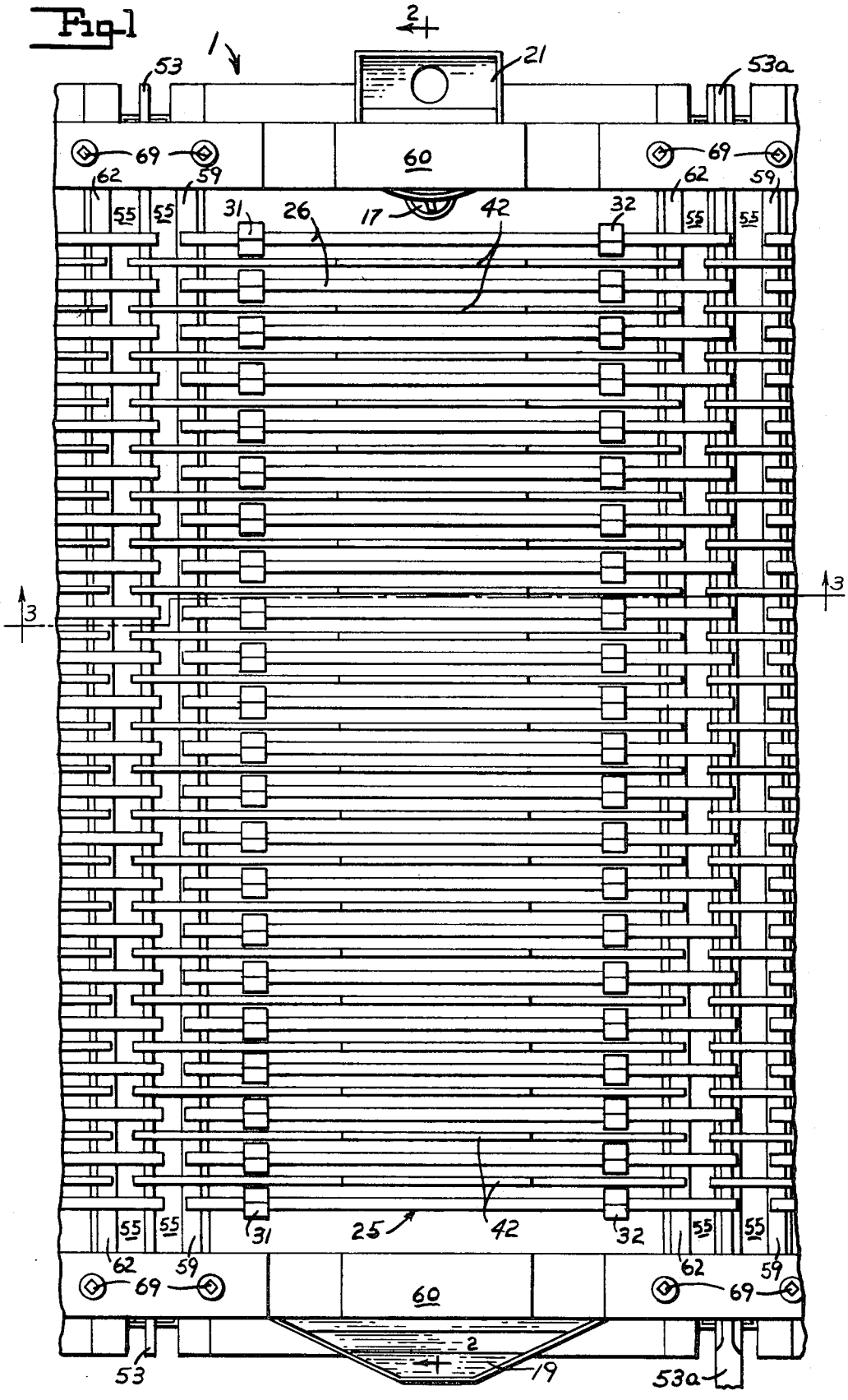
May 18, 1971 P. M. JASBERG 3,579,431

CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Fig 1

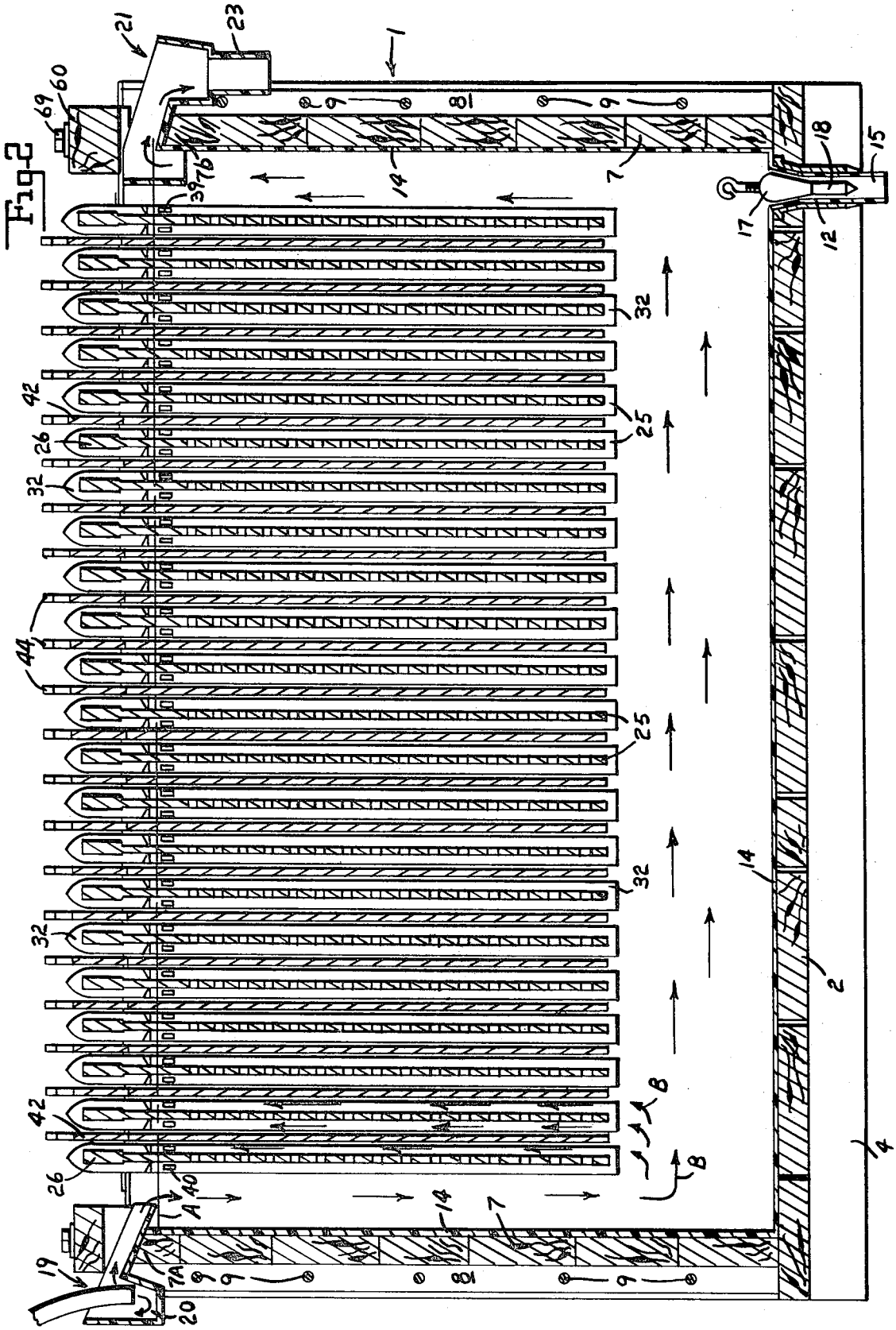


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CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Fig 2

