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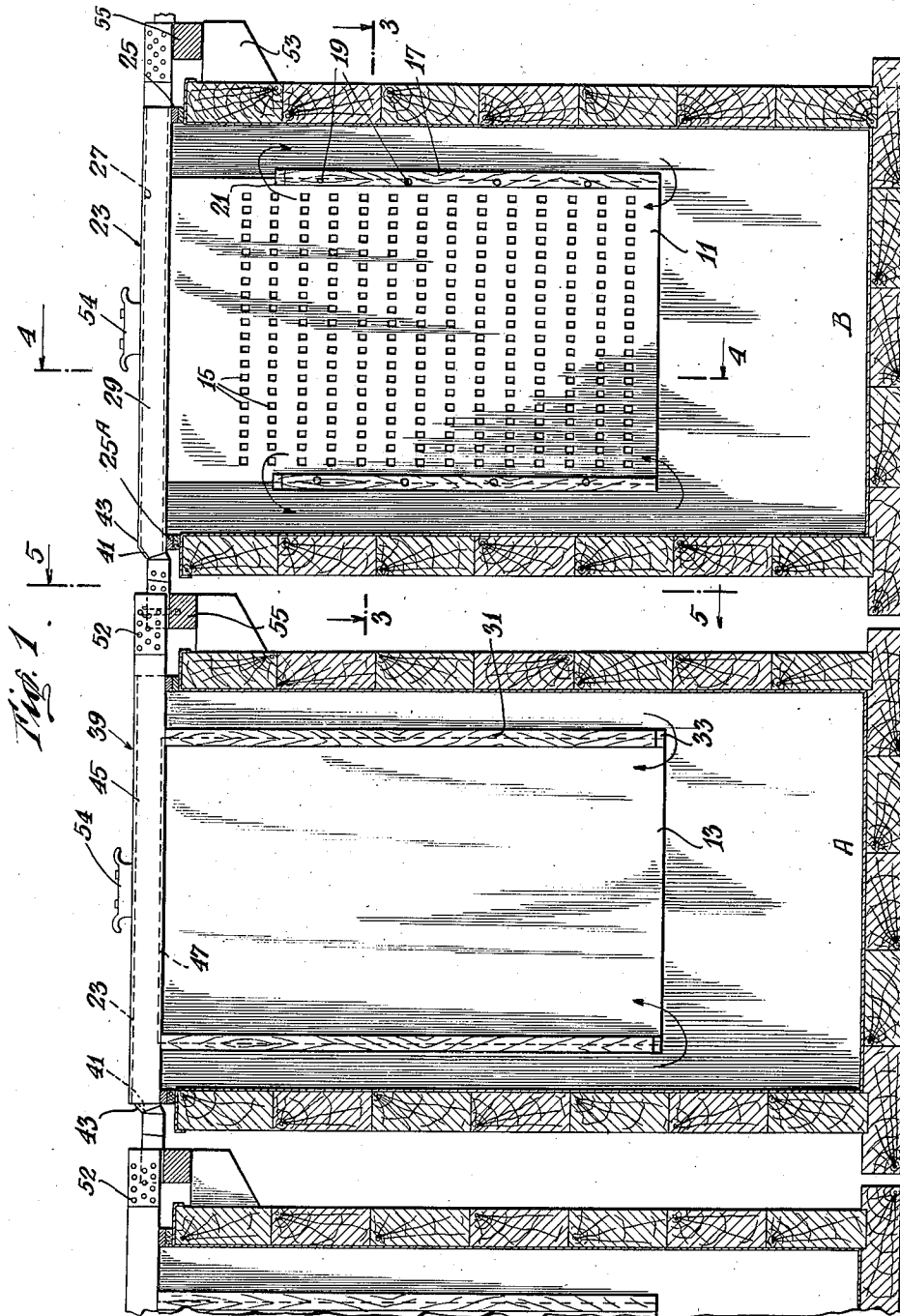
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2,115,004

