No. 789,721. PATENTED MAY 16, 1905.

F. A. DECKER.

ELECTROLYTIC APPARATUS.

APPLICATION FILED FEB. 29, 1904.

3 SHEETS—SHEET 1.

Fig. 5

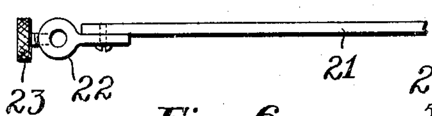


Fig. 6

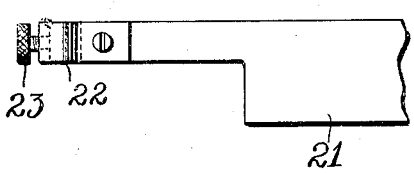


Fig. 1

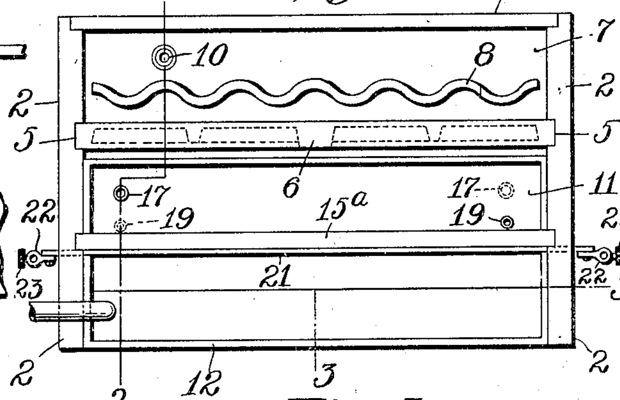


Fig. 2

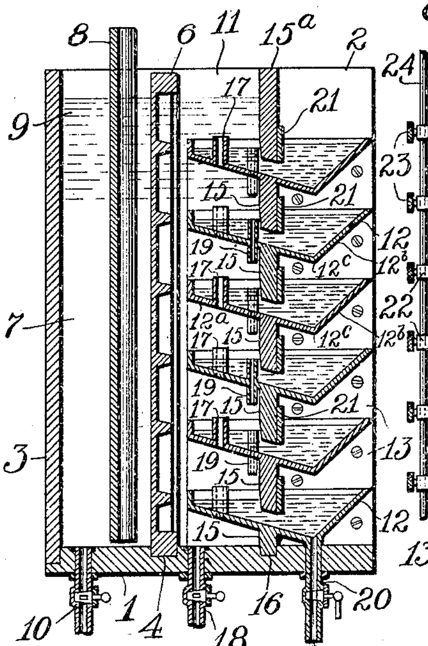


Fig. 3

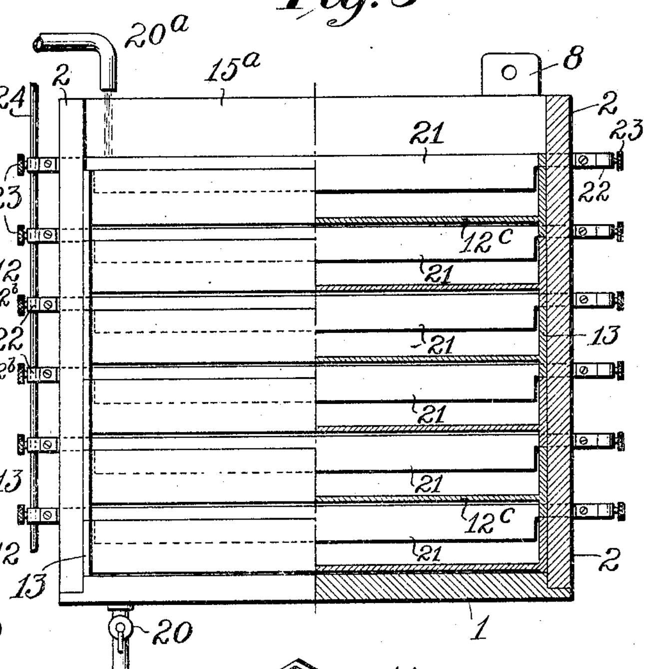
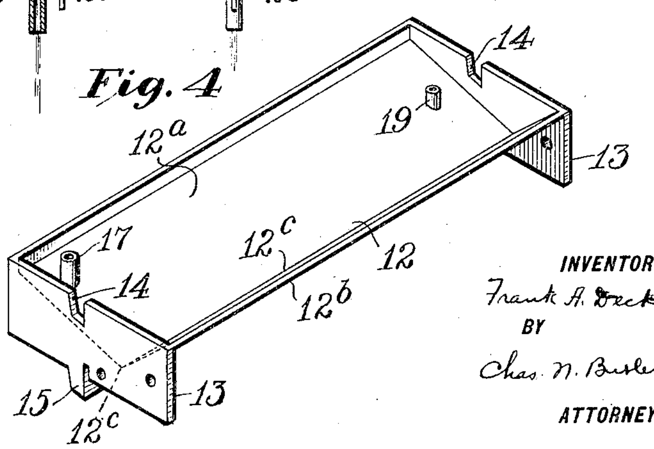