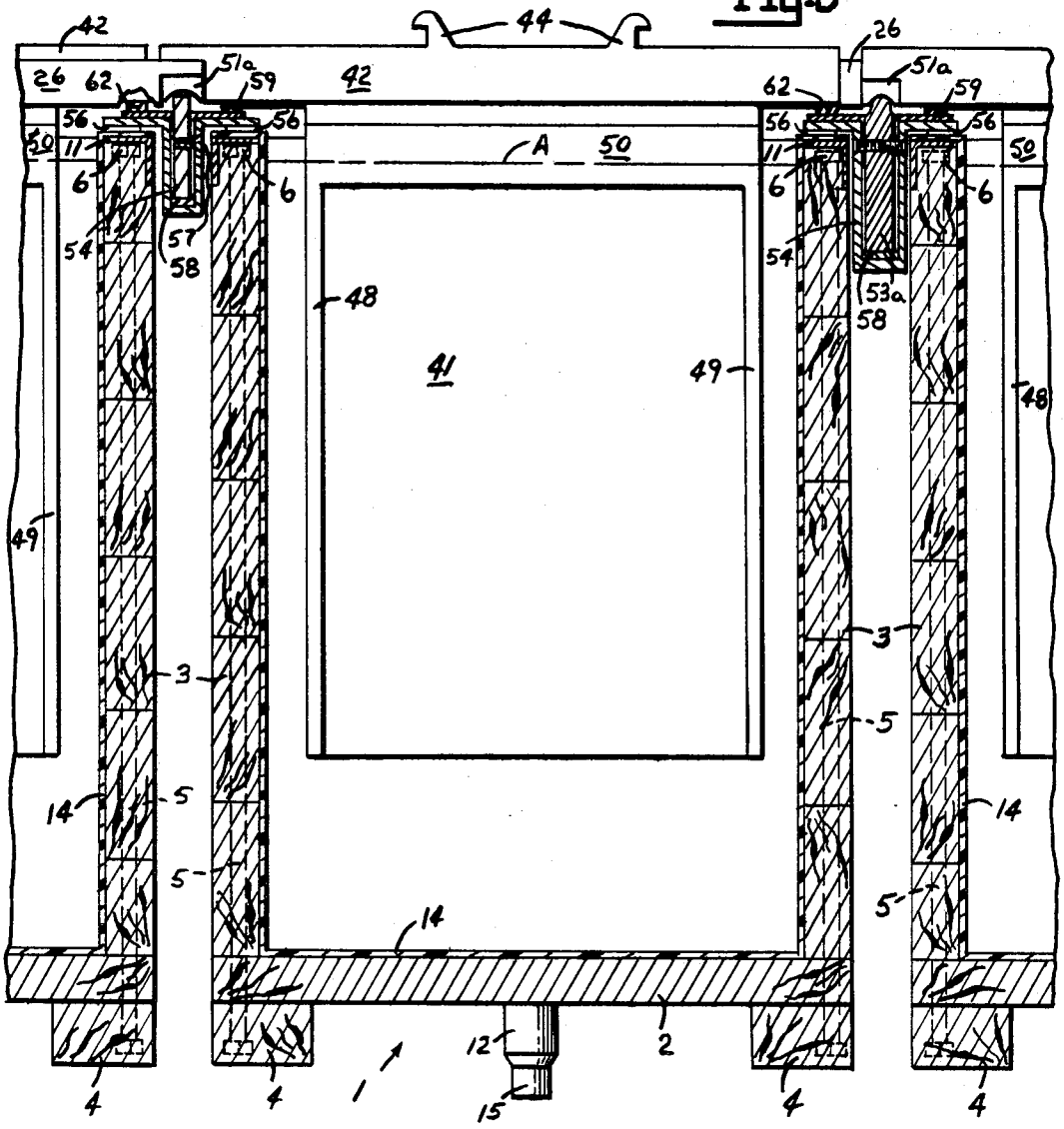


May 18, 1971 P. M. JASBERG 3,579,431

CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Fig-3



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CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Fig-4

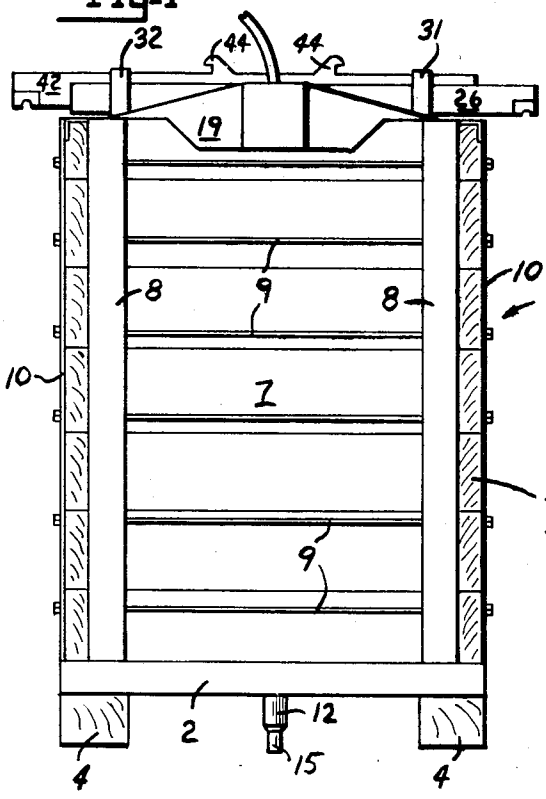


Fig-5

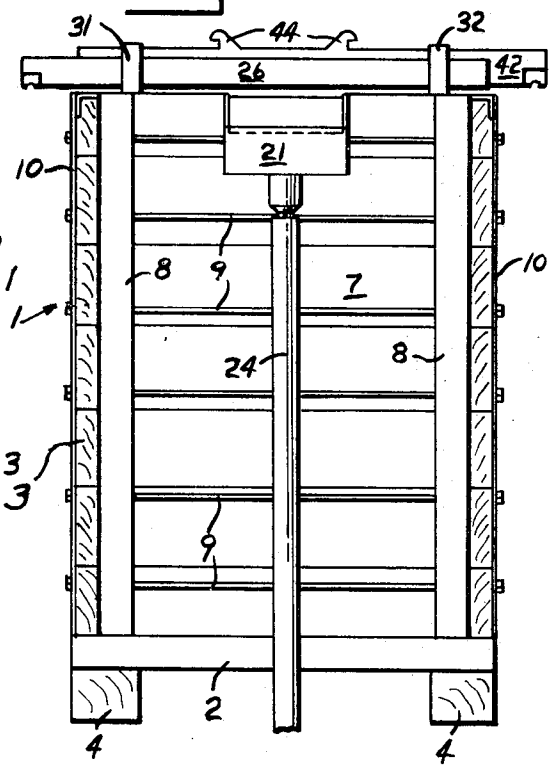
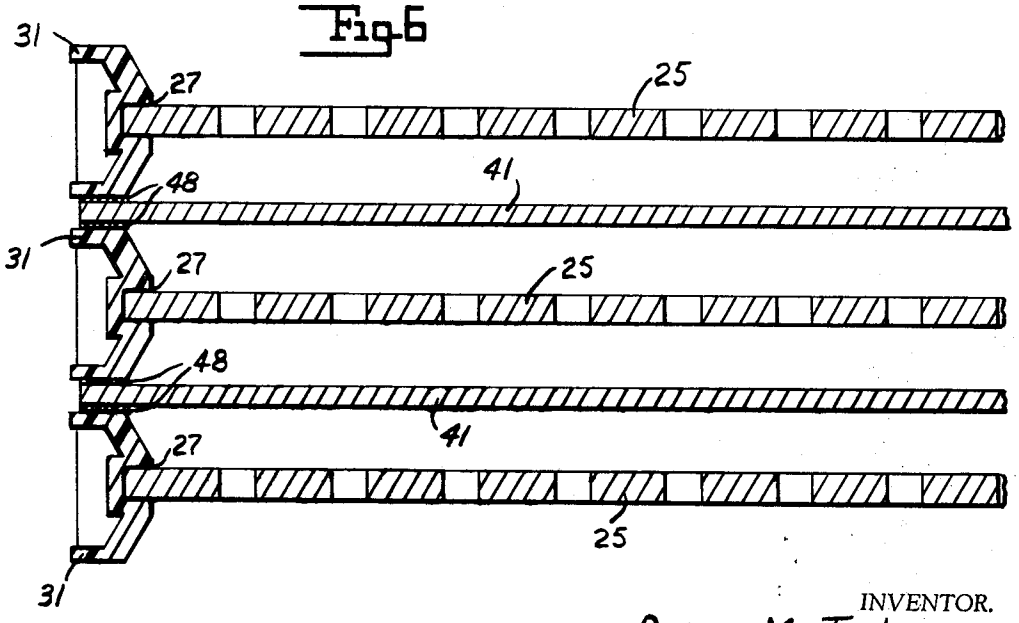


Fig-6



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CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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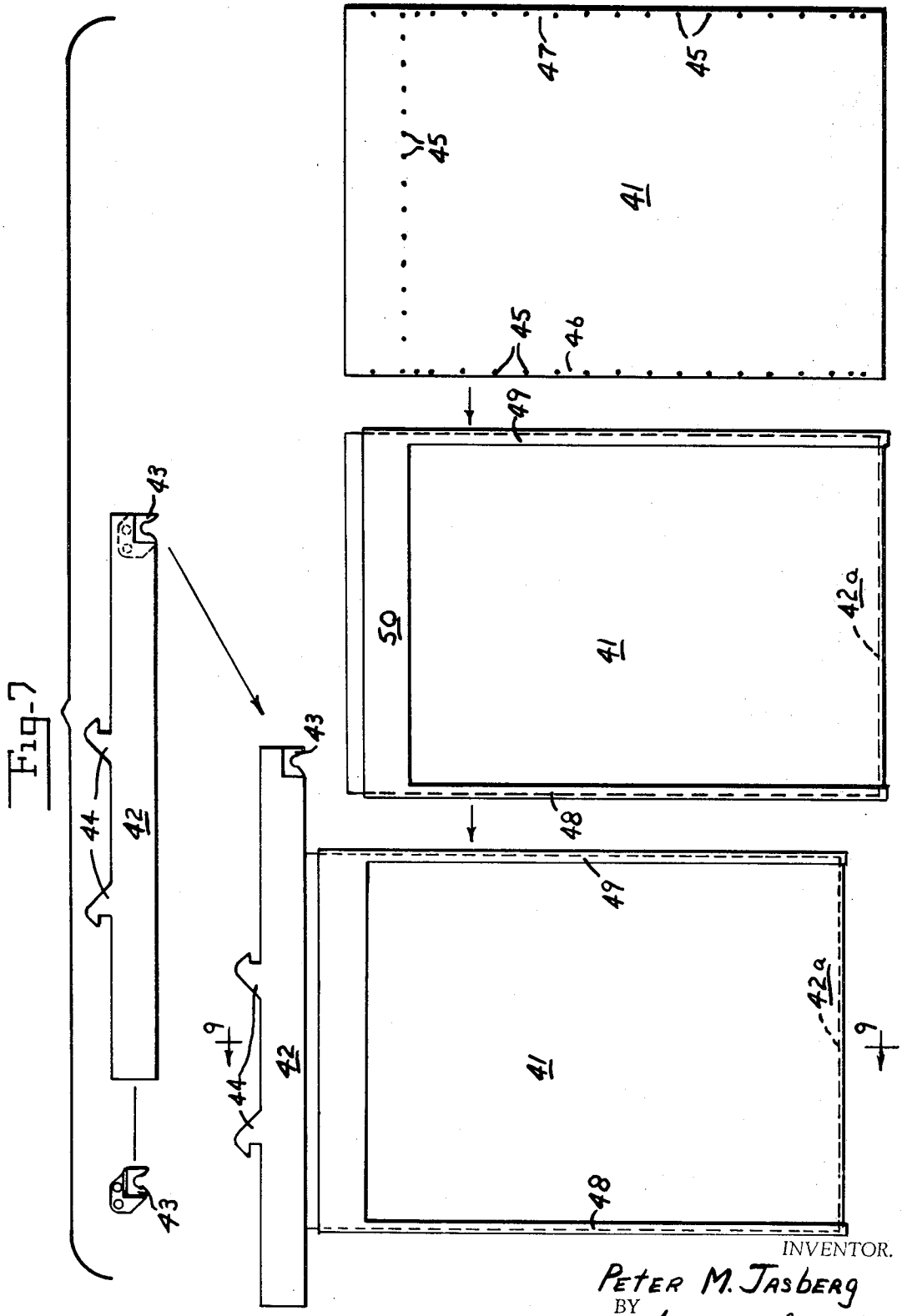