ELECTROLYTIC APPARATUS

Original Filed Feb. 14, 1935

3 Sheets-Sheet 1



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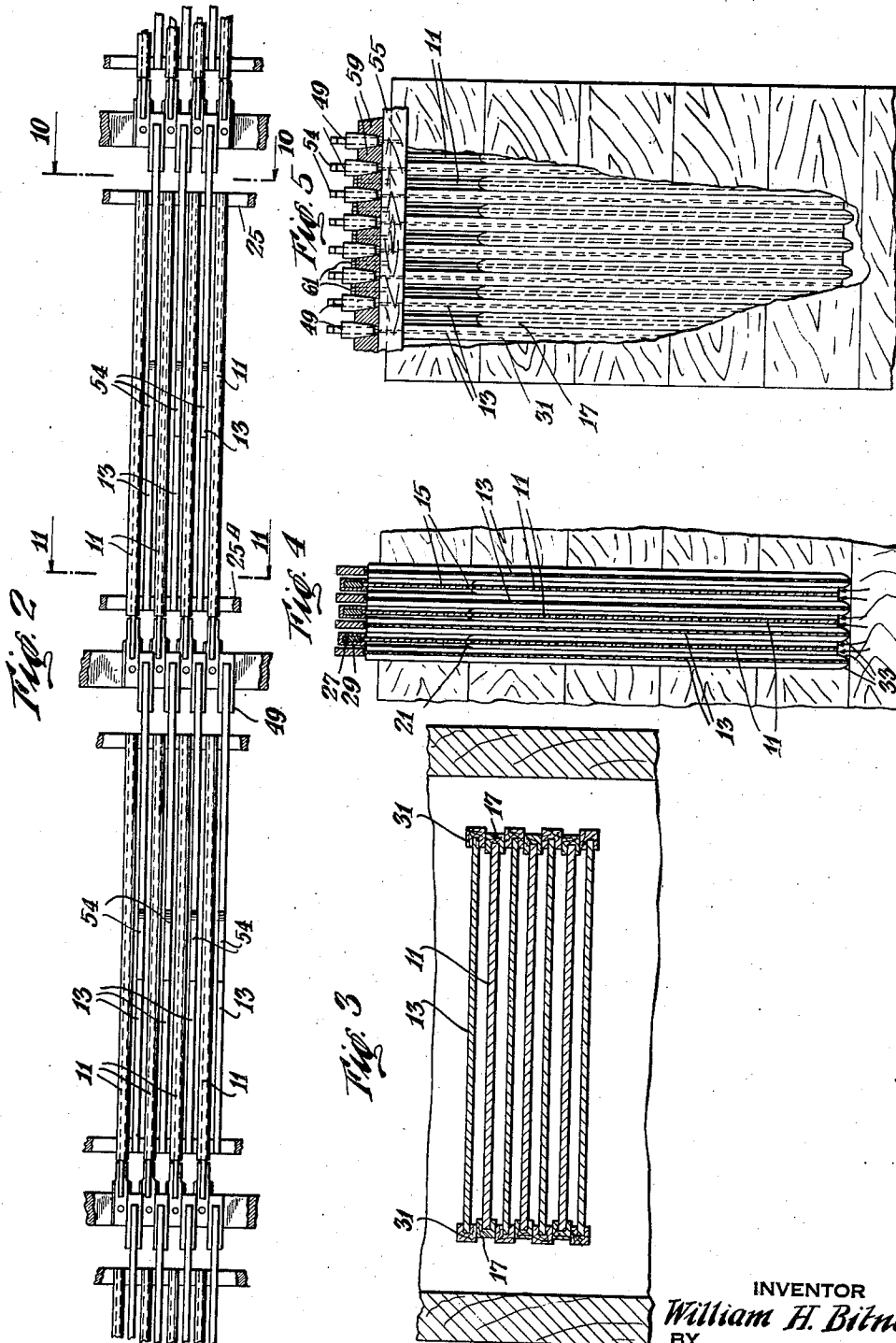
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3 Sheets-Sheet 2



