(No Model.) 2 Sheets—Sheet 1.

L. S. RANDOLPH.

METHOD OF AND APPARATUS FOR THE ELECTRODEPOSITION AND REFINING OF COPPER OR OTHER METALS.

No. 514,275. Patented Feb. 6, 1894.

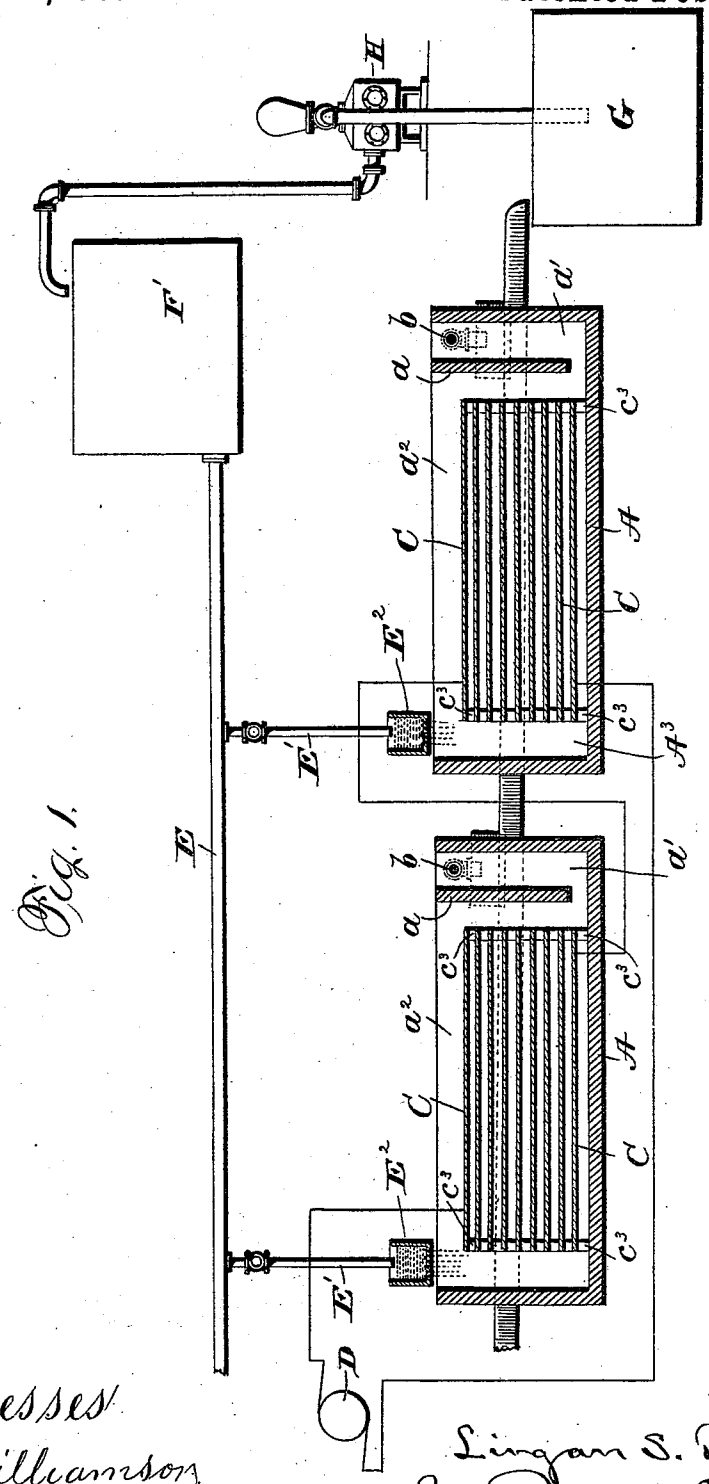

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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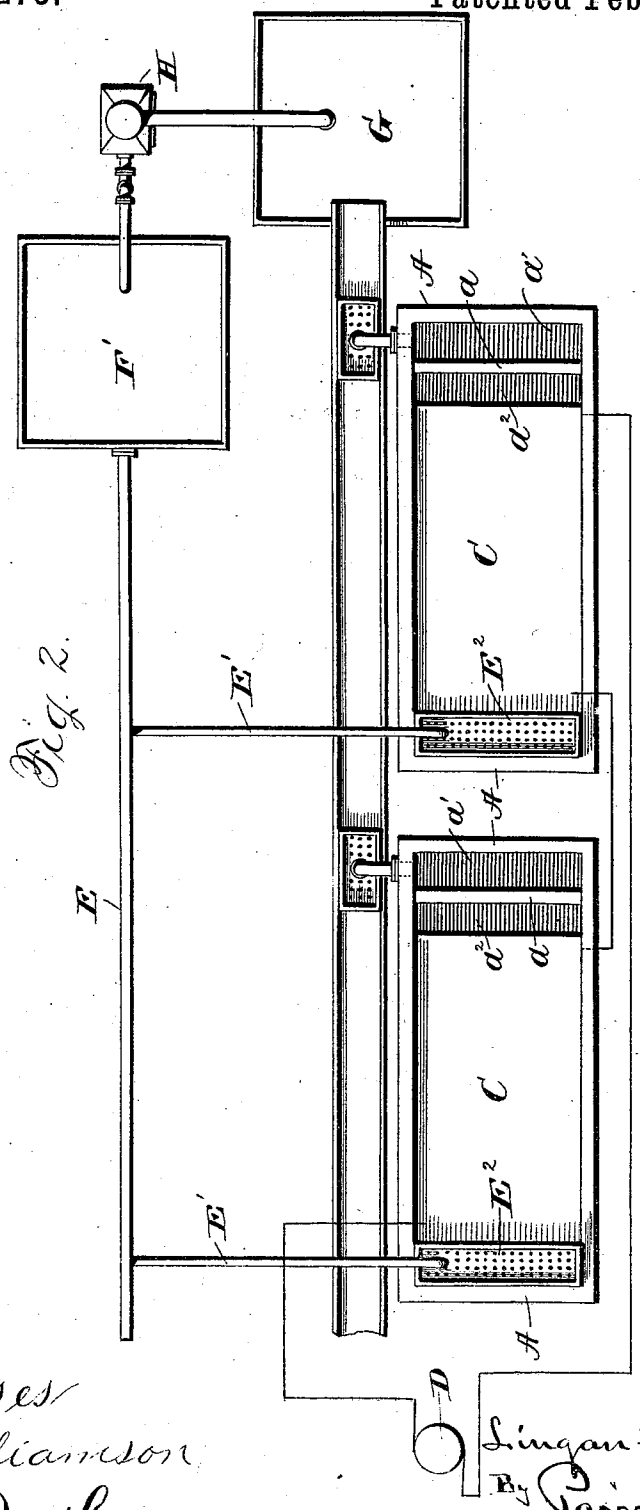

Fig. 2.

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UNITED STATES PATENT OFFICE.

LINGAN S. RANDOLPH, OF BALTIMORE, MARYLAND.

METHOD OF AND APPARATUS FOR THE ELECTRODEPOSITION AND REFINING OF COPPER OR OTHER METALS.

SPECIFICATION forming part of Letters Patent No. 514,275, dated February 6, 1894.

Application filed August 24, 1893. Serial No. 483,982. (No specimens.)

To all whom it may concern:

Be it known that I, LINGAN S. RANDOLPH, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Methods of and Apparatus for the Electrodeposition and Refining of Copper or other Metals; 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 appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

My invention relates to an improvement in the deposition or separation of copper and other metals by electrolysis through the agency of an aqueous solution or bath to free the copper or other metal from impurities and from any foreign metals combined therewith, and it refers particularly to the class of electrolytic cells in which the metal plates are horizontally disposed. In cells of this type the space between the adjacent plates may be said to constitute a cell and as heretofore practiced all the impurities produced in these several individual cells settle on the bottom plate of each individual cell (unless, as has been proposed, provision is made for catching the insoluble impurities on intercepting screens) or remain in suspension in the aqueous bath within the individual cells, with the result that when, as in the present case, the lower plate is made the anode and