Fig-7

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CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Fig-8

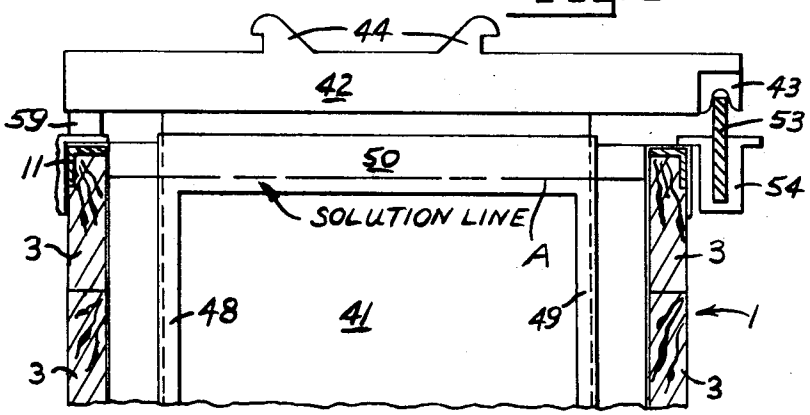


Fig-9

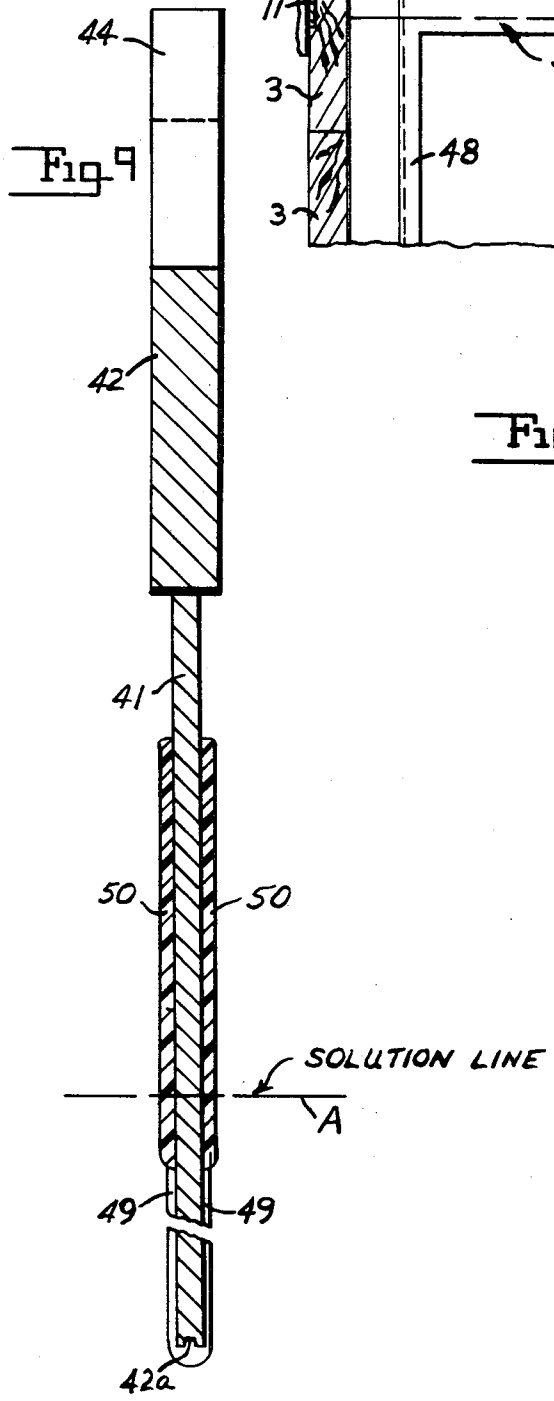
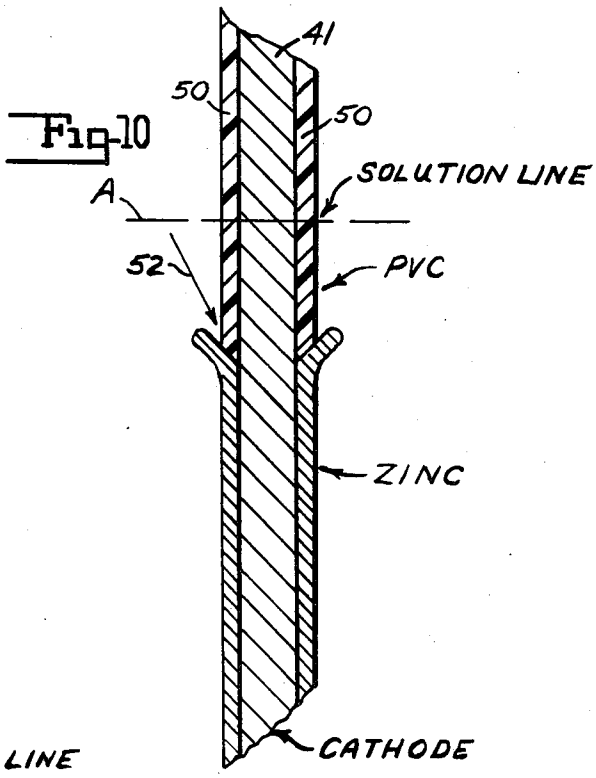


Fig-10



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CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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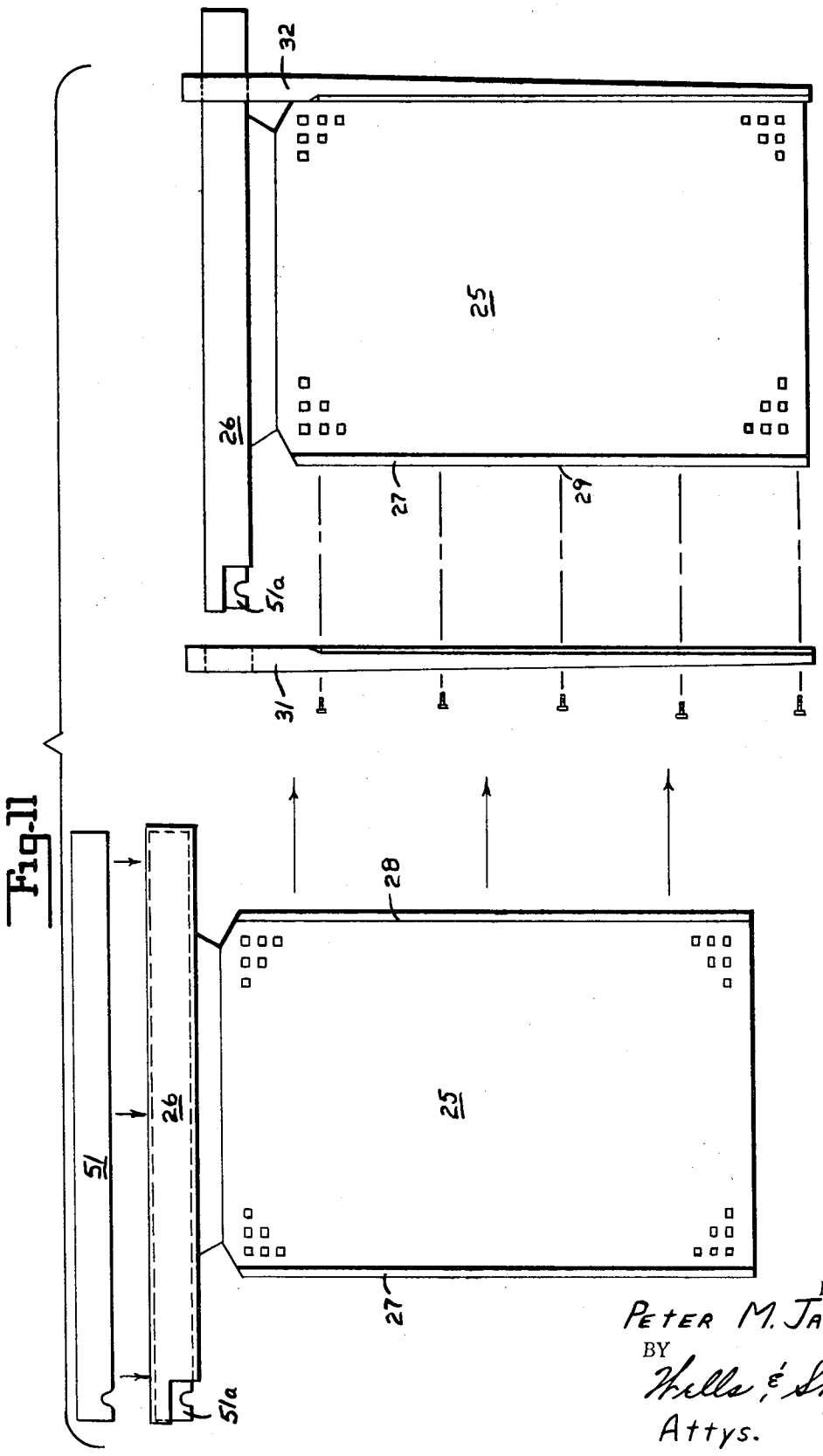