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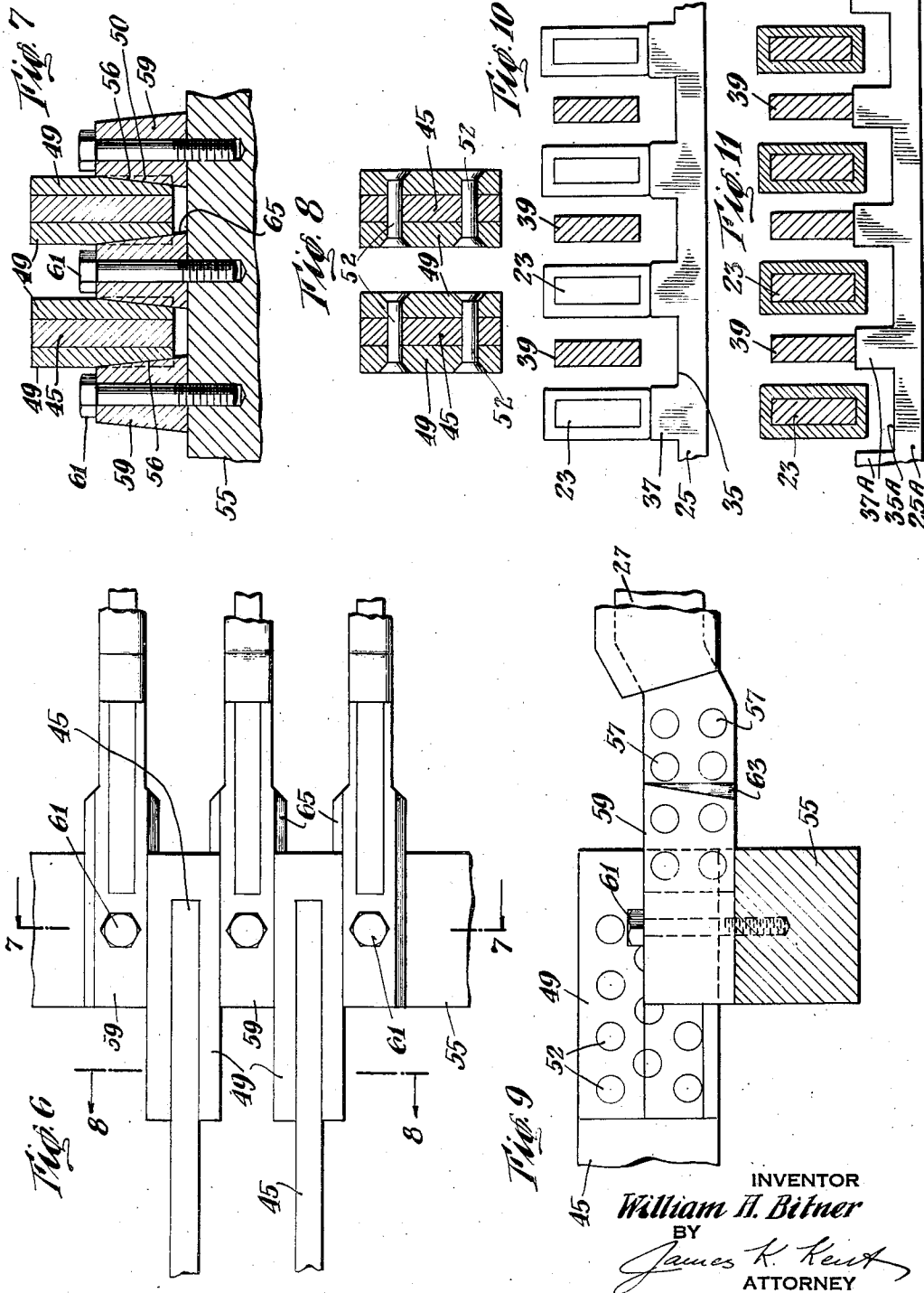
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ELECTROLYTIC APPARATUS