the upper plate the cathode, (in which case the deposition of the metal takes place on the under side of the several plates,) the impoverished solution, poor in the metal to be deposited and holding in suspension more or less of the impurities or slimes, is retained against the under or cathode side of each plate. Under such conditions the action of the cell is not uniform and the deposition of the metal is uneven and the liability to deposit impurities is much greater on account of the aforesaid impoverished solution being against the cathode plate.

The object of the present invention is to remedy this defect in cells of the aforesaid character and this is secured by causing the electrolyte to circulate through the cells, whereby all impurities or slimes sufficiently light to be held in suspension and carried by the current are carried out from between the plates by the moving or circulating electrolyte and deposited elsewhere.

The invention therefore consists primarily of a circulating electrolyte in conjunction with a cell having the plates horizontally placed. Where the solution charged with impurities held in suspension is allowed to remain in the cells the impurities are often mechanically caught and affixed to the anode by the deposition of the metal from the solution thereon, while by establishing a current of the electrolyte in connection with plates horizontally arranged and so connected in electric circuit that the deposition of metal takes place on the under side of the plates, through the cells the impurities produced by the disintegration of the cathode and held in suspension are carried out of the cells by the current before it is possible for any of them to become caught by the depositing metal on the anode and affixed thereto.

In carrying out my invention I employ an apparatus as illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of a pair of electrolytic cells. Fig. 2 is a plan view of the same.

