No. 719,870. PATENTED FEB. 3, 1903.

C. J. REED.

ELECTROLYTIC APPARATUS.

APPLICATION FILED MAY 5, 1899.

NO MODEL.

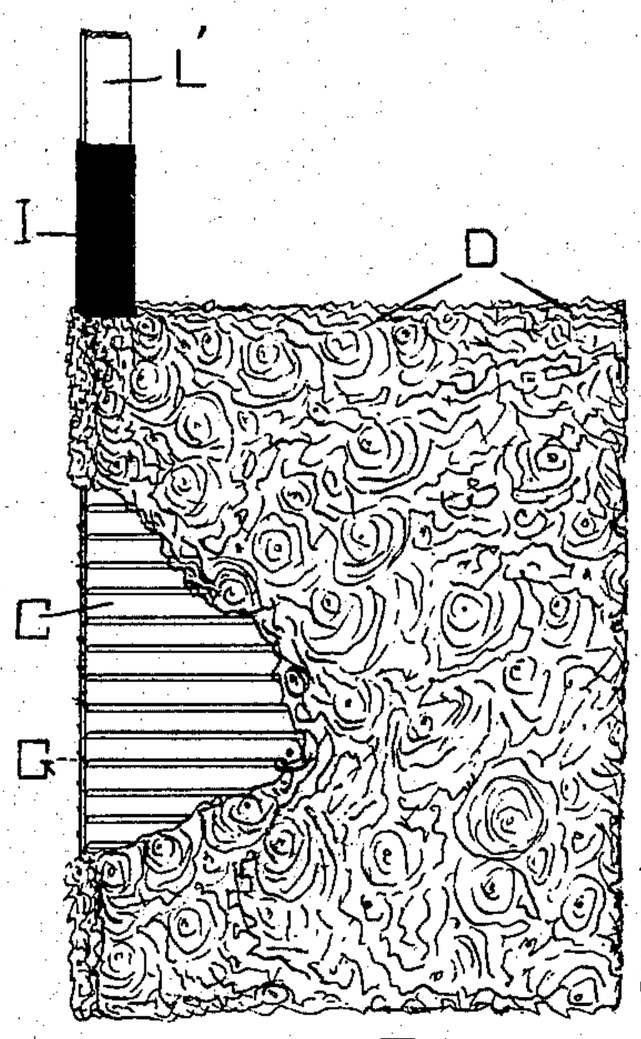

Fig. 2.

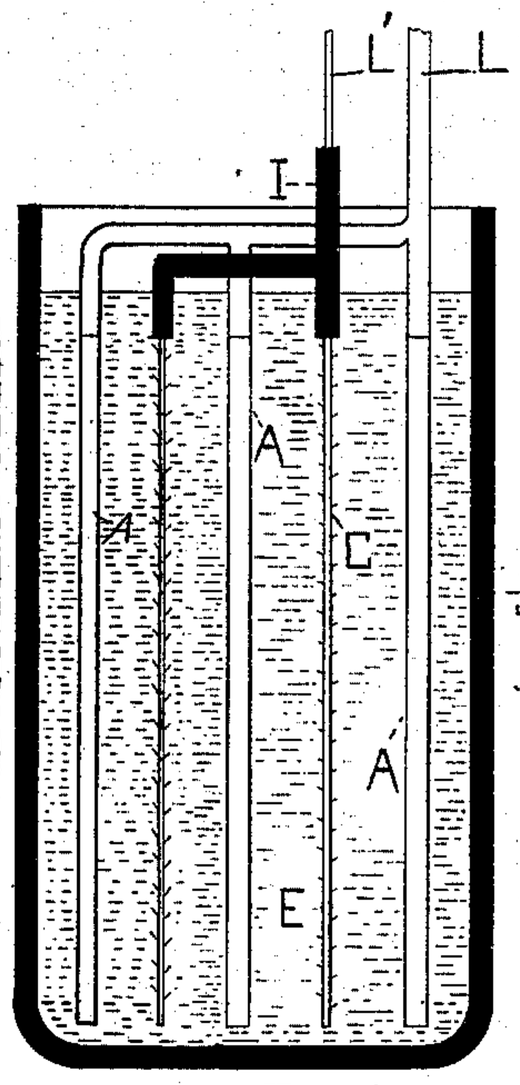

Fig. 1.

