W. E. GREENAWALT.

ELECTROLYTIC APPARATUS.

APPLICATION FILED FEB. 10, 1919.

1,365,033. **Patented Jan. 11, 1921.**

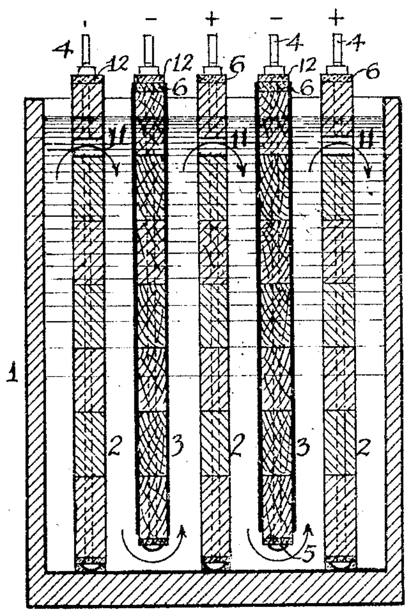

FIG 1

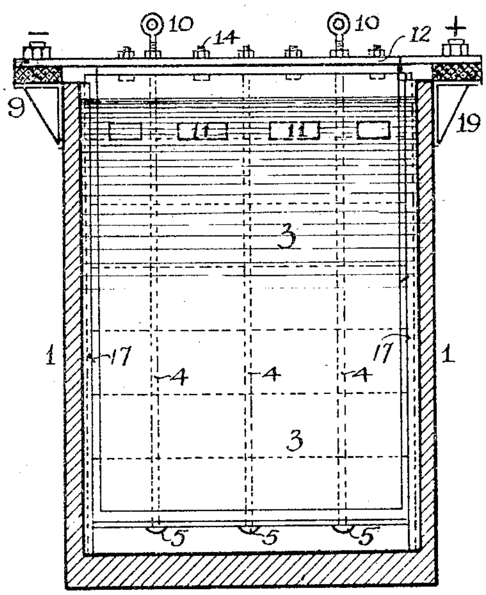

FIG 2

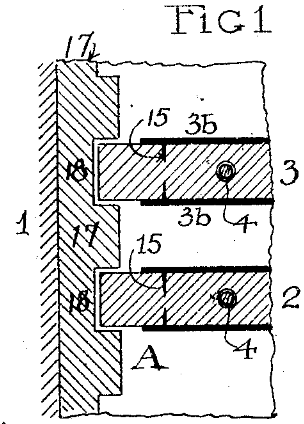

FIG 3

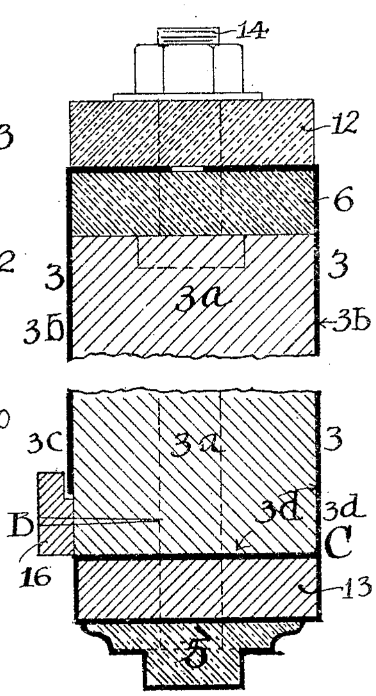

FIG 4

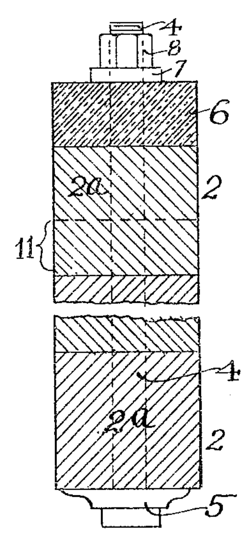

FIG 5

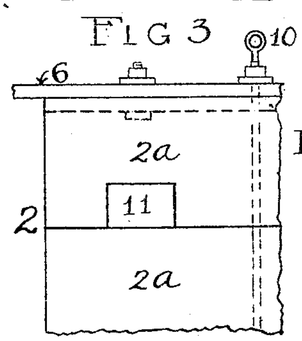

FIG 6

INVENTOR

William E. Greenawalt

UNITED STATES PATENT OFFICE.