Fig-11

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May 18, 1971 P. M. JASBERG 3,579,431

CELL FOR ELECTROLYTIC DEPOSITION OF METALS

Filed Feb. 23, 1968 11 Sheets-Sheet 8

Fig 12

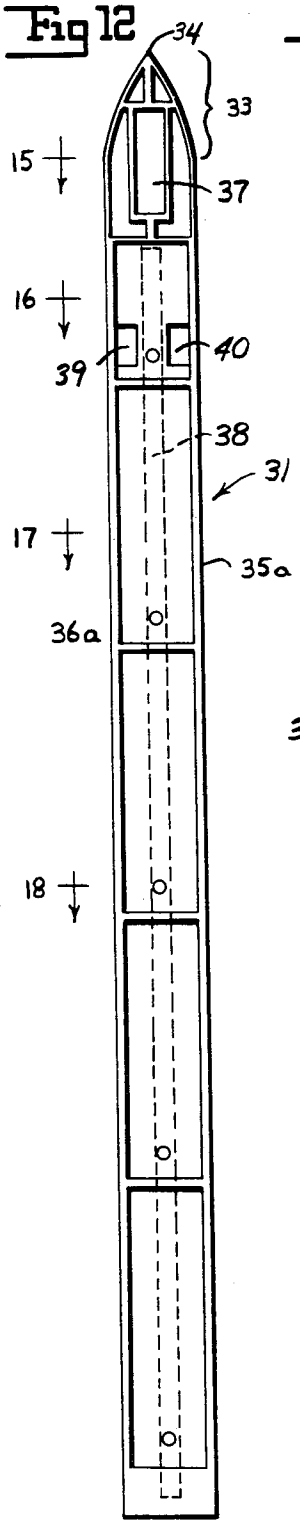


Fig 13

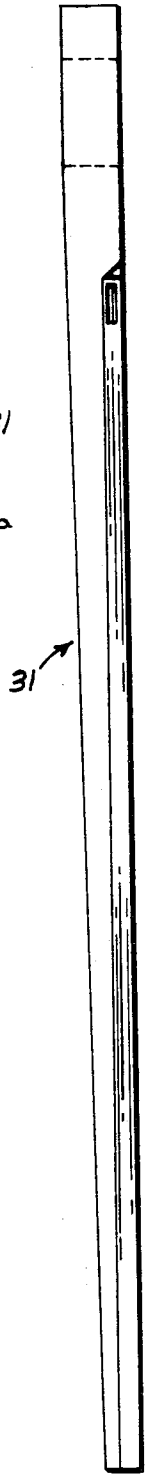


Fig 14

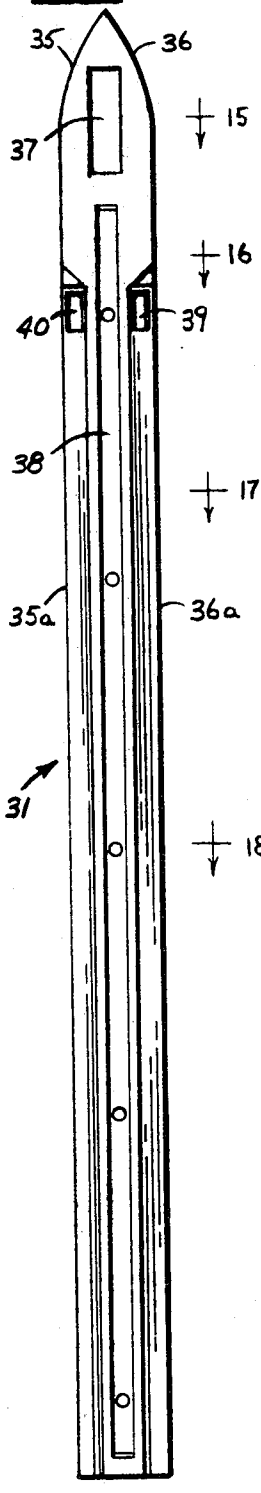


Fig 15

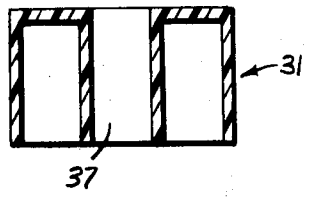


Fig 16

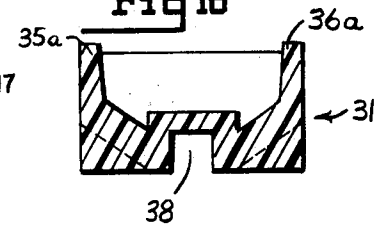


Fig 17

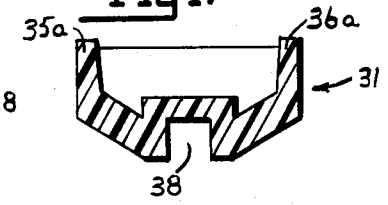
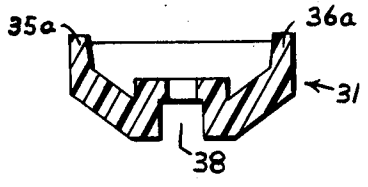


Fig 18



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CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Fig19

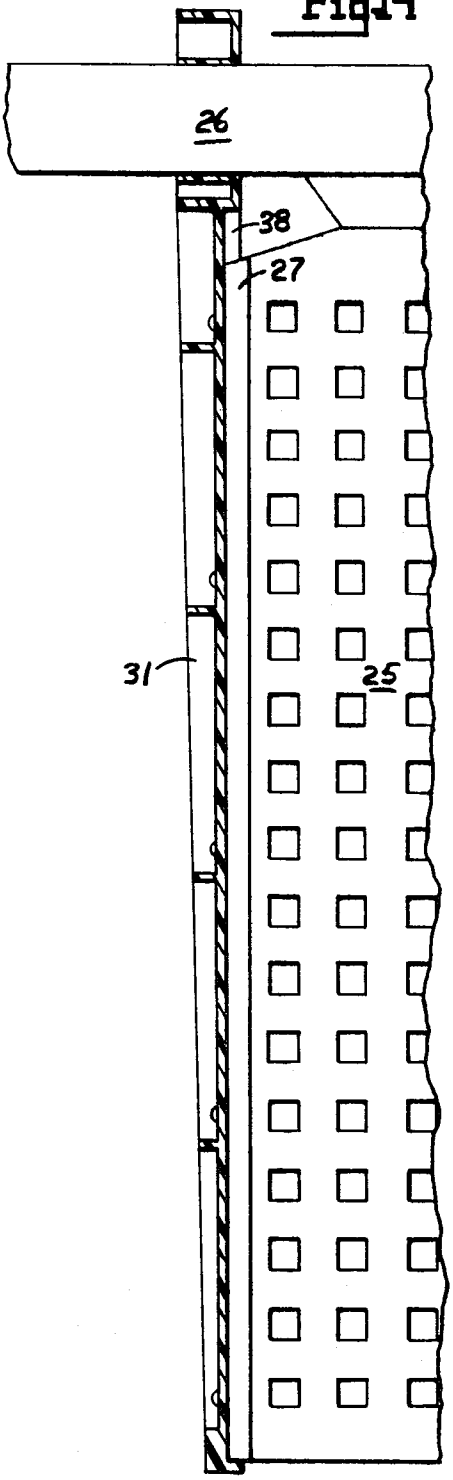
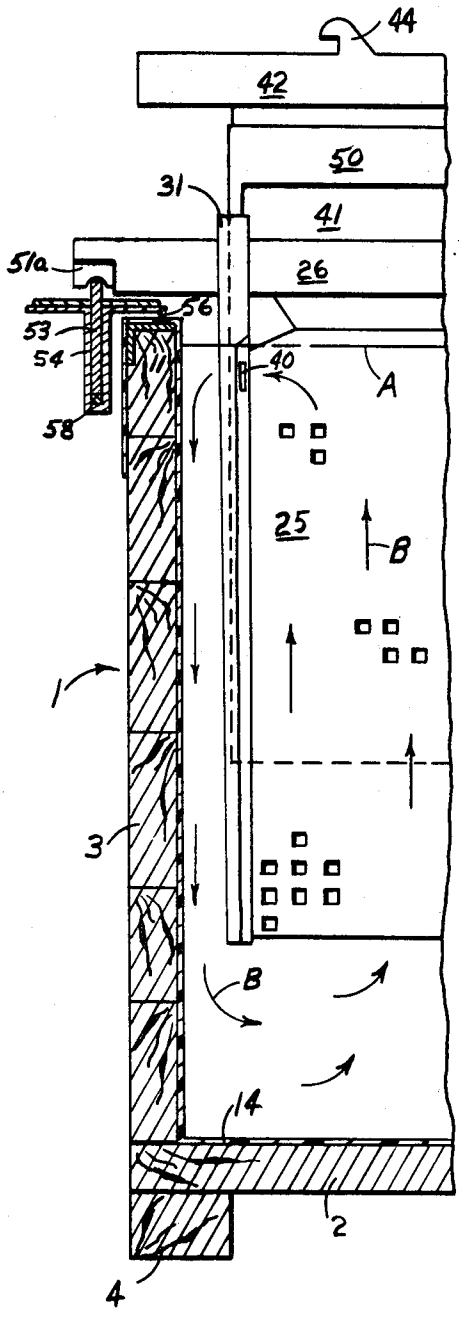


Fig20



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CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Fig-21