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3 Sheets-Sheet 3



## UNITED STATES PATENT OFFICE

2,115,004

## ELECTROLYTIC APPARATUS

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10 Claims. (Cl. 204—5)

The present invention relates to an improved form of electrolytic apparatus adapted for the electrodeposition of metals, such as, for example, copper, cadmium and zinc, and it pertains more especially to an improved construction and mounting of a multiplicity of anodes and cathodes in the cell whereby the cathodes of a given cell may be removed readily and simultaneously for stripping the deposited metal therefrom, after which the cathodes may be readily replaced in the cell for receiving further deposit of metal.

It has been the customary practice in the production of electrodeposits of metal as indicated above, for the purpose of maintaining the correct alignment of the electrodes, to employ wood strips attached to the vertical edges of the cathodes, these strips being customarily in the form of frames held in place by a structure within the cell. If the metal electrodeposited on the cathode surfaces is to be detached or stripped from the cathode, these strips or guides prevent the deposition of metal on the edges of the cathodes thereby facilitating detachment of the electrodeposited metal from the cathode.

The use of such frames held in place within the cells prevents ready manipulation of the cathodes, particularly when a plurality of cathodes are used in a cell and it is desired to remove them for stripping, as with such frames, individual replacement of the cathodes is required.

Furthermore, it is important that a good circulation of electrolyte be maintained in the cells. The use of the frames above referred to possesses the advantage of permitting such circulation to take place, since they maintain the electrodes in properly spaced relation; but, where the installation is a large one, unless the cathodes of a unit or bank of cells can be removed and replaced simultaneously, it is evident that there is required a substantial increase in the amount of handling of the cathodes with consequent loss of efficiency and increased operating costs.

The present invention has for one of its objects, the provision of an improved electrode structure and mounting for the anodes and cathodes of electrolytic cells wherein the cathodes may be removed and replaced readily and simultaneously, while automatically coming into correct alignment with the anodes, the improved structure and mounting retaining the advantages of the aforesaid framework heretofore customarily employed.

A further object of the invention is to provide an electrode construction wherein the electrodes

of each cell readily become arranged in such manner that the circulation of electrolyte past the electrode surfaces is greatly improved.

Other objects and advantages of the present invention will become apparent as the description proceeds, and the features of novelty will be particularly pointed out in the appended claims.

Referring more particularly to the drawings, Fig. 1 is a vertical sectional view through a plurality of electrolytic cells installed in accordance with the present invention.

Fig. 2 is a fragmentary plan view showing certain features of the mountings of the electrodes in the cells of Fig. 1.

Fig. 3 is a fragmentary sectional plan view through one of the cells of Fig. 1, the view being taken on the line 3—3 of Fig. 1, looking downwardly as indicated by the arrows.

Fig. 4 is a fragmentary vertical sectional view showing details of the electrode arrangement in the cells, the view being taken on the line 4—4 of Fig. 1, looking in the direction of the arrows.

Fig. 5 is a fragmentary elevational view taken on the line 5—5 of Fig. 1, looking in the direction of the arrows, a portion of the cell being broken away to show the arrangement of the electrodes, the view showing also the arrangement of contacts for the electrodes at the top of the cell.

Fig. 6 is a fragmentary plan view on an enlarged scale, showing the contacts between the electrodes at the tops of adjacent cells, as indicated also on Fig. 1.

Fig. 7 is a vertical section taken on the line 7—7 of Fig. 6, looking in the direction of the arrows.

Fig. 8 is a vertical section taken on the line 8—8 of Fig. 6.

Fig. 9 is a fragmentary side elevation showing the anode and cathode assembly as mounted on a bus bar, the view being taken substantially at right angles to Fig. 7.

Fig. 10 is a sectional elevational view taken on the line 10—10 of Fig. 2, looking in the direction of the arrows.

