

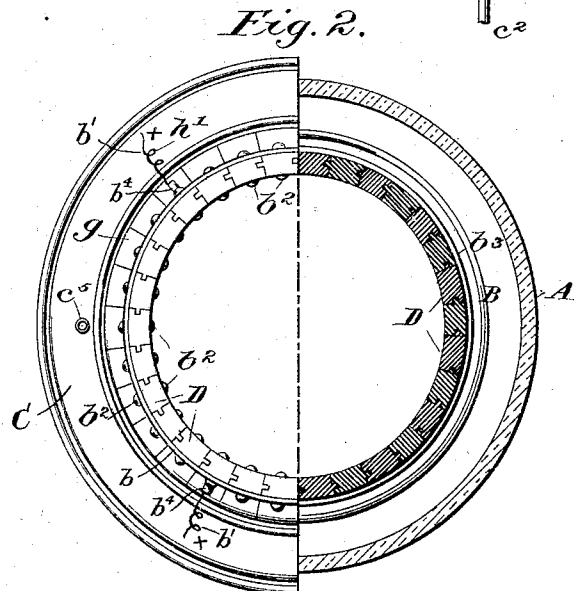
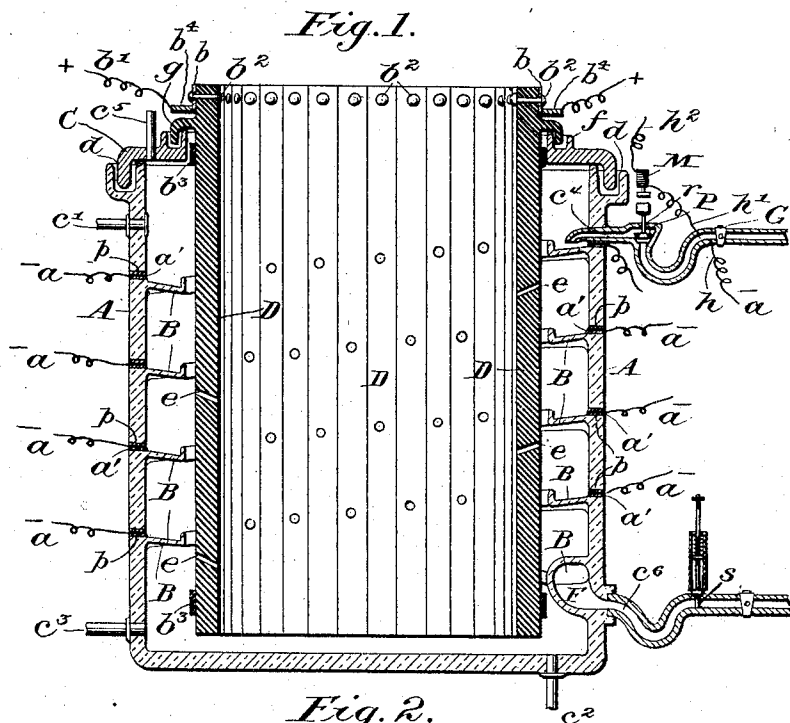
No. 784,592.

PATENTED MAR. 14, 1905.

H. PHILIPP.
APPARATUS FOR EFFECTING ELECTROLYSIS.

APPLICATION FILED AUG. 10, 1903.

2 SHEETS—SHEET 1.



Witnesses:

H. Chapman Liff
John F. Garrettson

Inventor:

Robert Philipp

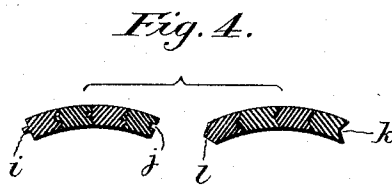
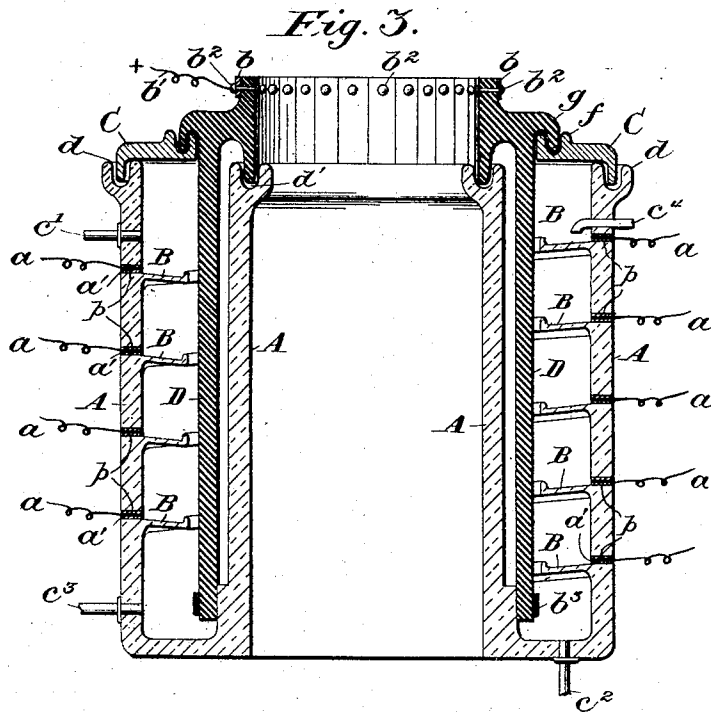
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

HERBERT PHILIPP, OF WYANDOTTE, MICHIGAN.

APPARATUS FOR EFFECTING ELECTROLYSIS.

SPECIFICATION forming part of Letters Patent No. 784,592, dated March 14, 1905.

Application filed August 10, 1903. Serial No. 169,036.

To all whom it may concern:

Be it known that I, HERBERT PHILIPP, a subject of the King of Great Britain, residing at Wyandotte, Wayne county, State of Michigan, have invented certain new and useful Apparatus for Effecting Electrolysis of Metallic Salts; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference thereon, which form part of the specification.

Similar letters refer to similar parts in each drawing.

It is well known that up to date the apparatus and methods for the electrolysis of the alkali-metal chlorids, while being fairly effective, are still faulty in many most essential features. Particularly is this the case where mercury is employed as cathode. In the present methods and apparatus as used the mercury soon becomes too rich in amalgam or in some cases does not become rich enough, due in each case to the imperfection of the means and apparatus employed. The present invention is designed to overcome these faults and imperfections and at the same time cheapen the cost of manufacture by direct and novel means whereby the decomposition of the alkali-metal chlorids or other salt is accomplished and a high efficiency of the electrical energy is made possible by most simple and direct means free from mechanical complications.

In this invention the mercury cathode is fed in an uninterrupted shallow stream winding about a cylindrical built-up carbon anode, the speed being regulated and the volume of the flow of mercury gaged to suit the density of the electric current to be utilized. I use any practical method for raising the mercury to flow into the cell.

The drawings illustrate my present invention, Figure 1 being a central vertical section of an elevation of one form of my cell. Fig. 2 is a plan with parts in horizontal section, showing cover partly cut away. Fig. 3 shows a form where solutions of alkali-metal salts can be efficiently used. Fig. 4 shows a section of the carbons shaped to form the cylinder.

In the apparatus illustrated, Fig. 1 shows a sectional elevation of a cylindrical vessel, preferably made of earthenware A A A, provided with a spirally-wound gutter or trough B B B and with an inlet-pipe c' and an outlet-pipe c'' . Also gas-outlet c^3 and other inlets and outlets may be used, if necessary, according to the size of the cell or vessel. c^4 is the mercury-inlet pipe, and c^5 is the mercury-outlet pipe. The cylindrical vessel is fitted with a cover C, with projections fitting into a water-lute $d d$. Fitting through the cover C is the carbon anode D, composed of carbon staves or shapes held together by rubber hoops or bands $b^3 b^3$. Electrical connection is made by an iron ring b , riveted through each stave by metal rivets b^2 . The electrical circuit is made through several metallic leads $b^4 b^4$, which are welded onto the iron ring b at various points according to the size and current density of the apparatus. These metallic leads are connected with the main current by wires $b' b'$. At various and convenient points along the spirally-wound gutter or trough are circular or oval perforations $a a a$, passing through the outer wall of the cylindrical vessel for the purpose of forming connections with the main circuit by wires $a a$.