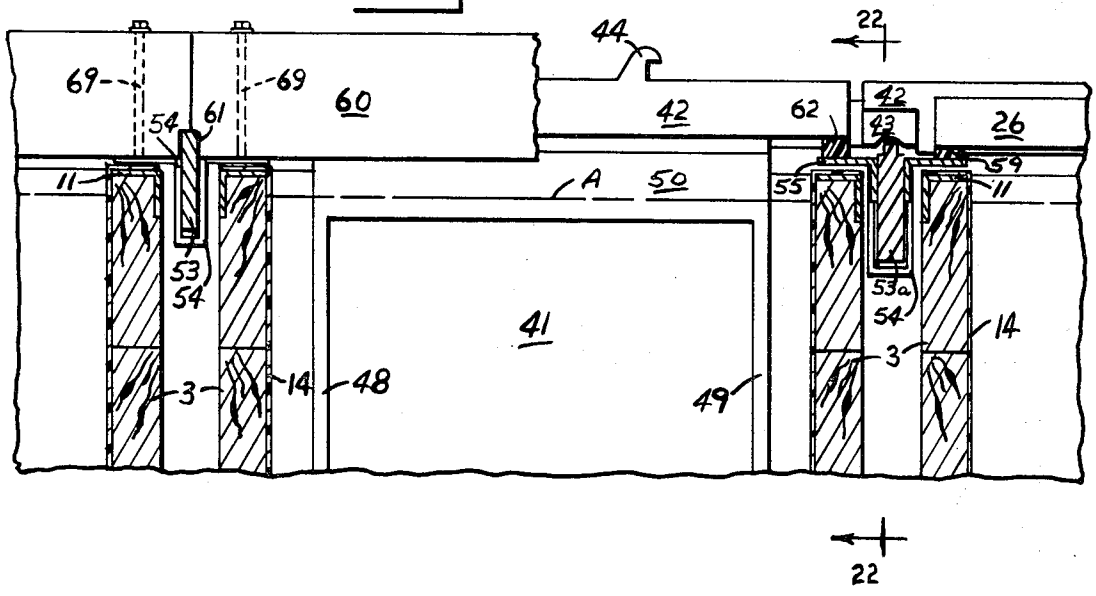
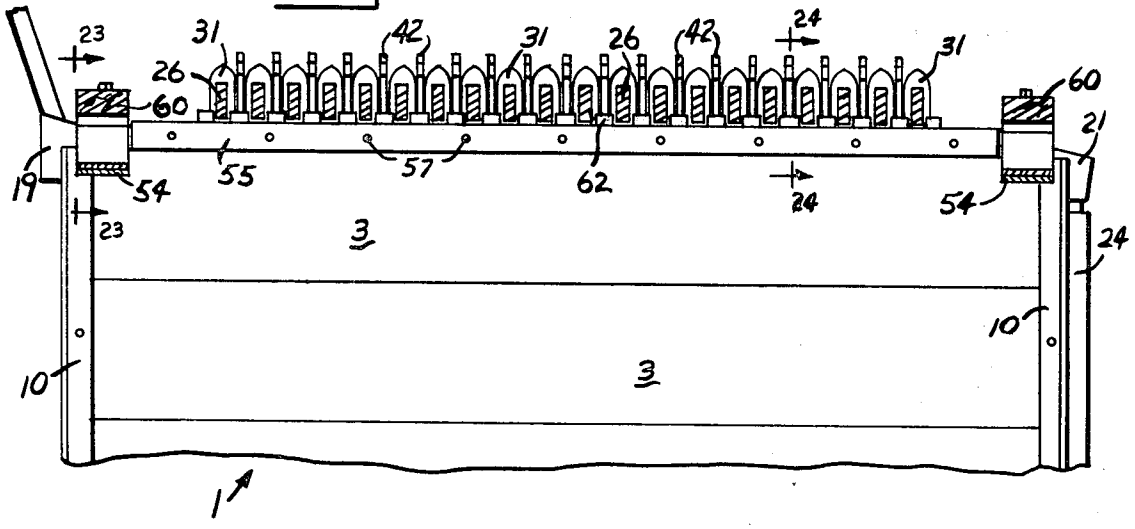


Fig 22



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CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Fig-23

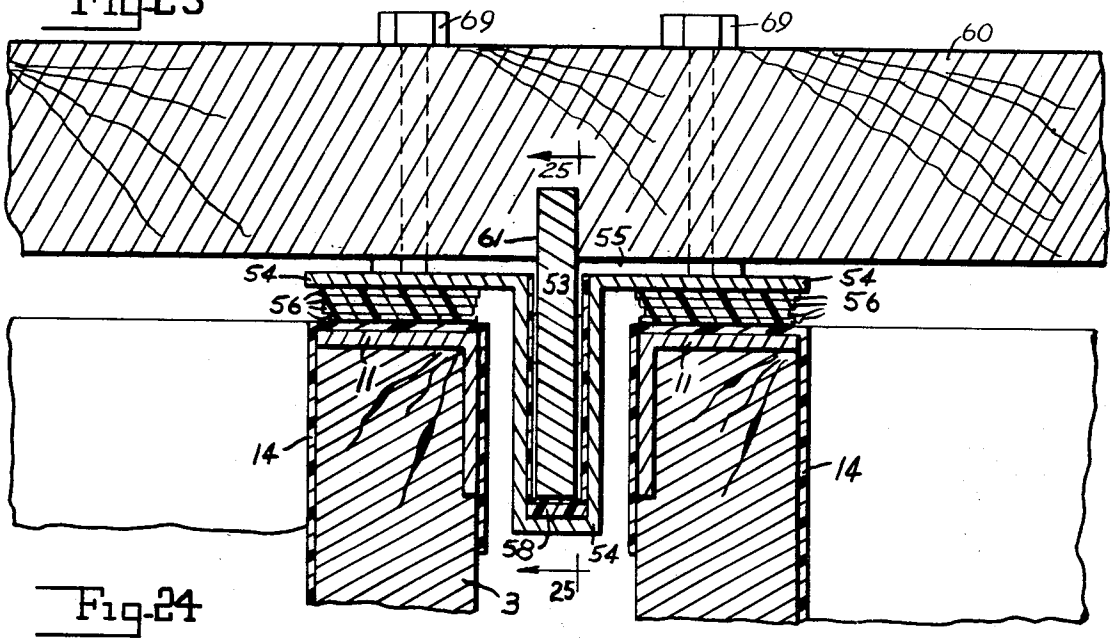


Fig-24

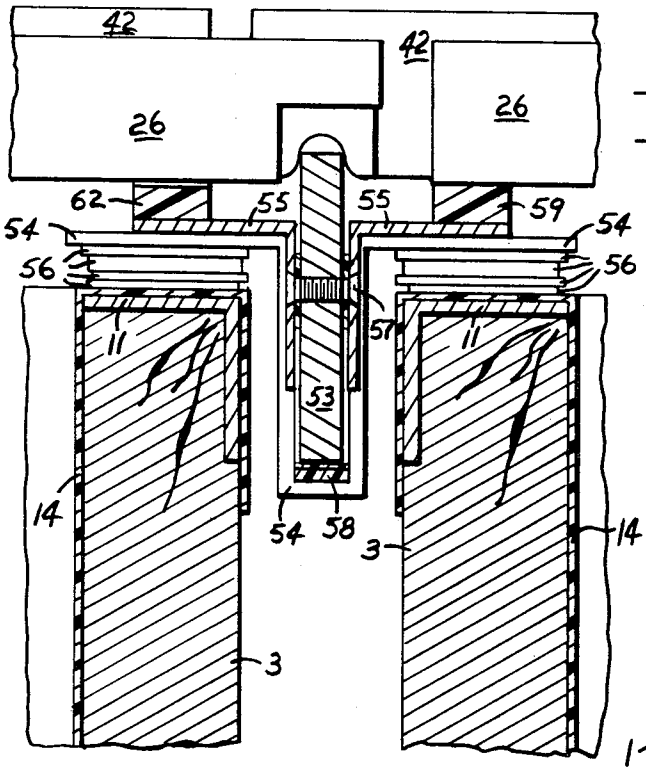
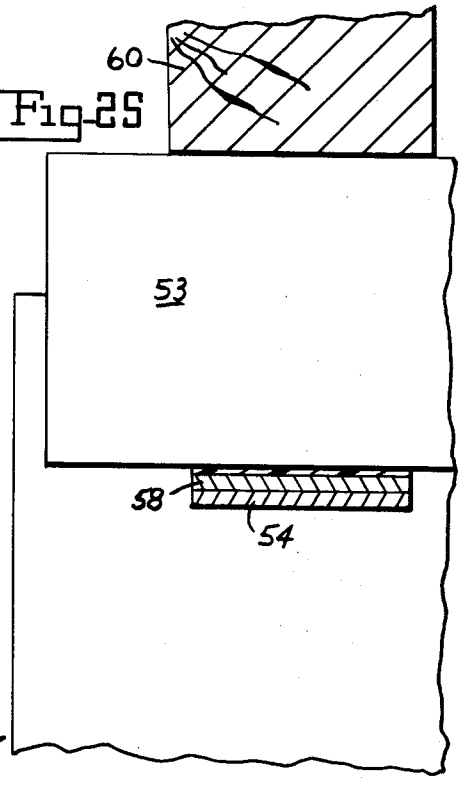


Fig-25



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United States Patent Office 3,579,431
Patented May 18, 1971

3,579,431

CELL FOR ELECTROLYTIC DEPOSITION OF METALS

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Filed Feb. 23, 1968, Ser. No. 707,847
Int. Cl. B01k 3/00, 3/02
U.S. Cl. 204—275 18 Claims

ABSTRACT OF THE DISCLOSURE

A cell assembly for electrolytic deposition of metals, designed to facilitate the electrolytic deposition and recovery of zinc or other metals similarly processed. The cell assembly includes an improved cell box comprising a treated wooden structure having a one piece protective liner. The liner includes an integral inlet box and outlet weir to insure consistent solution line elevation. An improved cathode structure is utilized, having protective non-conductive coverings applied thereto along the side and top portions of the plate on which metal is deposited. Improved anode assemblies include stiffening plastic guides attached thereto which position the cathodes relative to the anode structures in a constant spaced parallel relationship. Control of the deposition of metal is further achieved by an improved bus bar support system for the cathode and anode units, facilitating accurate adjustment and leveling of the units relative to the electrolyte.