Fig. 4



WITNESSES:

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Fig. 7

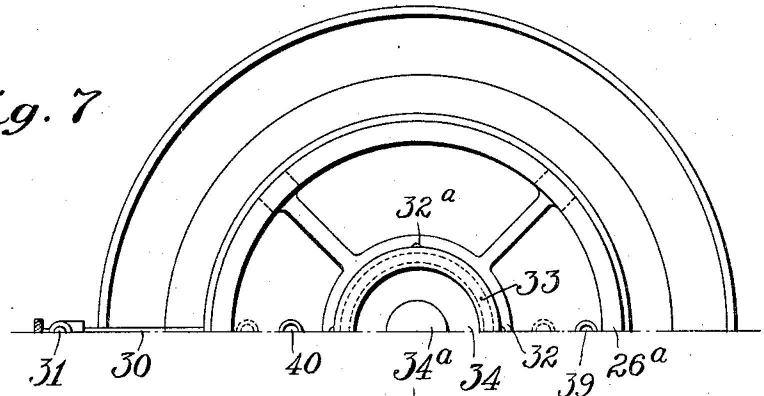


Fig. 8

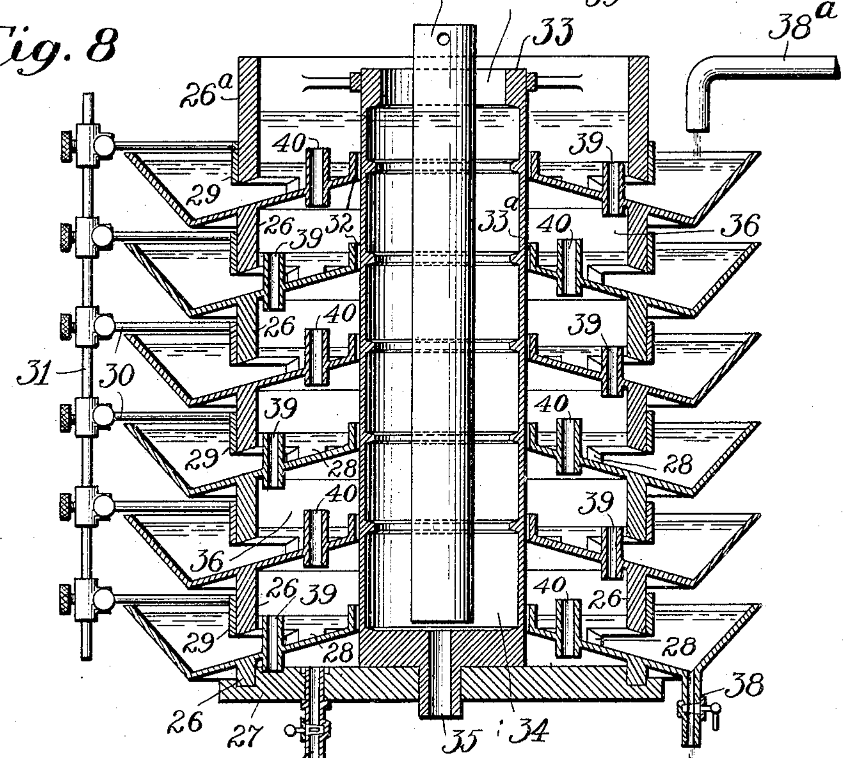
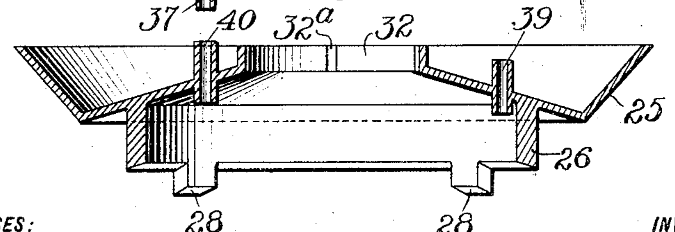


