, a cathode and a diaphragm between said cathode and said graphite slabs, said slabs being capable of substantially optimum spacing from said diaphragm during the life of the cell, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

6. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of graphite slabs extending substantially the working height of the cell and through said openings, supports for said slabs, a cathode, and a diaphragm between said cathode and said graphite slabs, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite salbs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

7. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, a first series of graphite slabs on one side of said cell extending substantially the working height of said cell and through said openings, supports for said first series of graphite slabs in the bottom of said cell, a first cathode, a first diaphragm between said first cathode and said first series of graphite slabs, a second series of graphite slabs adjacent the other side of said cell, said slabs extending substantially the working height of said cell and through openings in said arch, supports for said second series of slabs in the bottom of said cell, a second cathode, a second diaphragm between said second cathode and said second series of graphite slabs, and a sediment collecting trough in the bottom of said cell extending longitudinally of the same between said first series and said second series of graphite slabs.

8. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, a first series of graphite slabs on one side of said cell extending substantially the working height of said cell and through said openings, supports for said first series of graphite slabs in the bottom of said cell, a first cathode, a first diaphragm between said first cathode and said first series of graphite slabs,

a second series of graphite slabs adjacent the other side of said cell, said slabs extending substantially the working height of said cell and through openings in said arch, supports for said second series of slabs in the bottom of said cell, a second cathode, a second diaphragm between said second cathode and said second series of graphite slabs, a sediment collecting trough in the bottom of said cell extending longitudinally of the same between said first series and said second series of graphite slabs, and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

9. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, a first series of graphite slabs on one side of said cell extending substantially the working height of said cell and through said openings, supports for said first series of graphite slabs in the bottom of said cell, a first cathode, a first diaphragm between said first cathode and said first series of graphite slabs, a second series of graphite slabs adjacent the other side of said cell, said slabs extending substantially the working height of said cell and through openings in said arch, supports for said second series of slabs in the bottom of said cell, a second cathode, a second diaphragm between said second cathode and said second series of graphite slabs, an inlet pipe, and a gas outlet pipe, said pipes being substantially external to said cell, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

10. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, a first series of graphite slabs on one side of said cell extending substantially the working height of said cell and through said openings, supports for said first series of graphite slabs in the bottom of said cell, a first cathode, a first diaphragm between said first cathode and said first series of graphite slabs, a second series of graphite slabs adjacent the other side of said cell, said slabs extending substantially the working height of said cell and through openings in said arch, supports for said second series of slabs in the bottom of said cell, a second cathode, a second diaphragm between said second cathode and said second series of graphite slabs, cathode chambers adjacent said first and second cathode, means for introducing into said cathode chambers a gas reactable with the product of electrolysis, and a sediment collecting trough in the bottom of said cell extending longitudinally of the same between said first series and said second series of graphite slabs.

11. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, a first series of graphite slabs on one side of said cell extending substantially the working height of said cell and through said openings, supports for said first series of graphite slabs in the bottom of said cell, a first cathode, a first diaphragm between said first cathode and said first series of graphite slabs, a second series of graphite slabs adjacent the other side of said cell, said slabs extending substantially the working height of said cell and through openings in said arch, supports for said second series of slabs in the bottom of said cell, a second cathode, a second diaphragm between said second cathode and said second series of graphite slabs, a sediment collecting trough in the bottom of said cell extending longitudinally of the same between said first series and said second series of graphite slabs, means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell, an inlet pipe, a gas outlet pipe, said pipes being substantially external to said cell, cathode chambers adjacent said first and second cathodes, means for introducing into said cathode chambers a gas reactable with the product of electrolysis, removable walls for said cell, and clamps for holding said walls in position on the cell.

12. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of graphite slabs extending substantially the working height of the cell and through said openings, supports for said slabs, a cathode, and a diaphragm between said cathode and said graphite slabs, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell, removable walls for said cell and clamp means substantially external to said cell for holding said walls in position on the cell.

13. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of graphite slabs extending substantially the working height of the cell and through said openings, at least one of said slabs being a composite of two previously used and worn slabs, supports for said slabs, a cathode and a diaphragm between said cathode and said graphite slabs, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell, removable walls for said cell and clamp means substantially external to said cell for holding said walls in position on the cell.

14. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, an anode comprising a plurality of reversible graphite slabs extending substantially the working height of the cell and through said openings, at least one of said slabs being a composite of two previously used and worn slabs, supports for said slabs, a cathode and a diaphragm between said cathode and said graphite slabs, said slabs being capable of substantially optimum spacing from said diaphragm during the life of the cell, a sediment collecting trough in the bottom of said cell extending longitudinally of the same below said graphite slabs and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell, removable walls for said cell and clamp means substantially externa. to said cell for holding said walls in position on the cell.

15. An electrolytic cell comprising a continuous arch extending substantially the length of the cell and having openings, a first series of graphite slabs on one side of said cell extending substantially the working height of said cell and through

said openings, supports for said first series of graphite slabs in the bottom of said cell, a first cathode, a first diaphragm between said first cathode and said first series of graphite slabs, a second series of graphite slabs adjacent the other side of said cell, said slabs extending substantially the working height of said cell and through openings in said arch, supports for said second series of slabs in the bottom of said cell, a second cathode, a second diaphragm between said second cathode and said second series of graphite slabs, removable walls for said cell, and clamp means substantially external to said cell for holding said walls in position on the cell, a sediment collecting trough in the bottom of said cell extending longitudinally of the same between said first series and said second series of graphite slabs, and means adjacent one end of said trough defining an outlet in which sediment accumulated in said trough may be removed without dismantling the cell.

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