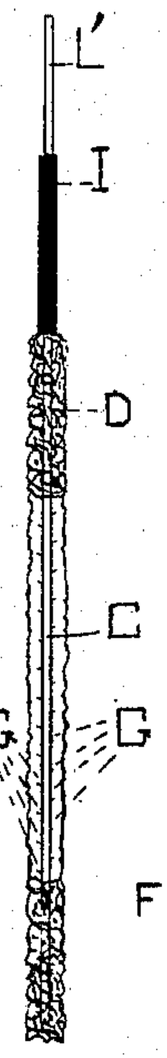

Fig. 3.

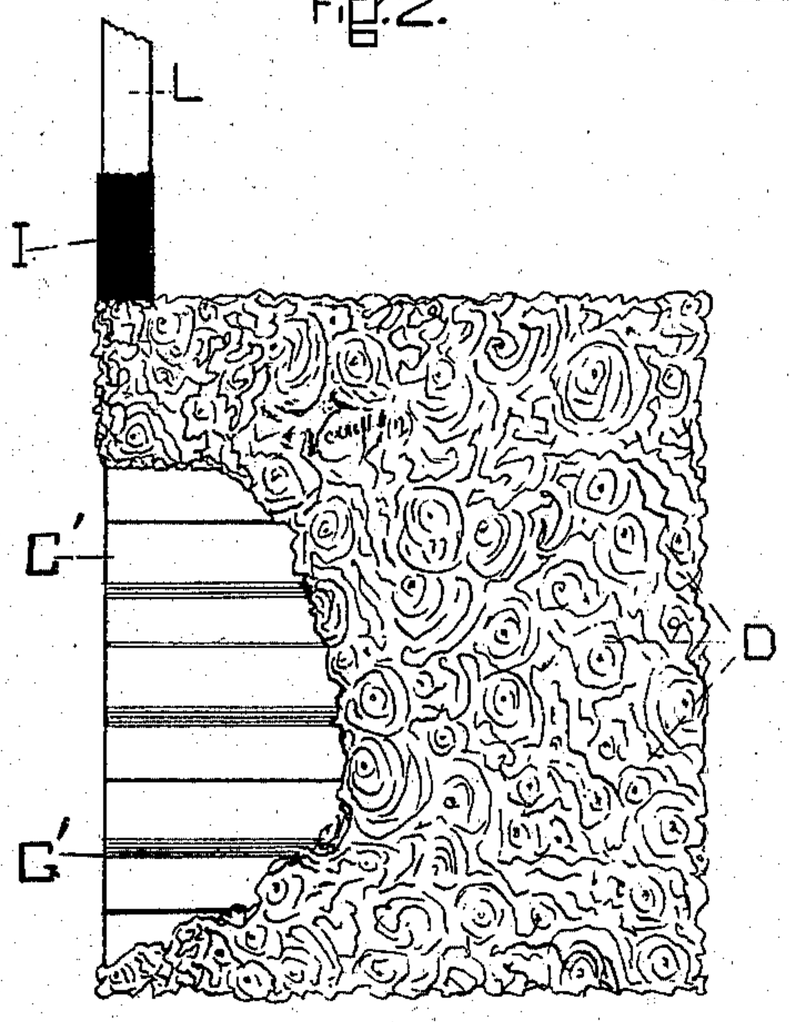

Fig. 4.