Fig. 9



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3 SHEETS—SHEET 3.

Fig. 11

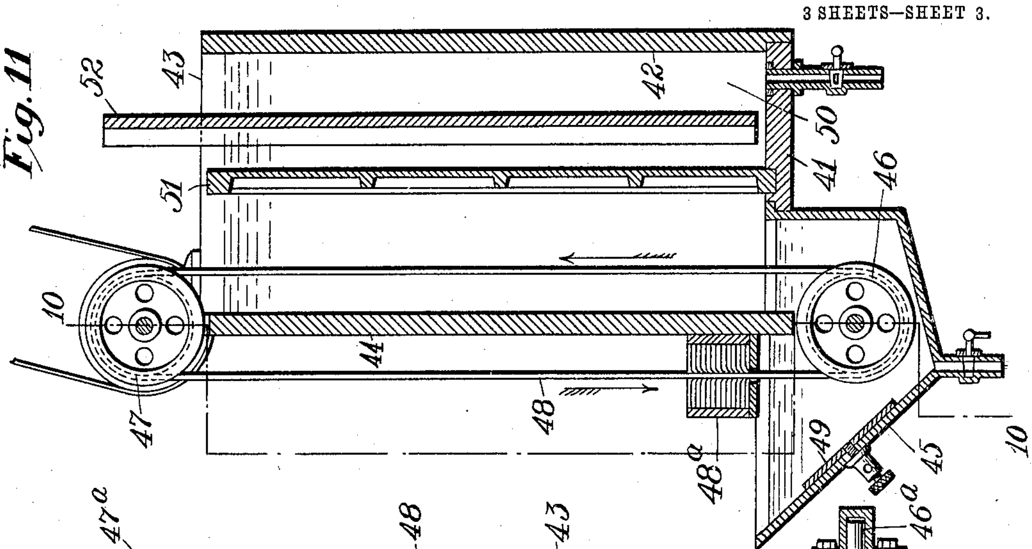
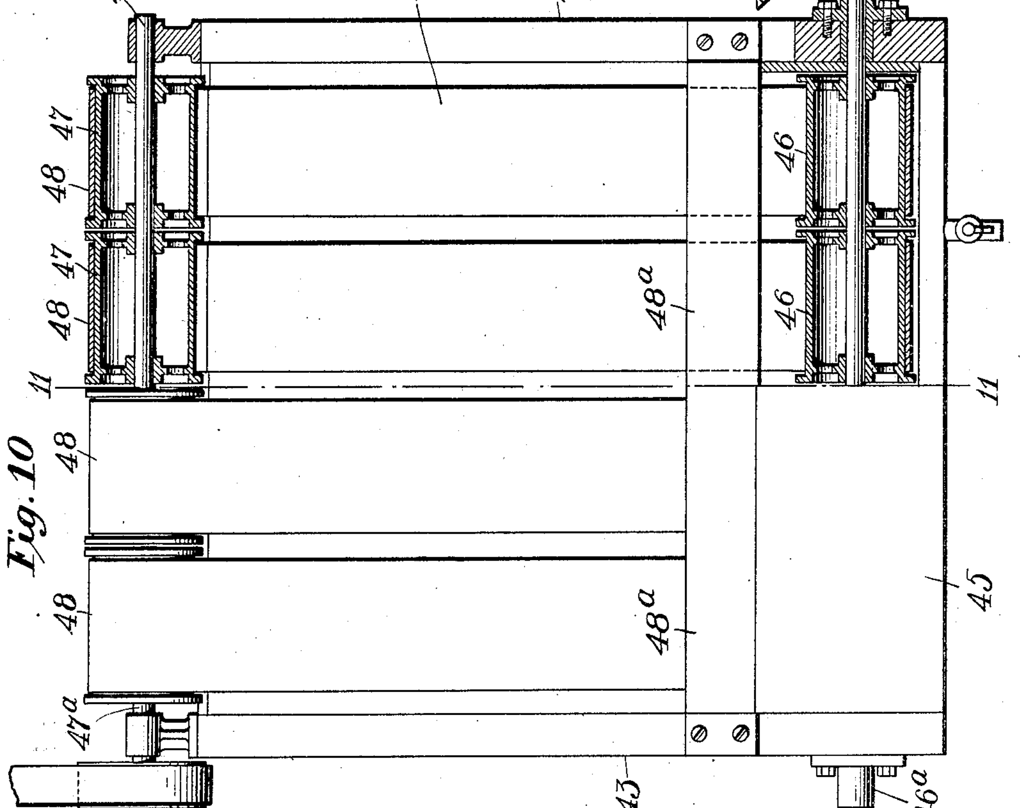