The operation of the apparatus is as follows: The cylindrical carbon D is filled with an alkali-metal chlorid or other salt and constitutes the containing-chamber, while the body of the vessel is filled with a saturated solution of the same salt to be electrolyzed. On the solution becoming weakened by electrolysis it resaturates itself by the presence of the solid alkali-metal chlorid or other salt. The carbon staves or shapes are supplied with a series of openings or holes $e e$, passing entirely through the carbon at various and convenient distances, according to the size of the apparatus. These holes are arranged at such an angle that they will be lower on the inside of the carbon than on the outer side, and thus allowing the saturated solution of the alkali-metal salt to diffuse freely through the electrolyte while the gases evolved ascend on the outside of the carbon only. The solution inside the carbon cylinder or form will be fully saturated, and therefore specifically

heavier than the solution on the outside, which will continually become weakened through the decomposition of the alkali-metal salt by the electric current. By this means the solution is kept continually being resaturated until such a time as the electric current should stop, thus making the solutions on both sides of the carbons at the same point of saturation. The apparatus is provided with an anode D, which, as stated, is formed by a cylinder of carbon, built up of strips or staves and held in place by rubber hoops b^3 . The cylinder is placed in the cell through a circular cover or lid C, made gas-tight by water-lutes d and f , as shown in the drawings. The carbon cylinder is fitted with a metal ring b , fastened to each stave in the cylinder by a rivet b^2 , as shown, to which, as stated, are welded metallic leads b^4 , provided with wires b , which are attached to the positive wire of the main electric circuit. The cell is now in condition to have the electric current switched on. The hand-valve G on the mercury-inlet pipe c^4 is opened, the mercury strikes the wire h , which is attached to the negative main circuit a as soon as it passes the valve-opening, as shown in the drawings. At a convenient distance from this point the mercury strikes another wire h , which is let in the top portion of the pipe c^4 , being carefully insulated at the point where it passes through the metal part of the pipe, the height of h being regulated by a micrometer-screw or otherwise. This wire h is attached to an electromagnet M, which is again connected by a shunt-wire h^2 to the positive main conductor. As soon as the mercury strikes the wire h the electromagnet will lift the valve P, and so let the mercury enter the spirally-wound gutter or trough B inside the cell. The valve-disk is so arranged that should any mercury or other liquid happen to be behind it before the valve opens it would easily flow through the holes r , made for that purpose. The wire h is so arranged that it will allow the necessary quantity of mercury to flow in a continuous stream through the inlet-pipe c^4 into the spirally-wound gutter or trough B in a quantity sufficient to cover the bottom of the gutter to the necessary depth. The spirally-wound gutters are so placed as to form a regulated incline, so that gravity will impart a proper speed motion to the mercury in its flow from the top or inlet pipe to the bottom or outlet, forming an uninterrupted and continuous flow of the mercury or cathode surface as long as the cell is in operation. In addition to the inclination first named the gutter or trough is also inclined as to its bottom surface and at such an angle as to counteract the centrifugal action of the flowing mercury and regulates the action, so that an exact and even depth of the moving cathode is at all times assured. Conducting-wires a are passed into the perforations of the walls of the cylindrical vessel A and made perfectly tight by

rubber plugs p , corks, or other substance, by which fluid-tight insulation is secured. These wires carry the negative current from the flowing mercury, completing the circuit, the mercury thus becoming the cathode. The arrangement of the wires in this manner admits of a perfect contact being made without exposing the terminals to corrosive action, which would be the case were they carried completely through into the gutter or trough.