Fig. 11 is a sectional elevational view taken on the line 11—11 of Fig. 2, looking in the direction of the arrows.

Referring more particularly to the drawings, A and B represent two electrolytic cells of adjacent cell banks installed side by side in substantial parallelism in a cell room of an electrolytic plant. These cells are adapted for the electrolytic recovery of metals such, for example, as zinc, copper or cadmium, though not limited to these metals; but for purposes of illustration, it will be

considered that these cells are employed for the recovery of zinc from zinc sulphate solutions produced by the leaching of non-sulphide zinc ores or concentrates by sulphuric acid.

Within each cell there are positioned a plurality of anodes and a plurality of cathodes. The anodes are designated at 11 and the cathodes at 13. It will be seen that looking in a direction longitudinally of the cell banks there is an anode between each pair of cathodes, and in the transverse direction, across adjacent cell banks, the anodes and cathodes are staggered.

Where, as in the present illustration, the deposit is to be stripped from the cathodes, the cathodes are desirably of sheet aluminum to enable ready stripping of the deposit without likelihood of injuring the electrode surface, the aluminum also, by reason of its low specific gravity, facilitating handling the cathodes. The anodes 11 are, in accordance with the present illustration, insoluble in a zinc sulphate electrolyte and may comprise, for example, a silver-lead alloy as disclosed in U. S. Letters Patent No. 1,759,493 to Uryln C. Tainton.

Referring first to the construction of the anodes, it will be seen that, in the illustrated form, they are made of substantially rectangular sheets provided with a multiplicity of holes 15 disposed substantially uniformly over the surface of the anodes. These holes serve a two-fold purpose, namely, that of reducing the weight of the anodes while increasing the amount of active surface thereof. The edges of the anodes are encased in strips 17 of suitable insulating material such as wood, rubber, synthetic resins, glass, etc., and they are attached to the edges of the anodes by suitable fastening members, such as dowel pins 19. The anode strips 17 are substantially shorter than the anodes themselves, the tops of the strips in practice being approximately four inches below the solution line in the cells. The anode strips 17 are beveled at their tops, as indicated at 21, for a purpose to be hereinafter described; and these strips 17 reinforce the anodes and maintain them flat, overcoming any tendency of the anodes to buckle under their own weight, along any of the holes 15. The anodes are supported across the cells on bars 23 which rest on strips 25, positioned along the top of the cells, as will be pointed out hereinafter in greater detail.

The bars or hangers 23 are desirably made up of an internal bar of high conductivity metal, such as copper, designated at 27, which is encased in a lead sheath 29 cast around the bar 27, the sheath 29 encasing the upper edge of the anode plates 11 and forming a substantially integral union therewith.

The cathodes 13 alternate with the anodes 11 in the assembled cells, there being an anode 11 between each pair of cathodes 13. The cathodes 13 are formed of sheets of somewhat greater width than the anodes 11, aluminum being a very desirable cathode material, where the deposit is to be stripped, as its lightness enables the cathodes to be handled more readily, and the properties of aluminum are such that the deposited metal is readily stripped therefrom.

The edges of the cathode sheets 13 are covered with strips 31, generally similar to the anode strips 17, but being held in frictional engagement therewith, so that they may be readily removed from the cathode plates when the deposit is to be stripped from the cathodes. The cathode strips 31 extend substantially the entire length of the

cathodes, and are beveled at their bottoms as indicated at 33. Thus when the cathodes are inserted in the cell, the beveled portions 21 of the anode strips 17 come into engagement with the beveled portions 33 of the cathode strips 31, the cathodes thus being guided into proper alignment with the anodes. The combination of the strips 17 on the anodes, together with the strips 31 on the cathodes space the anodes and cathodes relatively to each other so as to produce compartments between each cathode, the compartments being closed at their sides by the engagement between the strips 17 and 31, the compartments being open at their tops and bottoms. During electrolysis, oxygen evolved at the anode surfaces causes a gas lift within the electrolyte which produces an upward flow of the electrolyte along the electrode surfaces, this circulation of electrolyte being designated by the arrows in Figs. 1 and 4. These arrows show the flow of electrolyte upwardly through the compartments, over the tops of the anode strips, and down the cell walls to again recirculate.