WILLIAM E. GREENAWALT, OF DENVER, COLORADO.

ELECTROLYTIC APPARATUS.

1,365,033. Specification of Letters Patent. Patented Jan. 11, 1921.

Application filed February 10, 1919. Serial No. 275,995.

To all whom it may concern:

Be it known that I, WILLIAM E. GREENAWALT, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Electrolytic Apparatus, of which the following is a specification.

This apparatus may be regarded as a continuation, in part, of my co-pending applications Serial No. 145,884, filed February 1, 1917, and Serial No. 231,534, filed April 29, 1918, and has for its object the overcoming of certain electrode difficulties which occur, more particularly, with large electrodes, especially, in this case, with the cathode.

The apparatus will be described more particularly in reference to copper deposition, although it is not intended to limit it to any particular use.

The object of this apparatus is to overcome certain electrode difficulties, especially in the electrolysis of solutions with insoluble anodes.

In my co-pending applications referred to, as also in this application, it is intended to use fairly large electrodes. When large electrodes are used certain very serious difficulties are encountered, and these difficulties are not entirely absent when using comparatively small electrodes. The anode difficulties, when using carbon, magnetite, or ferrosilicon as the electrode material, may be summarized as follows: When employing these materials, the anode, as a whole, has to be built up of component parts, or sections, because the size of each piece is fairly small, on account of inherent manufacturing limitations. Ordinarily the parts, or sections, are arranged upright, and, as in carbon anodes, the upper part of the various sections is cast in a lead socket which secures the parts and is also used in making electrical connections with the electric conductor. This is usually unsatisfactory and uncertain, principally on account of the creeping salts, which soon corrode the contacts. The method of suspending such electrodes is also unsatisfactory.

If lead anodes are used the difficulties are increased as the size is enlarged. There is no difficulty in using a lead anode, say, three feet square and from one eighth to one fourth inch thick. If however, the size is increased to, say, six feet by eight feet, it would be quite impracticable to use the lead anode in the ordinary way. One very serious difficulty would be in suspending the electrode vertically and maintaining it parallel with the other electrodes, and effective electrolysis is not possible with electrodes which are not parallel.

Large cathodes also offer very serious difficulties—quite as serious as those of the anode. So far as I am aware, very large cathodes have never been successfully used in copper deposition. The principal trouble arising from the use of thin starting sheets is that they warp and twist, and it is quite impossible to maintain the entire surface parallel with the corresponding anode surface, and if not maintained parallel, trees will form and short circuits will quickly follow. This difficulty is experienced in ordinary copper refining where the cathodes are quite small; it would be very pronounced when using cathode starting sheets, say six feet by eight feet. Then, too, there would be trouble in supporting so large a cathode in the ordinary way; in fact, it could not practically be supported in the ordinary way.

I overcome these difficulties enumerated by building up the electrode in superimposed sections. Either electrode may be the anode and either the cathode, depending on the details of operation. If carbon is used as the anode material, holes are drilled through the carbon slabs edgewise and rods inserted through the holes to hold the slabs, or sections, in place, and also to cause a pressure, or compression, for better electrical contact between the various sections of the superimposed series. If lead is used as the anode material, the construction will be much the same as for the cathode, and the cathode is constructed by bolting a series of wooden planks together in vertical series, and then attaching the thin metal sheets to the face of these planks.

The apparatus may be more definitely described by referring to the accompanying drawings, in which Figure 1 is a longitudinal section, Fig. 2 a cross section, Fig. 3 a plan of a detail showing the relation of the electrodes to the sides of the tank and method of keeping them parallel and in vertical position, Fig. 4 a detail of the cathode, Fig. 5 a detail of the anode, and Fig. 6 a detail elevation of a portion of the anode.