Fig. 10



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UNITED STATES PATENT OFFICE.

FRANK A. DECKER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO DECKER MANUFACTURING COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

ELECTROLYTIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 789,721, dated May 16, 1905.

Application filed February 29, 1904. Serial No. 195,706.

To all whom it may concern:

Be it known that I, FRANK A. DECKER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain Improvements in Electrolytic Apparatus, of which the following is a specification.

This invention relates to electrolytic apparatus designed for the recovery of zinc, magnesium, or other substances from acid or neutral solutions, such as spent battery fluids and solutions obtained in the reduction of metal from its ores or scrap.

In existing and proposed forms of apparatus in which zinc, magnesium, or other substances are deposited in mercury to be separated therefrom or left in the form of amalgam the mechanical and electrochemical difficulties of operation are excessive from an economical standpoint. By means of my cell a very complete and simple removal of the deposited substances may be effected, with the minimum loss of mercury and spilling of the electrolytic solution. The cell is very compact because of the close proximity of the electrodes, insuring low internal resistance and low voltage, and a very high ampere efficiency can be obtained because of the immediate withdrawal of the deposit from contact with the solution.

The apparatus comprises a cell divided into two compartments by means of a porous partition of low resistence to the electric current and offering relatively high resistance to diffusion of liquids. This arrangement is used, however, only in cases where a substance in the electrolytic solution or the electrolyte itself is chemically altered by oxidation or becoming too acid by the electronegative element separated at the positive pole of the cell. When this is not the case, as when a zinc-sulfate solution is electrolyzed with an anode capable of taking up the negative element, such as lead, a cell of one compartment may be used.

The positive electrode of the cell may be of carbon, peroxid of lead, or other suitable material. The negative electrode is formed by a receptacle or tray or a series thereof of usual material, arranged one above the other, containing a liquid metal (mercury) physically and electrically connected together, permitting the ready removal of deposits in the tray from the exterior without disturbing the cell, the construction providing a sectional wall having the tray or trays projecting on either side thereof and the wall-opening sealed by the mercury contained in the trays.

The principle employed in this apparatus may be used for the electrolysis of solutions of chlorid, sulfate, and sulfite of zinc, salts of magnesium, sodium, and potassium, spent battery solutions containing salts of zinc mixed with reduced salts of depolarizers, such as bichromates reduced to chromium salts or for the recovery of gold and silver. In cases such as the regeneration of battery solutions the depolarizer, as chromic acid, may be regenerated at the same time.