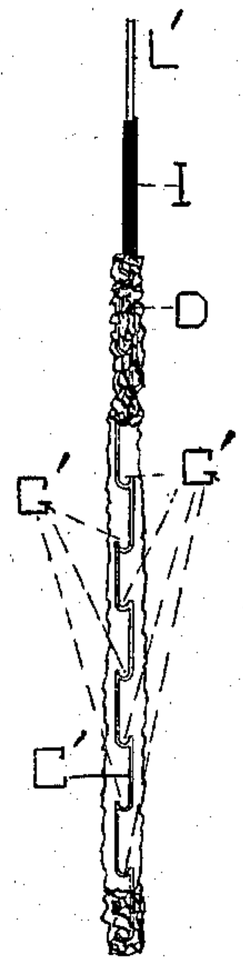

Fig. 5.

Witnesses
J. Guernsey Wilt,
Frank D. Cannar.

Inventor
Charles J. Reed

UNITED STATES PATENT OFFICE.

CHARLES J. REED, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE SECURITY INVESTMENT COMPANY, A CORPORATION OF PENNSYLVANIA.

ELECTROLYTIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 719,870, dated February 3, 1903.

Application filed May 5, 1899. Serial No. 715,682. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. REED, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Improvement in Electrolytic Apparatus, (Case No. 824,) of which the following is a specification.

My invention relates to electrolytic apparatus in which it is desired to deposit in a metallic state from an electrolyte a highly-electropositive metal, such as sodium, potassium, or zinc; and it has for its object to provide a simple and efficient means for insuring a thorough and effective amalgamation of the metal deposited upon the cathode of the apparatus.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section of an electrolytic cell. Fig. 2 is a side view of one of the cathodes having a deposit thereon, part of which is broken away to show the surface of the plate. Fig. 3 is an edge view of the cathode shown in Fig. 2. Fig. 4 is a side view of a modified form of cathode having a deposit thereon, part of which is broken away. Fig. 5 is an edge view of the cathode shown in Fig. 4.

Like letters refer to similar parts throughout the several views.

In the electrolytic deposition of highly-electropositive metals from aqueous solutions it is customary, in order to prevent the rapid redissolving of the metal, to employ a cathode consisting either entirely or in part of mercury, the object of the mercury being to form an amalgam with the deposited metal, which is much more difficult to dissolve than is the metal deposited in the free state. The employment of pure mercury as a cathode is objectionable on account of its liquid state and also on account of the impossibility of using it in any other form than that of a horizontal sheet the upper surface only of which is active. Copper and certain other metals have such an affinity for mercury that plates made of these metals and placed in a vertical position will retain a limited amount of mercury on their surfaces. Plates of this kind have been tried and found to work when freshly prepared. If, however, it is desired to redissolve and redeposit the metal a number of times on the same cathode, (as is the case in the operation of preparing caustic soda and chlorin from sodium chlorid, for example,) it is found that the mercury at each successive operation of depositing and redissolving gradually works downward through the action of gravity and finally leaves the vertical surfaces of the cathode nearly destitute of mercury. By reason of this action the employment of vertical cathodes for the deposition and redissolving of highly-electropositive metals has not heretofore been successful.

My invention constitutes such an improvement in the cathodes as enables a vertical plate to retain mercury on its surface in sufficient quantity to thoroughly amalgamate the deposited metal. I effect this result by providing on the sides of a substantially vertical plate of copper or other suitable metal, at different heights and at frequent intervals, horizontal grooves or receptacles in which the mercury may be retained either by capillarity or gravity or by the combined action of gravity and capillary attraction. I have found in practice that a considerable quantity of mercury may be retained for a long time in a small amalgamated groove located at any desired height above the bottom of the plate.