The electrolytic cell A has therein near one end a partition *a* extending across the cell from side to side and down to within a short distance of the bottom of the tank, a passage being left beneath the partition *a* for the flow of the electrolyte from the large compartment a^2 of the cell, in which are placed the plates C, under the partition and into the small end compartment *a'*, and from thence through an overflow orifice or outlet *b* near the top of the end compartment *a'* into a trough leading to a settling tank G. The electrolyte is pumped or elevated from the settling tank and allowed to flow back into the cell as hereinafter described.

Within the main chamber or compartment a^2, of the cell the metal or copper plates *c* (assuming it is desired to deposit copper) are placed in a horizontal position, the successive plates being separated by non-conducting strips or blocks c^3, preferably of glass, porcelain or other vitreous material placed between the successive plates at the corners so as to support them in a pile or stack, the intervals between the plates being uniform for the entire pile and each plate insulated from all the

rest except through the medium of the solution. The metal plates to be treated may be rolled, pressed or cast, although the best results are obtained by using rolled or pressed plates because of the greater uniformity of the surface and homogeneity of the metal. The positive and negative poles of a dynamo, diagraphically shown at D, or other generator or source of electricity, are respectively connected with the bottom and top plates respectively of a series of plates C, there being no electrical connection between the anode and cathode plates of the series other than through the electrolyte and the intermediate plates. The plates with their separating strips are a little shorter than the length of the compartment a^2, of the cell, leaving spaces thereby at the end for the free flow and circulation of the electrolyte.

Arranged just above and a little to one side of the cell is a circulating or supply pipe E, in practice leading from an elevated tank, as for example F′, into which the electrolyte or solution is pumped from the settling well or tank G hereinbefore referred to, into which latter tank the electrolyte from the cell, overflowing through the discharge opening b passes. The pipe E has a valved arm or branch E′ discharging into a foraminous-bottomed box E^2 just above and across the end of the plate apartment a^2 of the cell, and adapted to discharge the electrolyte into the end space A^3, at the end of the cell, in a shower of drops, in order that there may not be a continuous fluid connection at any instant between the solution in the cell and the solution in the box E^2 or the box itself and the supply pipe connected therewith. A similar broken flow for the electrolyte from the cell into the trough leading to the tank G is provided for a like purpose. The electrolyte or solution being turned on, by opening the valve in the branch pipe E, it will enter the end space A^3 of the cell and thence, the cell being full, will circulate through the aforesaid individual cells or horizontal passages between the plates and thence flowing down under the partition a, and rising into the end compartment a', the electrolyte will overflow at b and pass off into the tank G. A pump H elevates the electrolyte from the settling tank G into the supply tank F from which it flows through the supply pipe E back into the cell again. Thus a circulation of the solution is maintained to effectually remove from between the plates the slimes or impurities precipitated out of the metal plates and held in suspension by the solution, and allow them to settle in the bottom of the cell or in the tank or cistern G where they cannot impair the deposition of metal from the electrolyte.

I am aware that an apparatus has been designed for electrolytically depositing metals, where the plates of metal to be refined, or electrolytically deposited, have been placed horizontally and the current passed from bottom to top, but in that case no provision has been made for circulating the electrolyte, this circulation of the electrolyte being the feature of the present invention, whereby there is prevented the accumulation or formation of an impoverished solution, *i. e.* a solution poor in the metal to be deposited, against the lower or cathode side of the plate, and the presence of impurities held in suspension in close proximity to the cathode sides of the plates is avoided, thereby preventing the deposition of impurities.

In my invention, the plates of copper or other metal to be treated to have removed therefrom impurities, or baser or more precious metals therein contained, being arranged horizontally in the aqueous solution of the sulphate of copper (it being presumed it is intended to deposit pure copper), the electric current passing from the bottom plate to the top plate passes through the intermediate plates and the bath solution therebetween and dissolves the metal or copper from the upper side of the plates and deposits it upon the lower side of the plates next in series, leaving the insoluble impurities or slimes behind resting upon the upper or anode side of the plate from which there are produced, such light particles as do rise and float in the solution being carried away by the circulating electrolyte out of the individual cells and allowed to settle elsewhere and thus are kept off the cathode surfaces.

It is well known that, in processes for electrically refining metals using a liquid or fluid electrolyte, more or less impurities are introduced into the refined metal by being mechanically carried from the surface of the anode by the solution and deposited upon the surface of the cathode, and subsequently covered up by copper deposited over them. This will be entirely or largely prevented by means of my invention as is obvious from the foregoing.

Having thus described my invention, what I claim is—

The process of electrolytically separating metals from foreign metals or impurities combined therewith herein described, which consists in placing in an electrolytic bath a series of superimposed plates of the metal to be treated in a horizontal position with spaces therebetween, with the plates all insulated from each other except through the medium of the solution, in making the bottom and top plates respectively the anode and cathode and subjecting the plates to the action of an electric current, and in causing the electrolyte to circulate through the cell between the horizontally disposed plates, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

LINGAN S. RANDOLPH.

Witnesses:

CLAYTON PUERNELL,

THOS. G. PORTER.