In the accompanying drawings, Figure 1 represents a top plan view of a cell made in accordance with my invention. Fig. 2 represents a vertical sectional view taken on the line 2 2 of Fig. 1. Fig. 3 represents a side elevation, partially in section, taken on the line 3 3 of Fig. 1. Fig. 4 represents a perspective view of a receptacle or tray. Fig. 5 represents a top view, and Fig. 6 represents a side view, of the end of a conductor. Fig. 7 represents a sectional top plan view, and Fig. 8 represents a vertical central section, of a modified form of the invention. Fig. 9 represents a vertical central section of a tray used in the construction shown in Figs. 7 and 8. Fig. 10 represents a side elevation, partially in section, taken on the line 10 10 of Fig. 11, of an additional form of the invention; and Fig. 11 represents a sectional view taken on the line 11 11 of Fig. 10.

Referring to Figs. 1 to 6 of the drawings, the base 1 has the sides 2 and the back 3 connected therewith, forming cell-walls of any usual material, the base having the seat 4 and the sides having the seats 5 for the reception of the porous partitions or diaphragm 6, preferably of clay. A compartment 7 is thus formed which contains the electrode 8 and the solution 9, the compartment being drained by the faucet 10. A second compartment 11 is produced by the tier of receptacles or trays 12, each having the rectangular ends 13, provided with the notches 14 and the depending wall sections or aprons 15, the aprons and trays forming an outer wall having openings with receptacles therein. The bottom tray has its apron inserted in the seat 16 of the base, while its ends rest on the base and are secured to the side walls of the cell. The higher trays have their ends supported on the ends of the lower and connected to the side walls, while their aprons are seated in the notches in the ends of the lower trays, the aprons of the higher trays extending into the interiors of the lower. The top tray receives the separate apron 15^a, which is connected with the side walls of the cell. A tube 17 extends from the bottom to the top of each of the trays, providing a passage through the trays for the better circulation of gas and fluid contained in the compartment 11. This compartment is drained by the faucet 18 in the bottom thereof. A tube 19 extends through the bottom to the desired height for the surface of the mercury to be maintained in each tray, excepting the lower tray, which has the drainage-faucet 20, extending therefrom through the bottom of the cell. As the upper tray receives mercury from the faucet 20^a, means are provided for effecting the circulation of the mercury through the trays. The tubes 17 and 19 are preferably placed at opposite ends of the receptive trays and their positions are transposed in the alternating trays to provide a circuitous circulation. The tray-bottom 12^a extends downwardly and outwardly to meet the inclined wall 12^b at the apex 12^c, by which the deepest part of the tray lies outside of the apron therein or outside of the cell-wall and the deposits gravitating thereto may be removed without disturbing the apparatus. The receptive aprons 15 15^a have the conductors 21 fixed thereto and dipping into the mercury beneath them, the respective conductors having the seats 22 and binding-screws 23 for engaging the conductor 24, by which they are united into an electrode dipping into the mercury. It will be seen that the parts are readily removable or changeable, that the diaphragm 6 may be dispensed with in the use of the cell for a single fluid, and that both the deposits and fluids may readily be removed.

As shown in Figs. 7, 8, and 9, the receptacles or trays 25 are circular in form and have the circular wall sections or aprons 26 depending therefrom, the bottom tray having its apron seated in the base 27, the higher trays having their aprons dipping into the mercury contained in the lower, while the highest tray has an apron 26^a dipping therein. The aprons which dip into trays below them have the feet 28 thereon, which rest upon the bottoms of the lower trays. Conductors 29, fixed on the aprons and dipping into the mercury in the trays beneath them, carry the conducting-arms 30, connected by the conducting-rod 31, providing an electrode connected with the mercury in each of the trays. Each of the trays has the circular opening 32 therein, through which the cylindrical diaphragm 33 passes and rests upon the base, forming a compartment 34, drained through the passage 35, the diaphragm with the trays and their aprons forming a compartment or compartments 36, drained by the faucet 37. The compartment 34 contains the electrode 34^a. The mercury may be drawn off from the bottom tray by the faucet 38, while its level in the higher trays is regulated by the overflow-tubes 39, and as the faucet 38^a supplies mercury to the upper tray provision is thus made for the circulation of mercury through the trays. The several trays also have the tubes 40 for the circulation of gas and fluid. The tubes 39 and 40 are staggered, as previously described, for effecting a better circulation. The circular openings 33 are provided with grooves 33^a cut in their respective peripheries to facilitate the escape of gases.