It will be understood from this description that the parts described, properly assembled and supplied with an electric current of proper voltage and amperage, and the cylindrical body of the carbon charged with a proper quantity of the desired alkali-metal chlorid or other salt, and a saturated solution of the same being placed between the walls of the vessel and the outer side of the carbon cylinder, decomposition takes place by electrolysis, the chlorine or other gases evolved passing off through the gas-outlet c^5 , as shown, while the sodium amalgam formed is carried by the flow of the mercury out through an aperture placed at the lower part of the vessel. The end of the spirally-wound gutter or trough B enters a small basin F with a roof, so as to prevent any mercury jumping over into the earthenware vessel. It then passes through an aperture placed at the lower part of the vessel, passing through a pipe c^6 , furnished with a convenient form of tripping-valve S, as shown in the drawings. This valve is so arranged as to withstand the weight of the alkali-metal chlorid or other salt solution, but to lift when the specifically heavier mercury strikes it, so it will only allow the mercury and amalgam to pass to the oxidizing apparatus and prevent the alkali-metal-salt solution from following. So long as the electric current passes from the carbon anode to the mercury the cathode absorbs the alkali-metal liberated by the electric current; but should the electric current cease to flow the electromagnet M will be released and the valve P will close, the mercury in the vessel finding its exit at c^6 , and thus the vessel will contain only the initial elements. This is a decided advantage over a horizontal cell in which a portion of the mercury is always exposed to the chlorinated alkali-metal-chlorid solution in such cases where alkali-metal chlorids are used. In the case of the horizontal cell when the electric current is cut off the mercury goes in solution and forms a mercury salt. In my invention the apparatus described is shown to be automatic, inasmuch as when the current is cut off the mercury entirely leaves the body of the vessel which can then be flushed and cleaned without waste of time, labor, or taking the apparatus to pieces, or, again, as shown in Fig. 1, the terminal shown at h when in contact with the mercury acts through the magnet M, and the valve P is held up as long as the circuit is closed and

as long as the necessary quantity of mercury is moving through the inlet-pipe, as described above. Should the current, however, be shut off or should the quantity of mercury be too little, (and so not touch the wire *h'*), the valve closes by the releasing of the electromagnet *M* and the mercury in the cell all flows out at the egress-valve *S*.

Fig. 3 shows a practical form of apparatus where the alkali-metal-salt solutions only are used. The carbon in Fig. 1 is made with a hook or rim *g*, which fits in the lute *f* of the earthenware lid, forming an absolute gas-tight joint, also providing a handhold, facilitating the removing of the carbon. Fig. 3 shows an additional lute *d'* on the inside of the inner wall of the earthenware vessel *A*, into which the carbon hook or rim rests. This also helps to form a gas-tight joint.

In Fig. 4 I have shown two methods of forming an interlocking edge of the carbon staves. In the form shown to the left a tongue *i* is formed on one edge of the stave which enters a corresponding groove *j* in the edge of the adjacent stave, while in the construction shown at the right the edge of the stave is made angular, as shown at *l*, the angular projection entering a corresponding recess *k* in the edge of the adjacent stave. Other forms of interlocking joints may be resorted to.

The various details of construction illustrated in the figures of the drawings and described above may be varied without departing from the nature and principle of the invention.

The particular construction of the specific-gravity valve *S* and the particular construction of the magnetically-operated valve *r* are not herein particularly referred to, but are shown largely diagrammatically, inasmuch as the invention is not limited in this particular to such construction as any desired form may be employed.

What I claim as new, and desire to secure by Letters Patent, is—

1. An electrolytic apparatus comprising a vessel having a feed and discharge opening and a mercury-conducting trough extending spirally from top to bottom, a separated compartment within the vessel around which the trough extends, and means for supplying mercury to the apparatus.

2. An electrolytic apparatus comprising a vessel having a feed and discharge opening, a mercury-conducting trough extending spirally from top to bottom thereof, a separated containing-compartment arranged within the plane of the spiral trough, an inlet leading into the space between the containing-compartment and the wall of the vessel, and an outlet leading from said space.

3. In an electrolytic apparatus, the combination with a vessel having a containing-compartment arranged therein, an inclined trough in the space between the compartment and the

wall of the vessel and inclined transversely, a feed communicating with the upper end of the trough and a valve-outlet at the lower end thereof, and inlet and outlet openings arranged respectively at the top and bottom portions of the vessel.

4. An electrolytic cell comprising a vessel having a mercury-conducting trough of uninterrupted spiral formation, an anode wholly within the plane of the spiral trough, means for introducing mercury into the cell, and a valve-discharge at the lower end of the trough.