BACKGROUND OF THE INVENTION

(1) Field of the invention

The invention disclosed herein relates to a cell assembly for electrolytic deposition of metals such as zinc. In a zinc recovery process, roasted zinc ore is leached with sulfuric acid to produce an electrolyte liquid containing zinc sulfate. The pure zinc is then recovered from the electrolyte liquid by electrolysis in a cell box, the zinc being deposited in the process on aluminum cathode plates which form part of a series circuit through the electrolyte to anode plates conventionally fabricated from a lead and silver alloy. The deposited metal is periodically stripped from the cathode plates and processed further to produce bulk metal for manufacturing processes.

(2) Description of the prior art

Conventional cell assemblies for electrolytic deposition of metals such as zinc have required considerable manual effort. Control of the deposition of metal on the cathodes has been rather unrefined, and the resulting inconsistency in the area and nature of the deposited metal has been accommodated by manual effort. The stripping of the cathodes, when carried out manually, can adapt to variations in the height of metal on the cathode caused by changes in the level of electrolyte and variations in deposited metal thickness. These variations are most difficult to accommodate in a mechanical or automated system of cathode stripping. The principal purpose of the present development is to provide a cell that can accommodate automated handling of the cell elements and mechanized stripping of metal deposited on the cathodes.

The manual handling of cell components has permitted the use of expendable wooden guides for the cathodes and anodes in a cell box, since the person positioning the elements can visually recognize and manually accommodate variations in the guides due to wear and warping of the members. However, more rigid control of a consistent location of each member is required in order to develop an efficient mechanical system of handling these elements.

Cell assemblies conventionally have required a considerable amount of maintenance due to inefficient flow characteristics of the electrolyte in the cell, resulting in areas of reduced liquid movement that cause solid deposits to foul the cell, necessitating frequent cleaning operations. Manual stripping of the cathodes, besides requiring a large work force of generally unskilled labor, results in considerable damage to the cathodes and constant replacement of these rather expensive elements. The present assembly provides a complete integrated combination of improved elements in such a cell to improve cell efficiency and to adapt the electrolytic recovery system to automated methods of handling the desired metal.

SUMMARY OF THE INVENTION

The present invention basically comprises a completely redesigned cell for electrolytic deposition processes. In this cell, an improved cathode, having a partially covered and insulated plate structure, is precisely spaced between improved anodes by non-conductive guides that extend the full height of the anode structures and which are attached to them to provide required stiffening of the anodes. The positioning and confinement of the cathodes by the anodes and anode guides provides improved liquid flow characteristics in the cell assembly. The cell box itself is constructed with an integral liner including an inlet box and outlet weir designed for optimum handling capability. The anode structure, including the stiffening guide elements, is designed for the best liquid flow and maximum anode-cathode surface area relationships to control the coating of metal on the cathode and to prevent excess deposition, particularly along the top and side edges of the cathode area that is to be coated with the deposited metal. Control of the level of the electrolyte is provided, and accurate leveling of the anodes and cathodes is insured, by an improved adjustment apparatus designed into the bus bar assembly at each side of the cell.

It is a general object of this disclosure to provide improved operational characteristics in the cell assembly by insuring accurate anode to cathode spatial relationships and by proper insulation of the anode and cathode units to provide more efficient electrolytic deposition in a given cell structure. The combination disclosed herein is designed specifically for adaptation to mechanical handling techniques for removing and replacing cathodes and anodes in relation to the cell and in relation to associated mechanical processing devices, such as stripping equipment and washing mechanisms. The unit is designed to increase production of cell assemblies and to extend the useful life of each cell component. The structure reduces the maintenance and manpower requirements in electrolytic recovery assemblies as known today. The entire combination has been developed to produce a stable system to which modern methods of automation can be adapted as its development progresses.

A primary object of the cell assembly disclosed herein is to provide a cell structure for the deposition of metal which is adaptable to hydraulic stripping of the deposited metal in the manner disclosed in my co-pending application, Ser. No. 636,797, now Pat. No. 3,501,385, "Process for Stripping Metal From a Cathode." Hydraulic stripping requires accurate control of the position and amount of deposited metal on the cathode plate, which are fundamental requirements guiding the designed structural features of all the elements disclosed herein.

Another object of the invention is to facilitate automation of cell operation by providing uniformity in the cathode and anode locations within the cell, uniformity in the elevation of the solution line of electrolyte maintained within the cell and consistent metal deposition and control of the area of metal deposition on the cathode plates.

Another object of the invention is to provide an improved anode structure designed for longer life and maximum material usage. The anode structure provides an attached guide for the cathodes to insure proper cathode-anode separation and to provide a restricted vertical "chimney" in the electrolyte between adjacent cathode-anode units.

One object of the invention is to minimize cell maintenance requirements. This is accomplished by more effective design of the anode and cathode units and by providing improved electrolyte flow characteristics in the cell. Maintenance is also relieved by more effective protection of the cathode and anode surfaces by use of cover materials and non-abrasive plastic guide structures.

Another object of the invention is to insure proper deposition of metal along the upper portion of the cathodes by providing accurate adjustment of the cross level orientation of the cathode and anode units. This is provided by an improved bus bar adjustment feature that simultaneously positions both the contact and heel ends of the header bars that support these units.

Another object of the invention is to provide within the cell an improved cathode structure having covered side and top areas which control the area of metal deposition and reduce damage to the vulnerable cathode surfaces during insertion or removal from the cell. The covered areas, together with the remaining portions of the cell assembly, increase the amount of metal deposition at the top of the cathode to facilitate hydraulic stripping operations.

Another object of the invention is to provide an improved cell box structure including a one piece liner having integral inlet box and outlet weir structures. This eliminates problems of leakage and corrosion and provides a liner apparatus that can be adapted to existing box structures during modification of a cell line.

These and further objects will be evident from the following detailed disclosure, particularly in view of the claims at the conclusion of this specification. The mechanical and physical details of the apparatus as disclosed herein are not intended to limit the scope of the invention disclosed, which is set out in the language of the claims.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a complete cell assembly, portions of the adjacent cell assemblies being broken away at the respective sides thereof;

FIG. 2 is a vertical sectional view taken along line **2—2** in FIG. 1;

FIG. 3 is a vertical sectional view taken along line **3—3** in FIG. 1;

FIG. 4 is an end view, at a reduced scale, of the inlet end of a single cell box;

FIG. 5 is an end view opposite to FIG. 4;

FIG. 6 is a fragmentary horizontal sectional view illustrating the cathode-anode spatial relationship;

FIG. 7 is a view illustrating the fabrication of the cathode unit;

FIG. 8 is a somewhat simplified view illustrating the position of the top portion of a cathode unit in a cell box;

FIG. 9 is a vertical sectional view taken along line **9—9** in FIG. 7 at an enlarged scale, the central portion of the cathode unit being broken away;

FIG. 10 is a further enlargement along a vertical plane through a cathode unit adjacent to the solution line, illustrating the deposition of metal on the cathode faces;

FIG. 11 is a view illusrating the fabrication of an anode unit;

FIG. 12 is a side view of an anode guide;

FIG. 13 is an end view of the anode guide shown in FIG. 12;

FIG. 14 is a side view of the anode guide opposite to that shown in FIG. 12;

FIGS. 15 through 18 are enlarged cross sectional views

taken along lines **15—15** through **18—18** respectively in FIG. 12;

FIG. 19 is an enlarged vertical sectional view taken along a transverse plane through the center of an anode unit along the side portion thereof, the remainder of the anode unit being broken away;

FIG. 20 is a somewhat simplified view taken similarly to FIG. 3, illustrating the insertion of a cathode unit between adjacent anode units;

FIG. 21 is a fragmentary end view and cross sectional view through the cell assembly, illustrating specifically the adjustable supports for the bus bars;

FIG. 22 is a longitudinal sectional view taken along line **22—22** in FIG. 21;

FIG. 23 is an enlarged sectional view showing a single bus bar support as seen along line **23—23** in FIG. 22;

FIG. 24 is a sectional view through a bus bar as seen along line **24—24** in FIG. 22; and

FIG. 25 is a fragmentary vertical section view taken along line **25—25** in FIG. 23, illustrating the relationship between the support and the bus bar.

PREFERRED EMBODIMENT OF THE INVENTION

The disclosure herein comprises a cell assembly having an arrangement of liquid electrolyte cell box, cathodes and anodes with guides and lateral supports therefor, and supports for electric current carrying bus bars. It also includes electrolyte inlet and outlet means capable of regulating the liquid level in the cell.

Each anode is in the form of a tapered grid with an integral header bar and an attached insulating guide at each side thereof. The anode guides are spaced to receive cathode plates therebetween and have apertures to straddle the header bars of the anodes. One end of each anode header bar has a downwardly opening V-notch to receive the top edge of the bus bar so the header bar may conduct current to the anode.

Each cathode plate includes a cast aluminum header bar which joins the plate at the top. This header bar includes ears by which it may be lifted and a notched end similar to the end of the anode header bar to engage the current-carrying bus.

The cathode plate has an electrically non-conductive peripheral covering which is impervious to the electrolyte. This peripheral covering extends across the top of the plate and down the vertical edges to define a metal deposit area on each side face of the plate. A suitable covering is a polyvinyl chloride resin sold under the trade name "Paraline." This covering acts as a protector of the edges of the cathode plate and of the air-solution line adjacent the header bar. This air-solution line is the most vulnerable area on the cathode for attack by the electrolyte. The bottom edge of the cathode plate is channelled to prevent grow-around of the metal plated thereon from one side to the other.