The cathode sheets may be, preferably, quite thin in order to reduce the weight thereof, being in practice sheets of aluminum foil of only sufficient thickness to prevent destruction thereof during the stripping operation. The strips 31 comprise reinforcing or stiffening means for the sheets 13, preventing their deformation during handling and maintaining them rigid during the deposition thereon.

Referring now in greater detail to the mountings of the anodes and cathodes in the cells, it will be recalled that it has been mentioned above that the hangers for the anodes and cathodes rest on strips 25, 25A positioned on the side walls of the cells. Fig. 10 illustrates the position of the electrodes relative to these strips 25. It will be seen from Figs. 10 and 11 that the strips 25, 25A, are notched as indicated at 35, 35A, respectively, the notches 35, 35A being formed between the lugs 37, 37A, respectively. The notches and lugs may be of equal width, and the strips 25, 25A are positioned relatively to each other so that the notches 35 and lugs 37 of one strip are staggered with the lugs 37A and notches 35A of the opposite strip, so that the strip 25 and the anode hangers 23 will be supported at one end by the lugs 37, while at the opposite strip 25A the anode hangers 23 register with the notches 35A, there being a substantial clearance between the anode hangers 23 and the said notches 35A.

The cathode hangers 39 are positioned in like manner, the hangers 39 being supported on the lugs 37A adjacent to the clearance between the notches 35A and the anode hangers 23, and clearing the notches 35 of the strip 25 upon the lugs 37 of which rest the anode hangers 23. This arrangement effectively prevents any tendency for short circuits to be formed between the anodes and cathodes.

It has been said that the anode hanger 23 comprises an internal copper conductor bar 27 with a lead sheath 29 cast therearound. Contact is between the anode plates 11 and the conductor bar 27, the function of the lead sheath being to protect the conductor bar 27 from spray from the electrolyte; for when zinc sulphate is the electrolyte, the sulphuric acid present therein has a markedly corrosive action on copper, and there would result a very harmful contamination of the electrolyte with copper sulphate were not this conductor bar 27 protected by the sheath 29. At a

point adjacent to one end, the conductor bar 27 is bent downwardly as indicated at 41, and the lead sheath 29 slopes similarly as indicated at 43. These sloping portions extend beyond the inner walls of the cells and cause any condensed electrolyte which may contact with the exposed end of the conductor bar 27 to run outside of the cells, thereby serving as a further preventative of electrolyte contamination, as above referred to. When the anodes are assembled in the cells, they are mounted so that the ends of the anode hangers are clear of the strips 25A, the plain ends of the anode hangers resting upon the lugs 37 of the strip 25. The remaining details of the anode mountings will be referred to fully hereinafter.

The cathode hanger 39 comprises an aluminum bar 45 which is grooved as indicated at 47. The cathode plate 13 is inserted in this groove and welded in place. Of course, metals other than aluminum may be used, but aluminum is preferred owing to its low specific gravity. The cathodes are removed from the cells when not in use.

It will be observed, see Figs. 1 and 2, for example, that the cells A and B are spaced from each other, and that on the sides of the cells are mounted wooden brackets 53 which carry bus bars 55, suitably of copper.

As will be seen from the drawings, each of the anode conductor bars 27 has secured to its bent end, by rivets 57, or the like, a copper contact shoe 59, these being secured to the bus bars 55 by cap screws 61, thereby holding the anodes in proper spaced relationship when they are assembled. These shoes 59 are comparatively wide and flat, flaring outwardly as indicated at 63. They also taper outwardly from top to bottom, as will be seen at 65, being substantially wider at their bottoms than at their tops.