In the drawings, 1 is an electrolytic tank, 2 the anodes, taken as a whole, and 3 the cathodes. The anodes, for the present, may be described as composed of carbon slabs, or sections, 2^a, bolted together by rods 4 passing through holes bored edgewise through the carbon slabs. The carbon slabs, which should be as large as convenient, may be assumed to be about 2 inches thick, 10 inches wide, and 48 inches long. They are preferably planed on the contacting edges so as to make a close fit and good electrical contact, and also to effectively protect the metal rods from the corrosive action of the electrolyte. It is also necessary to protect the exposed head of the rods from the action of the electrolyte; this is preferably done by dipping the combined head and washer 5 into molten lead, which covers the surface of the head with a coating of lead. The lead covering is satisfactory in most electrolytes. Connection is made with the electrical conductor by means of the copper bar 6, Fig. 5, which contacts along the upper edge of the upper section 2^a, of the electrode 2, and is connected with the positive electrical conductor 19. It is desirable to have a little flexibility in bolting the various sections of the electrode together so as to avoid breakage by unresisting pressure; for that reason flexible rubber washers 7 are placed between the nut 8 and the conductor bar 6. Two of the rods are extended above the electrodes into an eye 10 by means of which the anodes may be easily lifted from the tank by means of a traveling crane, or otherwise. The anode rests, preferably, on supports at the bottom of the tank, and is arranged, with the cathode, to give the electrolyte a sinuous flow through the tank. In order to do this, and have an exposed electrical contact, the upper section of the carbon electrode is arranged with holes, or passages, 11, to allow the electrolyte to flow through the anode from one side to the other. This, as shown in the drawings, does not interfere with the electrical connections, either above or below the surface of the electrolyte, and still the metal rods are protected from the electrolyte.

The cathode 3, is preferably constructed of a middle portion built up of wooden planks 3^a bolted together by rods 4 passing through holes bored through the planks edgewise. As in the anode, two of these rods are extended above the cathode into eyes 10, to handle it. In order to better secure the planking, metal bars, or hard wood strips, bound the upper and lower edges of the planking as shown at 6 and 13 respectively. Passing through the metal bar 6, but not through the planking, are short bolts 14, by means of which the conductor bar 12, is bolted to the cathode. When the planks are assembled and bolted together, the thin metal cathode sheets 3^b, presumably thin copper starting sheets, are spread on the face of the wooden middle portion; the upper edges are then bent over, between the metal bar 6 and the conductor bar 12, and the two bars are bolted together by the short bolts 14. This secures the metal sheets and makes an excellent electrical contact for almost the entire length of the conductor bar. The metal bar 6 is supposed to be fixed, as also the rods 4; the conductor bar 12 is supposed to be removable when it is desired to withdraw or insert metal sheets. The thin metal sheets, having been secured at the upper edges, the sides may be secured as shown at A, Fig. 3, by tacking the edges with copper nails 15. The bottom may be similarly secured. When deposition commences the copper nails will be plated over the same as the copper sheet, and when the finished cathode sheet is removed there will not be the slightest difficulty in pulling out these nails with the thick cathode sheet. It is preferred, however, to secure the sides and bottom as shown at B, Fig. 4, by tacking a wooden strip 16 along the edges of the starting sheet so as to secure the edges of the sheet to the planking. When the deposited copper is removed, these strips are easily removed with it. Small iron nails will answer the purpose, but copper nails are preferred. If nails, in any form, are objectionable, the bottom of the metal sheets may be secured much the same as the top by bending the lower edge of the sheet over the edge of the wooden planking as shown at 3^d, Fig. 4, and securing it by the bottom strip 13. This construction will not ordinarily be used if the electrode is to be employed as a cathode. It is, however, the preferred arrangement if the electrode is to be used as an anode, for, in that case the nails would soon be eaten away and the metal sheet would probably not remain parallel to the other electrodes.

The anode, as stated, may be constructed the same as the cathode, with a wooden middle portion as the background for the anode material, whether this material is a metal sheet or thin slabs of carbon, magnetite or ferrosilicon. If the electrode is to be used as an anode, the construction as shown at B Fig. 4, is preferred. If the electrode, using lead sheets, is to be employed as an anode, the wooden middle portion is covered with the lead sheet, and secured at the top as described for the cathode, and the bottom is secured as shown by 3^d, at C, Fig. 4, by bending the sheet over at the bottom and clamping it to the wooden middle portion by means of the strip 13 and the bolts 4.

The rods 4 are intended to fit fairly, snugly into the holes in the wooden planking, so as to keep the electrode, as a whole, in true alinement and parallel with the other electrodes.