Referring now to Figs. 1, 2, and 3 of the drawings, J is a jar of any suitable material—such, for example, as glass or hard rubber—which contains an electrolyte E in the form of an aqueous solution of a salt of the metal to be deposited upon the cathode of the apparatus—such, for example, as sulfate of zinc. The anodes A, suitably located in the electrolyte, may contain the metal to be operated upon or they may be composed of platinum, lead, carbon, lead peroxid, or any other suitable material not rapidly destroyed by electrolytic or chemical action, and are provided with or joined to a lug or terminal L for connection with one terminal of the external circuit. The cathode C, in the form of a plate of copper or other suitable conducting material, is provided on both sides with substantially horizontal grooves or pockets G and with a lug L′, which may be either an integral part of the plate or a separate strip

riveted to it. The plate C may be of other material than copper; but I prefer that metal, for the reason that it is capable of amalgamation without becoming too soft or too brittle for mechanical stability. The grooves G may be either cut or otherwise formed in or upon the plate and preferably, though not necessarily, extend downwardly, as well as inwardly, in substantially the form indicated in the drawings. The lug L′ is preferably provided with a band or collar I at the surface of the electrolyte in order to prevent electrolytic and chemical action at this point. The deposit D upon the surface of the plate is amalgamated, as it is formed by the mercury contained in the grooves or pockets G, the deposited metal serving by capillary action to draw the mercury upward out of the grooves or pockets in which it is contained.

In Figs. 4 and 5 of the drawings I have shown a cathode-plate C′ the grooves or pockets G′ in which are of greater capacity than the corresponding parts shown in the other figures and are formed by bending the plate laterally in opposite directions at suitable intervals, so as to form the pockets on opposite sides of the plate alternately.

I desire it to be understood that my invention is not limited to the specific form shown in the drawings, but includes any suitable form or arrangement of horizontal grooves or receptacles formed in or upon the substantially vertical surfaces of the cathode-plates. The grooves may be uniformly distributed over the entire surface, as indicated, or they may be otherwise located and arranged so as to best adapt the plate for any particular requirements of service. The metal deposited upon the plates may also be varied, though I have found that this form of cathode is especially well adapted to the deposit of sodium and zinc in cases where it is desired to dissolve and redeposit the metal a great many times. It will also be understood that separators of hard rubber or other suitable insulating material may be inserted between the anodes A and cathodes C, if found necessary, in order to prevent accidental contact between such elements.

The operation of my invention is as follows: An electric current from a dynamo or other suitable source of electrical energy is passed through the electrolyte E, which contains in solution a salt of an electropositive metal—such, for example, as zinc—and through the electrodes A and C in the proper direction to cause deposition of the metal on the amalgamated cathode C. As the metal is deposited upon the mercury the latter is absorbed and drawn out of the grooves and forms a solid or plastic mass of amalgamated zinc, as indicated at D. On redissolving the deposited metal, which may be readily accomplished by connecting the lug L′, through any suitable electrical conductor or translating device for absorbing electrical energy, with the lug L of an anode consisting of a highly-oxidizing substance—such, for example, as lead peroxid—or by passing an electric current through the cell in the opposite direction, the liberated mercury is returned by the action of capillary attraction and gravity into the grooves G or G′, as the case may be. These operations may be repeated indefinitely.

The term "electrolytic apparatus" here employed is intended to include any and all forms of apparatus in which an electric current is or may be employed either continuously or interruptedly to produce chemical changes either in the electrolyte or the electrodes through which it passes, an accumulator or storage battery being one example of such electrolytic apparatus.

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. In an electrolytic apparatus, a cathode consisting of a substantially vertical plate of conducting material that is not easily destroyed by mercury, said plate being provided with horizontal grooves or channels in or upon both of its faces and at various heights, which project downwardly and inwardly and contain mercury, substantially as herein set forth.

2. In an electrolytic apparatus, a cathode consisting of a substantially vertical plate of conducting material, provided with horizontal grooves in or upon both of its faces, which project inwardly and downwardly and contain mercury, substantially as herein set forth.

3. In an electrolytic apparatus, a cathode consisting of a substantially vertical amalgamated plate of conducting material adapted to receive an electrolytic deposit of a highly-electropositive metal and having horizontal grooves or receptacles formed in or upon both of its faces at various heights above the bottom which project inwardly and downwardly and contain mercury, substantially as herein set forth.