In a somewhat similar manner, the cathode hangers 45 are provided, at one end of each, with copper contact shoes 49 adapted to enter between the anode shoes 59 and be wedged therebetween. For this purpose the cathode shoes are tapered inwardly from a point intermediate their tops and bottoms, as indicated at 50, the slope of this taper being somewhat greater than the slope of the taper 65 of anode shoes 59 to enable the cathode contact shoes to become wedged between the anode shoes as clearly shown in Figs. 5 and 7, so that when the anodes and cathodes are assembled in the cell, the cathode shoes are held thereby out of contact with the bus bar 55. This wedging of the cathode contact shoe 49 between the anode shoes maintains the cathode plates in alignment relative to the anodes. As will be seen from Figs. 7 and 8, the cathode contact shoes 49 need not be beveled for their entire length. The contact shoes 49 are riveted to the cathode bars 45 by rivets 52. The beveled portions of the contact shoes 49 are indicated at 56, Fig. 7.

For lifting the cathodes from the cells, the cathodes are provided with lifting lugs 54 which are adapted to be engaged by lifting instrumentalities on a crane, not shown, so that a number of cathodes may be removed from the cell at one time, and replaced; and the contour of the cathode contact shoes is such that the weight of an operator standing on a board or the like laid across the cathode bars 45 of one cell while positioning the cathodes of the adjacent cell will cause the cathode contact shoes to become wedged between the anode shoes 59.

During operation of the cell, current flows

from the cathodes of one cell to the anodes of the adjacent cell, passing through the electrolyte from anodes to cathodes in each cell, during which passage the electrolyte is circulated as described above, and as indicated by the arrows on the drawings; current passes from both surfaces of each anode to the adjacent cathode surfaces; and because of the presence of the wooden strips 31 along the edges of the cathodes which prevent deposition of metal to the very edges of the cathodes, the deposit is rendered very accessible for stripping. These strips 31 being only in frictional engagement with the cathode plates 13 are readily removable and replaceable.

It will be apparent, of course, that the present invention is not limited to the exact details of construction herein specifically illustrated and described, and which are to be regarded as being only illustrative of a convenient form of the invention as assembled and constructed; and it will be apparent that many modifications of these specific details may be readily effected by one skilled in the art without departing from the inventive concept. It will be understood, therefore, that it is intended and desired to embrace within the scope of this invention such modifications and changes as may be necessary to adapt it to varying conditions and uses.

What is claimed is:

1. Electrolytic apparatus comprising the combination with an electrolytic cell, of spaced electrodes therein, and marginal side strips on the electrodes forming compartments through which electrolyte is adapted to be circulated during electrolysis, the strips having tapered ends to form guides upon engagement of corresponding strips with each other for guiding the electrodes into proper alignment during assembly thereof.

2. Electrolytic apparatus comprising the combination with an electrolytic cell, of spaced electrodes therein, and marginal side strips on the electrodes forming compartments through which electrolyte is adapted to be circulated during electrolysis, the strips of one electrode being tapered at their upper ends while the strips of the next electrode are tapered at their lower ends to form guides upon engagement of corresponding strips with each other for guiding the electrodes into proper alignment during assembly thereof.

3. Electrolytic apparatus comprising the combination with an electrolytic cell, of spaced electrodes therein defining cathodes and anodes, there being an anode between each pair of cathodes, the cathodes and anodes comprising sheets defining compartments therebetween through which electrolyte is adapted to circulate, and hangers for the anodes and cathodes to which the sheets thereof are secured for suspending the cathodes and anodes in the cell, the anode hangers being of high conductivity metal attackable by the electrolyte being electrolyzed but being provided with a sheath insoluble in the electrolyte being electrolyzed for protecting the hangers against corrosive action of the electrolyte and preventing contamination of the electrolyte by material from the hangers, the said hangers and sheath being formed at one end into a guide for electrolyte collected thereon for causing the collected electrolyte to drain outside of the cell, the cathode hangers being of material innocuous to the electrolyte.