The electrodes are preferably supported from below and maintained in a vertical and parallel position by the side pieces 17, Fig. 3, having grooves 18, into which the ends of the electrodes, or wooden middle portion, fit. The electrodes should fit rather loosely in the grooves 18 so that they can be easily inserted and removed. In order that the deposited metal may not interfere with the removing of the electrodes from the grooves 18, and in order that the deposited metal may be readily removed from the wooden middle portion, the metal starting sheet is stopped short of the the grooves as shown in Fig. 3, so that the deposited metal can not be locked around the edge of the planking.

Any size electrodes may be constructed, and still maintain the electrodes of opposite polarity perfectly parallel. If the metal facing sheets are to be wider than ordinary marketable widths, there is no objection to making the electrode sheets in several sections vertically. Suppose, for example, an electrode 12x12 feet is desired: this could be made of three or four metal strips four or three feet wide, which are ordinary marketable widths.

In order to prolong the life of the rods, 4, they are preferably coated with an insulating and acid resisting paint, or inclosed in rubber tubing. This will not always be necessary, although at times it may be desirable.

I claim:

1. In electrolytic apparatus, an electrolytic tank, electrodes composed of superimposed sections, means for compressing the sections against one another and keeping them in alinement, and means at the side of the electrolytic tank for maintaining the electrodes parallel and in position in the tank.

2. In electrolytic apparatus, an electrolytic tank, electrodes composed of superimposed sections, means for compressing the sections against one another and keeping them in alinement, means arranged for supporting the electrodes from below, means for maintaining the electrodes parallel in the tank, and means for making electrical connections between the electrodes and the electrical conductor.

3. In electrolytic apparatus, an electrode consisting of an interior support composed of sections bolted together with rods passing through the interior of the respective sections, and metal sheets attached to the faces of the interior support.

4. In electrolytic apparatus, an electrode consisting of an interior support composed of planking bolted together with rods passing through the interior of the respective sections, and metal sheets attached to the faces of the interior support and arranged so that there will be a marginal exposure of the planking at the sides of the electrode.

5. In electrolytic apparatus, an electrode consisting of an interior support composed of a non-conducting material, and metal sheets secured to the faces of the interior support and arranged so as to leave a marginal exposure along the edges of the non-conducting interior.

6. In electrolytic apparatus, an electrode which consists of an interior portion composed of superimposed wooden planking bolted together edgewise with rods passing through the interior of the planking, metal sheets attached to the faces of the planking, and a conductor bar along the upper edge of the planking and arranged to secure the metal sheets to the face of the planking and to make electrical connection between the metal sheets and the electrical conductor.

7. In electrolytic apparatus, an electrode composed of a non-metallic acid resisting interior portion, metal sheets attached to the faces of the interior portion, and means for securing the metal sheets to the middle portion by compressing the upper edges of the metal sheets between two members with a conductor bar as one of the members.

8. In electrolytic apparatus, an electrode composed of superimposed sections bolted together with bolts passing through the interior of the respective sections, and means for protecting the exposed portions of the bolts from the action of the electrolyte.

9. In electrolytic apparatus having electrodes arranged so as to give the electrolyte a sinuous flow through the electrolyzer, anodes supported in the lower portion of the electrolyzer and arranged with openings to permit the electrolyte to flow from one side of the anode to the other, said openings being arranged between conducting portions of the electrode, with electrical connections above the surface of the electrolyte.

10. In electrolytic apparatus having electrodes secured to the sides of the electrolyte tank and supported below the surface of the electrolyte, electrical conductors at the sides of the tank, conductor bars in electrical contact with the electrodes, and means for making and breaking electrical connections between the electrical conductor and the conductor bar without disturbing the electrodes.

11. In electrolytic apparatus having electrodes with metal sheets attached to the faces of a non-metallic interior portion, removable strips arranged along the edges of

the electrode so as to secure the edges of the metal sheets to the non-metallic interior portion.

12. In electrolytic apparatus, electrodes composed of horizontally disposed non-conducting interior components and vertically disposed conducting exterior components.

13. In electrolytic apparatus, electrodes composed of a non-conducting interior and a conducting exterior, means for resting the electrodes on submerged supports, and means for making electrical contact with exposed conductors.

14. In electrolytic apparatus, electrodes composed of horizontally disposed superimposed sections and rods passing vertically through the respective sections to tie them together into a composite whole.

WILLIAM E. GREENAWALT.