The electrolyte, containing metal to be deposited on the cathode, is poured in over one end of the cell and has a temperature that is below the temperature in the active deposit zone between anodes and cathodes within the cell. The level of electrolyte in the cell is indicated in the drawings by the line A. The assembly of anodes, anode guides and cathode plates provides vertical channels through which the electrolyte, warmed by the current and the deposition reaction, can rise. The anode guides have apertures at the top through which the warm electrolyte can flow out toward the side cell walls. Here the liquid cools and flows toward the discharge end of the cell. The cell has an overflow weir at the end opposite the inlet weir to discharge spent electrolyte and to maintain the proper solution line level of electrolyte within the cell.

THE CELL BOX

The construction of each cell box is best seen in FIGS. 1–5. The structure can be fabricated as shown, or might be modified from existing cell box structures.

The cell **1** may be of any suitable material. Wood has been widely used. The cell is rectangular and as shown, comprises a base of bottom planks **2** on which side planks **3** are supported. The bottom planks **2** are carried on sills **4**. Rods **5** extend from the sills **4** to the top side planks **3** and are threaded to receive nuts **6** to clamp the side planks tightly together. The top side planks and the sills are counterbored so that the rod head and threaded end are inset. The top counterbores are filled with asphalt or other suitable sealer. End planks **7** are set into the side faces of the side planks. These end planks **7** are backed by vertical studs **8** which secure them into end panels. Rods **9** extend through the studs **8**, through the ends of the side planks **3** and through coated steel straps **10**. The top plank of the side planks **3** is rabbeted out to receive a load bearing angle iron **11** which is covered with a protective coating of an insulation material impervious to the electrolyte. Angle iron **11** distributes bearing loads along the cell and also prevents the upper cell box edges from bowing outwardly.

The cell body described is provided with a one-piece liner **14** which is composed of electrically non-conductive polyvinyl-chloride resin sold under the trade name of "Paraline" by the Barber-Webb Company. Any other suitable electrically non-conductive material that is impervious to the electrolyte used may be substituted for the polyvinyl-chloride resin.

The liner **14** fits the interior surface of the cell **1** and includes a drain tube portion **15** that fits in a drain outlet **12** of the cell used to empty the cell box during repair cycles. The drain outlet is a lead nipple **12** set in one of the bottom planks **2**. The tube **15** extends beyond the lead nipple. A drain hose (not shown) is fitted over nipple **12**. A plug valve **17** with a polyvinyl coated stem **18** closes the drain.

It will be noted from the drawings (FIG. 2) that the top end of plank **7***a* is cut on a taper across its top surface. The liner **14** has an inlet box **19** formed at the corresponding end thereof. The liner inlet box **19** expands toward the cell so that charged electrolyte poured into the cup portion **20** of the inlet box **19** will spread out and flow evenly into the cell **1** across the width thereof. The liner **14** has an outlet weir **21** at its other end to fit over the topmost plank **7***b* at the discharge end of the cell. Note that the plank **7***b* has its top surface tapered down outwardly from the inner edge thereof. The central portion of the plank is cut lower than the ends to receive the weir **21**. The weir **21** is an underflow weir that in practice retains froth on the electrolyte surface to reduce the emission of gas and mist from the cell box to the surrounding environment. The weir **21** has a tulubar outlet **23** for attachment of a drain hose **24** (FIG. 5). The hose **24** is also of polyvinylchloride resin. It can be expanded by heat and slipped over the outlet **23**. When it cools a fluid tight joint is established between outlet **23** and hose **24**. The liner **14** laps over the top side planks **3** and the end planks **7***a* and **7***b* as shown.

ANODE ASSEMBLY

The anode comprises a grid-type anode plate **25** which for zinc recovery is a lead-silver alloy and a header bar **26**, which is made up of a copper insert **51** and a lead-silver alloy cover. The cover of insert **51** and the plate **25** are cast integrally. The anode plate **25** decreases in cross sectional thickness from the top to the bottom to reduce weight. It also has enlarged ribs **27** and **28** of constant thickness along the vertical side edges for stiffening and for securing the anode guides **31** and **32**. The ribs **27** and **28** are tapped at **29** to receive mounting screws which are of polyvinyl-chloride resin of a hardness sufficient to self-thread in the lead-silver alloy of the ribs **27** and **28**.

Anodes have conventionally been cast in two pieces, the header bar being welded or otherwise fixed to the grid as a final assembly operation. As shown in FIG. 11, the anode disclosed herein can be cast as an integral unit, requiring only the final assembly of the side guides to the structure. By making a heavier anode than is conventional, warping and distortion of the anode grid is minimized and much longer life can be achieved than is normal in the industry.

Construction of the anode begins with the forming of a transverse copper insert **51**, whose surfaces are machined and pre-tinned before being cast integrally in the header bar of the anode structure. After casting of the anode plate **25** and header bar **26**, only a small notched portion of the insert **51** remains exposed, this being designated by the numeral **51***a*. This notched portion is utilized for direct electrical contact with the bus bar in the cell assembly. The final assembly step, shown to the right in FIG. 11, is mounting of two vertical anode guides, one being at each side of the anode plate **25** and each straddling the integral header bar **26**. These guides, designated by the numerals **31**, **32** are attached by the mounting screws mentioned above.

The anode guides **31** and **32** are molded of polypropylene. They are identical. The guide has a head portion **33** which is curved on opposite sides to converage at a ridge **34** at the top. The curved side surfaces **35** and **36** act as guides for cathode plates when the plates are lowered into the electrolyte. The head **33** has an aperture **37** to receive the header bar **26** of the anode **25**. Below the opening **37** the guide has a central channel **38** which extends to the lower end of the guide. This channel **38** receives the anode rib therein. The guides **31** and **32** are narrowed from the top to the bottom and are hollowed out to reduce the total weight. The ribs along each guide serve to stiffen the anode plates **25**. The side faces **35***a* and **36***a* are parallel to space cathode plates on opposite sides of the anode equidistant from the anode. The guides are flared outwardly to engage the side edges of the wider cathodes. In this manner a wider area of the cathode is exposed to the more narrow width of the anode face, resulting in reduced current density along the vertical side edges of the cathodes, eliminating excess deposition of metal or "treeing" in this area. Close to the upper end of the channel **38** each anode guide has two apertures **39** and **40** to permit circulation of electrolyte through the guides.

CATHODE ASSEMBLY

Referring now to the cathode plate **41** and its header bar **42**, the construction of the plate and the way in which this construction cooperates with the anode guide construction will be described. The cathode plate is usually, for zinc recovery, a rectangular sheet of aluminum made to quite rigid specifications as to purity and flatness of surface. Its fabrication steps are as shown in FIG. 7. The bottom end of the sheet is slotted as shown at **42***a* (FIG. 9) with a slot $\frac{1}{10}$ inch wide and $\frac{1}{16}$ inch deep. The cathode plate is slightly wider ($\frac{1}{2}$ inch on each side) and extends downwardly a slightly greater distance ($\frac{1}{4}$ inch) than the exposed anode area to improve deposition characteristics of the metal. Less metal will thereby be deposited along the side and bottom edges. The plate thickness usually is of the order of slightly less than $\frac{1}{8}$ inch. This cathode plate **41** is welded to the precast aluminum header bar **42** which has a copper insert **43** cast therein at one end. The copper insert **43** has a downwardly opening V-notch exposed to engage a bus bar. The header bar has two hooks **44** for lifting and lowering the cathode plate.

The cathode plate **41** has apertures **45** drilled therethrough from side to side along the side edges **46** and **47** within about $\frac{1}{4}$ inch of the edge and across the solution line area (FIG. 7). The cathode plate **41** is then provided with continuous edge coverings **48** and **49** extending inward beyond the apertures **45** and filling them. The coverings are joined across the top of the plate **41** by cross coverings **50** at the solution line some two to four inches below the junction of the header bar **42** with

the plate **41**. These cross coverings **50** are of sufficient width to cover variations in height of solution and splash coverage. A band four inches wide is adequate.

The coverings **48**, **49** and **50** are composed of polyvinyl chloride resin or other suitable electrically non-conductive material. The "Paraline" product mentioned above has proven to be satisfactory. The thickness of the coverings **48** and **49** prefreably is at least .030". The coverings **50**, however, are preferably .015" to .020". To apply the coverings the area to be covered is sandblasted to clean it, then coated with a primer and finally coated with the covering which is then cured in the usual manner of curing polyvinyl-chloride resin coatings.

CELL ASSEMBLY AND OPERATION

It will be noted from the drawings, particularly FIGS. 1, 2, 3 and 6 that the spacing of the anode guides **31** and **32** snugly receives the cathode plates **41** and header bars **42** between adjacent anode guides **31**, **32**. The cathode plates **41** fit between the anodes **25** with the portions covered by the coverings **48**, **49** engaged by the anode guides. This construction provides accurate and consistent cathode placement that permits the guided insertion and removal of the cathode plates **41** in a group of several plates by means of a lifter that has jaws closing on the hooks **44**.

The coverings **48**, **49** and **50** define deposit receiving areas on both sides of each cathode plate. The slot **43** prevents appreciable bridging of the deposit from one side of the plate to the other. The covering **50** establishes a line where the deposit stops on the plate surface. As shown in FIG. 10, the deposit of metal extends outwardly below the solution line at the lower edge of covering **50**. This facilitates entry of a hydraulic jet along arrow **52** for stripping purposes.