5. In an electrolytic cell, the combination with a vessel, of an anode constituting the walls of a compartment, an inclined conductor arranged wholly within the space between the anode and the wall of the cell, wire terminals passing through the walls of the cell, and means for supplying the conductor with an electrolyte.

6. In an electrolytic apparatus, the combination with a vessel having a spirally-arranged conducting-trough on the inner face of its outer wall, of an independently-removable and hollow anode located within the vessel, means for supplying a fluid material to the spiral trough, and an outlet for the said material at the lower end of the trough.

7. In an electrolytic apparatus, the combination with a vessel having an inclined mercury-conducting trough therein extending from and secured to its outer wall, a removable anode having a hollow center located within the vessel and terminals of electrical conductors passing through the walls of the vessel and terminating at the inner wall of the vessel.

8. A vessel provided with a lute around the upper outer edge for the purpose of making a gas-tight joint and provided with a trough inclined at an angle around its inner wall; said trough inclined transversely, as to its bottom surface, and provided at suitable distances along the outer bottom corner, or that portion nearest the inner wall of the vessel, with perforations passing entirely through the walls of the vessel, and conductors passing through the perforations, substantially as set forth and described.

9. The combination with a containing vessel having a marginal trough at its upper edge, a cover therefor having a depending flange entering the trough and formed with a trough or gutter at its upper edge, and an anode arranged within the vessel and provided with a depending flange entering the trough of the said cover.

10. In an electrolytic cell, the combination with a vessel having a mercury-conducting trough extending from its inner wall and inclined from top to bottom and transversely, the walls of the vessel being provided with a series of perforations in line with the bottom of the trough, and metallic points passing through the said perforations and terminating

adjacent the inner wall of the vessel, substantially as described.

11. In an apparatus of the character described, the combination with a vessel and an anode therein, of a conducting-trough extending at an inclination from top to bottom of the vessel and having an overhanging covered portion at its lower end, and an inlet at the upper end of the trough and an outlet at the lower end thereof.

12. In an apparatus of the character described, the combination with a vessel, of a compartment within the vessel, a mercury-conducting trough within the vessel, means for supplying mercury to the trough, an outlet for the mercury at the lower end of the trough, and means acting automatically to close the outlet when the mercury ceases to flow through the trough.

13. In an apparatus of the character described, the combination with a vessel having a removable anode therein, of hollow formation constituting a containing-chamber, of a mercury-conducting trough, means for supplying mercury to the trough, an outlet for the mercury, and means acting automatically to permit the flow of mercury from the trough and prevent the escape of the solution after the mercury has ceased to flow.

14. In an apparatus of the character indicated, a mercury-conducting trough, a feed for supplying mercury to the trough, an outlet for the trough, and a specific-gravity valve governing said outlet.

15. In combination with the vessel described, an anode composed of a series of carbon blocks or staves, of sufficient dimensions, when fitted together, to form a cylinder or

other shaped form and held in place by hoops, bands, or braces of suitable material, all as substantially set forth and described.

16. In combination with an anode composed of carbon blocks or staves, a metallic band, hoop, or brace, connected to each stave or block by a metal rivet, the metallic band or hoop being provided with metallic leads to which the positive terminal carrying the current, is attached, the whole forming an effective connection between the assembled carbons and the source of electric energy, also assisting to hold the carbons in proper position.

17. A hollow cylindrical vessel consisting of an outer wall or ring and an inner wall or ring, each wall provided with a recess or lute around its upper edge, the outer wall having the recess around the outer edge, the inner wall having the recess around the inner edge, the vessel also being constructed with an inclined gutter or trough around the inner surface of the outer wall, all as substantially set forth and described.

18. In combination with a hollow cylindrical vessel consisting of an outer wall or ring, a cylindrical-shaped carbon molded with a hook or rim around the circumference for the purpose of fitting into the recess or lute of the upper inner edge of the lid or cover, and an inner hook or rim, forming a circular male projection, made to engage the inner recess or lute on the inner wall of the vessel, all as substantially set forth and described.

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Witnesses:

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