4. In an electrolytic apparatus, a cathode consisting of a substantially vertical amalgamated plate of conducting material having horizontal grooves or receptacles formed in or upon both of its faces at various heights above the bottom which project inwardly and downwardly and contain mercury, in combination with an anode and an electrolyte containing a salt of zinc, substantially as herein set forth.

5. In an electrolytic apparatus, a cathode consisting of a substantially vertical plate of conducting material not easily destroyed by mercury, provided with longitudinal grooves or channels which are formed in or upon both of its faces at various heights and project inwardly and downwardly and contain mercury, in combination with anodes and an electrolyte containing a salt of a highly-electropositive metal, substantially as herein set forth.

6. In an electrolytic apparatus, a cathode consisting of a number of substantially vertical plates of conducting material not easily destroyed by mercury, each of which is provided with horizontal grooves or channels that are formed in or upon both of its faces at various heights and project downwardly and contain mercury, substantially as herein set forth.

7. In an electrolytic apparatus, a cathode consisting of one or more substantially vertical plates of conducting material not easily destroyed by mercury, each of which is provided with horizontal grooves or channels that are formed in or upon both of its faces at various heights and project downwardly and contain mercury, in combination with anodes and an electrolyte containing a salt of a highly-electropositive metal, substantially as herein set forth.

8. In an electrolytic apparatus, a cathode consisting of one or more substantially vertical plates of conducting material not easily destroyed by mercury, each of which is provided with horizontal grooves or channels that are formed in or upon both of its faces at various heights and project downwardly and contain mercury, in combination with anodes and an electrolyte containing a zinc salt, substantially as herein set forth.

9. In an electrolytic apparatus, one or more substantially vertical plate-electrodes of conducting material, amalgamated or adapted to become amalgamated, each of which is provided at various heights with grooves or channels that are formed in or upon both of its faces and project downwardly and contain mercury in contact with the plate, in combination with electrodes of oxidizing material and an electrolyte containing a salt of a highly-electropositive metal, substantially as herein set forth.

10. In an electrolytic apparatus, one or more substantially vertical plate-electrodes of conducting material, amalgamated or adapted to become amalgamated, each of which is provided at various heights with grooves or channels that are formed in or upon both of its faces and project downwardly and contain mercury in contact with the plate, in combination with electrodes of oxidizing material and an electrolyte containing a zinc salt, substantially as herein set forth.

11. In an electrolytic apparatus, one or more substantially vertical plate-electrodes of conducting material, amalgamated or adapted to become amalgamated, each of which is provided at various heights with grooves or channels that are formed in or upon both of its faces and project downwardly and contain mercury in contact with the plate, in combination with electrodes containing lead peroxid and an electrolyte containing a highly-electropositive metal salt, substantially as herein set forth.

12. In an electrolytic apparatus, one or more substantially vertical plate-electrodes of conducting material, amalgamated or adapted to become amalgamated, each of which is provided at various heights with grooves or channels that are formed in or upon both of its faces and project downwardly and contain mercury in contact with the plate, in combination with electrodes containing lead peroxid and an electrolyte containing a zinc salt, substantially as herein set forth.

13. In an electrolytic apparatus, one or more substantially vertical cathode-plates of conducting material, each of which is provided at various heights with integral, horizontal channels in both faces for retaining mercury in contact with the plate against the action of gravity, substantially as herein set forth.

14. In an electrolytic apparatus, one or more substantially vertical cathode-plates of conducting material each of which is provided with horizontal grooves of approximately **U** shape in cross-section and located at various heights on both faces for retaining mercury in contact with said faces, substantially as herein set forth.

In testimony whereof I have hereunto subscribed my name this 1st day of May, 1899.

CHARLES J. REED.

Witnesses:
JAMES W. LAWS,
ROBT. B. FLETCHER.