As shown in Figs. 10 and 11, the cell, having the base 41 and the walls 42 43 44, is provided at the bottom with the receptacle or tray 45, which communicates with the interior of the cell and projects beyond its wall 44, the lower section of the latter wall dipping into the mercury contained in the tray and acting as a seal for the opening to hold the acid in the cell. The cylinders 46, having the journals 46^a, are located in the trough beneath the wall 44, and the cylinders 47, having the journals 47^a, are located above the wall. These cylinders, revolved in any suitable manner, carry the combined conductors and conveyers 48, preferably copper belts, which move through the battery solution and the mercury seal, the deposits in the trough amalgamating and passing with the conveyers upward through the cell, over the upper cylinders, and down through the brushing or wiping devices 48^a, which removes the deposits and cleans the surface of the conveyer, so that it passes into the mercury in a condition effective for taking up the deposits. The trough 45 has fixed on its inner surface the electrode 49, immersed in the mercury contained therein, while the acid-compartment 50, formed by the diaphragm 51, contains the electrode 52.

It will be seen that in each form of the apparatus the vessel containing the electrolytic solution has an opening therethrough sealed by mercury contained in a receptacle to which access may be had from the exterior of the cell and the deposits removed without disturbing the apparatus.

Having described my invention, I claim—

1. In an electrolytic apparatus, a cell pro-

vided with an outer wall having an opening therethrough and a receptacle located in said opening, said receptacle being adapted for holding a fluid seal for said opening, substantially as specified.

2. In an electrolytic apparatus, a cell provided with an outer wall having an opening therethrough and a receptacle located in said opening containing a fluid for sealing the same, a section of said wall extending into said receptacle, substantially as specified.

3. In an electrolytic apparatus, a cell provided with a wall having an opening therethrough, and a receptacle in said opening projecting on either side of said wall, said receptacle having its deepest portion outside of said wall, substantially as specified.

4. In an electrolytic apparatus, a cell comprising a vessel for containing an electrolytic solution, said vessel having an aperture therethrough, and a receptacle for containing mercury, said receptacle being located in said aperture and having a bottom inclined downwardly and outwardly from the interior of said cell, substantially as specified.

5. In an electrolytic apparatus, a cell having a fluid-compartment, an opening through the casing of said compartment, a receptacle containing mercury in contact with the fluid in said compartment and sealing said opening, said receptacle extending beyond said compartment, and means for circulating said mercury, substantially as specified.

6. In an electrolytic apparatus, a cell having an outer wall comprising a series of receptacles and a series of aprons dipping into said receptacles, substantially as specified.

7. In an electrolytic apparatus, a cell comprising a fluid-compartment having an opening therethrough, a sealing and depositing receptacle in said opening having a section of the wall of said compartment extending therein, an electrode in said cell, and a second electrode in said receptacle, substantially as specified.

8. In an electrolytic apparatus, a cell having a sectional outer wall, apertures between the sections of said wall, receptacles located in said apertures, and electrodes supported by the sections of said wall and extending into said receptacles, substantially as specified.

9. In an electrolytic apparatus, a cell having a sectional outer wall, apertures between the sections of said wall, receptacles located in said apertures, an electrode member in each of said apertures, an electrode in said cell, and means for circulating a sealing and amalgamating fluid through said receptacles, substantially as specified.

10. In an electrolytic apparatus, a cell comprising an apertured wall having therein a series of superposed trays, each tray having an overflow-tube extending above and through the bottom thereof, substantially as specified.

11. In an electrolytic apparatus, a cell provided with a wall having an aperture therein, a receptacle located in said aperture and adapted for holding a fluid seal therefor, in combination with a diaphragm and a compartment separated thereby from said receptacle, substantially as specified.

In testimony whereof I have hereunto set my hand, this 27th day of February, 1904, in the presence of the subscribing witnesses.

FRANK A. DECKER.

In presence of—
THOMAS S. GATES,
UTLEY E. CRANE, JR.