4. An electrolytic anode comprising an anode sheet, a conductor bar to which the anode sheet is secured, the conductor bar being of high conductivity metal, and a protective sheath about

the conductor bar to protect the latter from electrolyte collecting thereon, the conductor bar and sheath having a downwardly extending portion adjacent to one end thereof for directing collected electrolyte to the outside of the cell in which the anode is used.

5. Electrolytic apparatus comprising the combination with electrolytic cells in side-by-side position, of spaced electrodes in the cells defining cathodes and anodes having electrolyte circulation compartments therebetween, oppositely disposed supporting bars for the electrodes on the cells, the supporting bars comprising a series of upstanding lugs defining notches therebetween, hangers for the cathodes supported at one end on the lugs of one of the supporting bars and having their other ends in the notches of the opposite bar but clearing the said bar, and hangers for the anodes having one end thereof supported on the lugs of the supporting bar cleared by the cathode hangers and extending into the notches, but clearing the same, of the bar upon the lugs of which the cathode hangers are supported.

6. Electrolytic apparatus comprising the combination with electrolytic cells in side-by-side position, of spaced electrodes in the cells defining cathodes and anodes having electrolyte circulation compartments therebetween, electrode supporting bars on opposite sides of the cells and provided with spaced notches, the bars being disposed so that the notches of one bar are in opposition to the lugs of the opposite bar, electrode hangers supported on the lugs of the said bars and substantially extending into, but clearing, the notches of the opposite bar, supports intermediate the cells for the electrode hangers, contact shoes for the anode and cathode hangers, and means securing the anode hangers to the supports intermediate the cells for securing the anodes in proper predetermined spaced relation, the contact shoes for the cathodes being adapted to become wedged between the cathode shoes for the anodes, thus removably positioning the cathodes in proper alignment with the anodes when the cells are assembled.

7. Electrolytic apparatus comprising the combination with electrolytic cells in adjacent side-by-side relation, of spaced electrodes in the cells defining cathodes and anodes, conductor bars for the cathodes and anodes extending across the

cells, means for rigidly holding the anode conductor bars in position on the cells, the said anode conductor bars defining wedge-shaped spaces therebetween, and contact means on the cathode conductor bars adapted to be wedged in the spaces between adjacent anode conductors for removably securing the cathodes in proper alignment with the anodes.

8. Electrolytic apparatus comprising the combination with electrolytic cells in adjacent side-by-side relation, of spaced electrodes in the cells defining cathodes and anodes, conductors for the cathodes and anodes extending across the cells, and contact shoes on the conductors, the contact shoes of the cathodes of one of the cells being adapted to be wedged between the contact shoes of the anodes of the adjacent cell for removably securing the cathodes in proper alignment with the anodes while enabling current to pass from one cell to the adjacent cell.

9. Electrolytic apparatus comprising the combination with electrolytic cells in adjacent side-by-side relation, of spaced cathodes and anodes in the cells, conductors for the cathodes and anodes extending across the cells, and tapered contact shoes on the conductors, the taper of the contact shoes of the cathode conductors of one cell enabling them to be wedged between the contact shoes of the anode conductors of the adjacent cell for removably securing the cathodes in proper alignment with the anodes thereby removably positioning the cathodes in proper alignment with the anodes when the cells are assembled while enabling current to pass from one cell to the adjacent cell.

10. Electrolytic apparatus comprising the combination with electrolytic cells in side-by-side relation, of spaced electrodes in the cells defining cathodes and anodes, conductor bars for the cathodes and anodes extending across the cells, contact shoes secured to the anode conductor bars, means for rigidly holding the anode conductor bars in position on the cells, the anode contact shoes being tapered to define wedge-shaped spaces therebetween, and wedge-shaped contact shoes on the cathode conductor bars adapted to be wedged in the spaces between adjacent anode conductor shoes for removably securing the cathodes in proper alignment with the anodes.

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