The assembly of anodes, anode guides and cathode plates with covered side edges provides a means of establishing well-directed upward circulation of the electrolyte by forming a "chimney" between anodes and cathode plate surfaces. The electrolyte confined in each vertical channel along the cathode side plates is warmed by the deposition reaction and rises as indicated by the flow arrows B in FIG. 2. Fresh, cool electrolyte flowing down from the inlet weir **19** moves along the bottom of the cell **1** and upward between anodes and cathodes to the top level of the liquid and flows out through the apertures **39** and **40** in the anode guides **31** and **32** as well as through the slight clearance between the cathode coverings **48** and **49** and the sides faces **35***a* and **36***a* of the anode guides, as indicated by the arrows B in FIG. 20. This circulation makes efficient use of the electric current in depositing the metal in the electrolyte on the cathode plates and provides for movement of the spent electrolyte toward the outlet end of the cell **1** along the sides thereof. This arrangement also permits removal and insertion of cathode plates without cutting off the electric current. If a cathode plate swings toward an anode only the non-conducting anode guides and side edge coverings of the cathode plates contact each other. The rather complete and constant liquid circulation in the cell prevents deposit of solids and minimizes the necessity of emptying and cleaning the cell box.

BUS BAR SUPPORTS

The cross leveling of the anodes and cathodes in this cell assembly is critical in order that the deposition of metal along the upper portion of the side faces of each cathode be as constant and consistent as possible. Consistency in the deposition of metal in this area as shown in FIG. 10 is critical for purposes of successful hydraulic stripping operations. To maintain the anode and cathode units in a level transverse position while suspended in the electrolyte, there is provided an improved vertical adjustment for the bus bar assemblies.

To understand the nature of the support provided for each bus bar, reference will be made to FIGS. 21–25. As shown in FIG. 21, the heel ends of the header bar **42** of each cathode assembly are supported right by an insulated member on the bus bars **53**, which also support the anode header bars **26** of the adjacent cells. The same is true of the anode header bars **26**, the heel ends of the anode header bar and cathode header bars in a cell being insulated from the supporting bus bar not contacted by them, and as explained below, are preferably adjusted elevationally along with the respective bus bars for the opposite elements.

Each bus bar **53** is a solid conductive plate having adequate physical strength to support the header bars engaged upon it during use. Most of them extend only along the length of a cell box. However, certain bus bars (shown at **53***a* in FIGS. 1 and 3) are enlarged in cross section and extend longitudinally from the box to assist in forming a shunt across several cell boxes during a repair cycle. These enlarged bus bars are supported and function in a manner identical to the normal bus bars **53** and therefore the following description of the bus bars **53** is equally applicable to the bars **53***a*.

The general features of the support apparatus are shown in FIGS. 21 and 22. Each bus bar **53** is carried by a pair of U-shaped metal saddles **54** at the respective ends of the bus bar. The saddles in turn are rigidly joined to longitudinal angle irons spaced transversely and extending oppositely from one another. These angle irons are designated by the reference numerals **55**. The bus bar **53** rests within the saddles **54** and between the angle irons **55**. Prior to receiving the bus bar **53**, the fabricated assembly of two saddles **54** and two angle irons **55** is coated entirely with polyvinyl chloride resin for insulating and corrosion protection purposes.

When assembled, the saddles **54** rest on the upper edges of the sides walls of two adjacent cells **1**. These saddles **54** rest on adjustable shims **56** which are utilized to level the bus bars **53**. The saddles **54** can be lifted by a lever during shim adjustment. The angle irons **55** are fastened along the entire length of each bus bar **53** by a series of screws **57**. The weight of the bus bar is also distributed to the saddles **54** by means of an insulating spacing member **58** at the bottom of each bus bar.

To maintain the bus bar **53** in a constant transverse orientation so that the spacing between bus bars **53** does not change, there are utilized large wooden beams **60** that span the ends of the cell **1**. Each beam **60** has carefully spaced slots **61** along its lower surface within which is received the upper edge of the respective bus bars **53**. The beams **60** are secured by bolts **69** having their respective bars welded to the flanges of saddles **54** (FIG. 21) and are therefore moved upwardly as a unit during vertical adjustment of the saddles **54** and bus bars **53**.

Each of the alternated anode and cathode units includes a supporting header bar having a contact end that rests on a bus bar **53** and a heel end that conventionally rests on the opposite side of the cell on an insulated surface. As shown, the heel ends of the header bars not in electrical contact with a particular bus bar **53** are supported by the outwardly protruding ledge of the angle iron **55** fixed to the bus bar. Each bus bar **53** has two of these ledges, each extending outward in opposite directions. The upper surface of each ledge is provided with a longitudinal insulating strip **59** or **62** to support the heel ends of the header bars of the anodes and cathodes respectively. Each is relieved below the contact ends of the header bars that freely pass over them. Thus, if a bus bar becomes misaligned, one need only vertically adjust a single bus bar **53** to vertically reposition the anodes and cathodes of adjacent cells in an accurate relationship with one another, since the anodes and cathodes move simultaneously. This eliminates the possibility of a cathode being cocked angularly relative to an adjacent anode, a condition which frequently results in "treeing" of the deposited metal and which sometimes results in a short circuit within a cell.

The prime purpose of the various components discussed above is to provide optimum metallurgical characteristics in the electrolytic recovery process carried out in the cell assembly. The accurate spacing and relative location of each cathode and anode serves to assist in controlling the rate and distribution of metal on the cathodes. The relative area dimensions of the cathode and anode plates below the solution line minimizes destructive "treeing" of deposited metal and resultant shorting of the circuits within a cell. The components therefore have a longer service life than is normally expected. The improved flow pattern of electrolyte as discussed above maintains the liquid in constant circulation and minimizes the collection of solids in still areas, thereby lengthening the period between cleaning cycles. These desirable results contribute toward improved recovery efficiency in addition to the provision of components adapted for automated handling and stripping.

Having thus described my invention, I claim:

1. A cell assembly for electrolytic deposition of metals comprising an upwardly open box having an inlet for receiving electrolyte liquid and an outlet for discharging electrolyte liquid spaced across the box from each other;
- a plurality of plate-like anodes suspended in the box, each embodying a header bar for supplying current thereto;
- an electrically non-conductive anode guide extending along each vertical edge of each anode and including opposed side faces spaced from the anode on both sides thereof;
- said anode guide faces of each two adjacent guides being in juxtaposition but spaced apart a distance adequate to receive a cathode plate between the adjacent giudes;
- a cathode plate interposed between each pair of said anodes, the cathode side edges being juxtaposed between the corresponding anode guide side faces; and
- electrically non-conductive coverings on the said side portions of the cathode plates that are between the anode guide side faces.

2. The cell defined in claim 1 wherein the anode guides are affixed to and carried by said anodes.

3. The cell defined in claim 1 wherein the anode guides and anodes substantially enclose the non-covered surfaces of the cathode plates and the anodes are spaced from the cathodes to provide a channel at each side of each cathode plate.

4. The cell defined in claim 3 wherein the anode guides are apertured adjacent to the upper end of the non-covered cathode plate surface of each cathode to permit escape of electrolyte after rising along said non-covered surfaces.

5. The cell defined in claim 1 wherein the anode guides are formed with converging curved guide surfaces extending down from the top thereof to direct a cathode plate between the anodes.

6. The cell defined in claim 1 wherein the cathode plate has a non-destructive covering on both side faces extending across the upper end of the plate from one of said side portion coverings to the other.

7. In combination with a cell box for electrolytic deposition of metals having an inlet and outlet for electrolyte to maintain the solution line of the electrolyte within the box at a fixed location, the improvements comprising:
- a plurality of anode assemblies suspended in the cell box by conductive header bars;
- and a plurality of cathode assemblies suspended in the cell box by conductive header bars individually interspersed between pairs of said anode assemblies, each cathode assembly having opposite face surfaces directed toward the respective anode assemblies adjacent thereto;

guide means to space each anode assembly from the adjacent cathode assemblies;
- and a cover applied to the face surface of each cathode across the top portions of the face surfaces and continuing along the side edges of the cathode to the lower end thereof.

8. The apparatus set out in claim 7 wherein said guide means comprises a pair of transversely spaced guide members of insulating material mounted at each side of each anode assembly and extending outward from the face surfaces thereof.

9. The apparatus in claim 8 wherein the covers along the side edges of each cathode are transversely overlapped by the guides of the adjacent anode assemblies.

10. The apparatus in claim 9 wherein the lower ends of the cathode and anode assemblies terminate short of the bottom of the cell box, and wherein the side covered edges of the cathodes transversely overlap and are in juxtaposition with the guides of the adjacent anode assemblies.

11. The apparatus in claim 7 wherein the cover across the top portions of the cathode assemblies extends below the solution line within the cell box.

12. The apparatus in claim 7 wherein the guides on said anode assemblies are set inwardly from the sides of the cell box and are apertured at each side thereof at an elevation slightly below the solution line within the cell box.

13. In a cell for electrolytic deposition of metals wherein the metal is deposited upon a cathode plate, an anode assembly comprising:
- a transverse header bar of electrically conductive material;
- a plate-like member of a suitable conductive material suspended rigidly from the header bar and having transversely spaced outer side edges defining wide faces;
- and a pair of rigid insulating guides fixed to said plate-like member along the respective side edges thereof, said guides extending outward beyond the faces of said plate-like member at each face thereof.

14. An assembly as set out in claim 13 wherein the portion of said plate-like member adjacent the side edges thereof is of constant thickness, the faces of said member between such portions being tapered in thickness downwardly from an initial thickness equal to said constant amount.

15. An assembly as set out in claim 13 wherein the header bar and plate-like member are cast integrally.

16. An assembly as set out in claim 13 wherein the guides extend over and engage the side surfaces of said header bar, the upper ends of the guides being tapered inwardly.

17. An assembly as set out in claim 13 wherein each guide is apertured at the respective sides of the plate adjacent the upper end of the plate.

18. An assembly as set out in claim 13 wherein the guides engage the side edge surfaces of the plate and overlap a portion of the side surfaces of the plate extending inwardly from the side edge surfaces in surface to surface contact.

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