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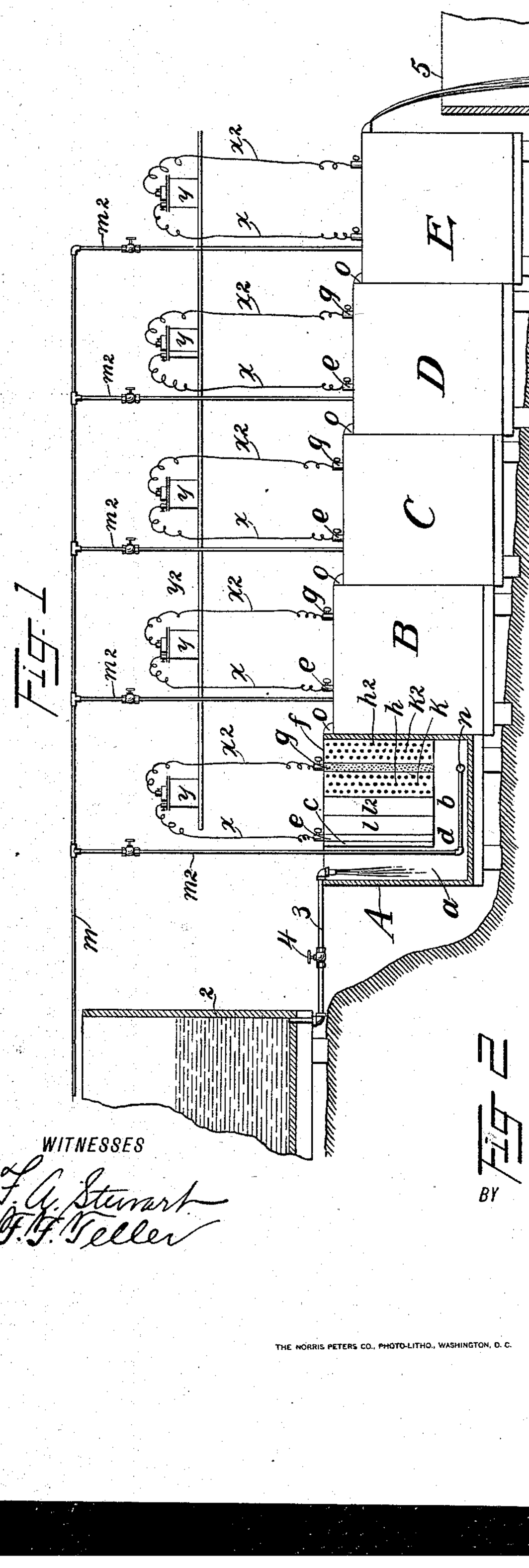
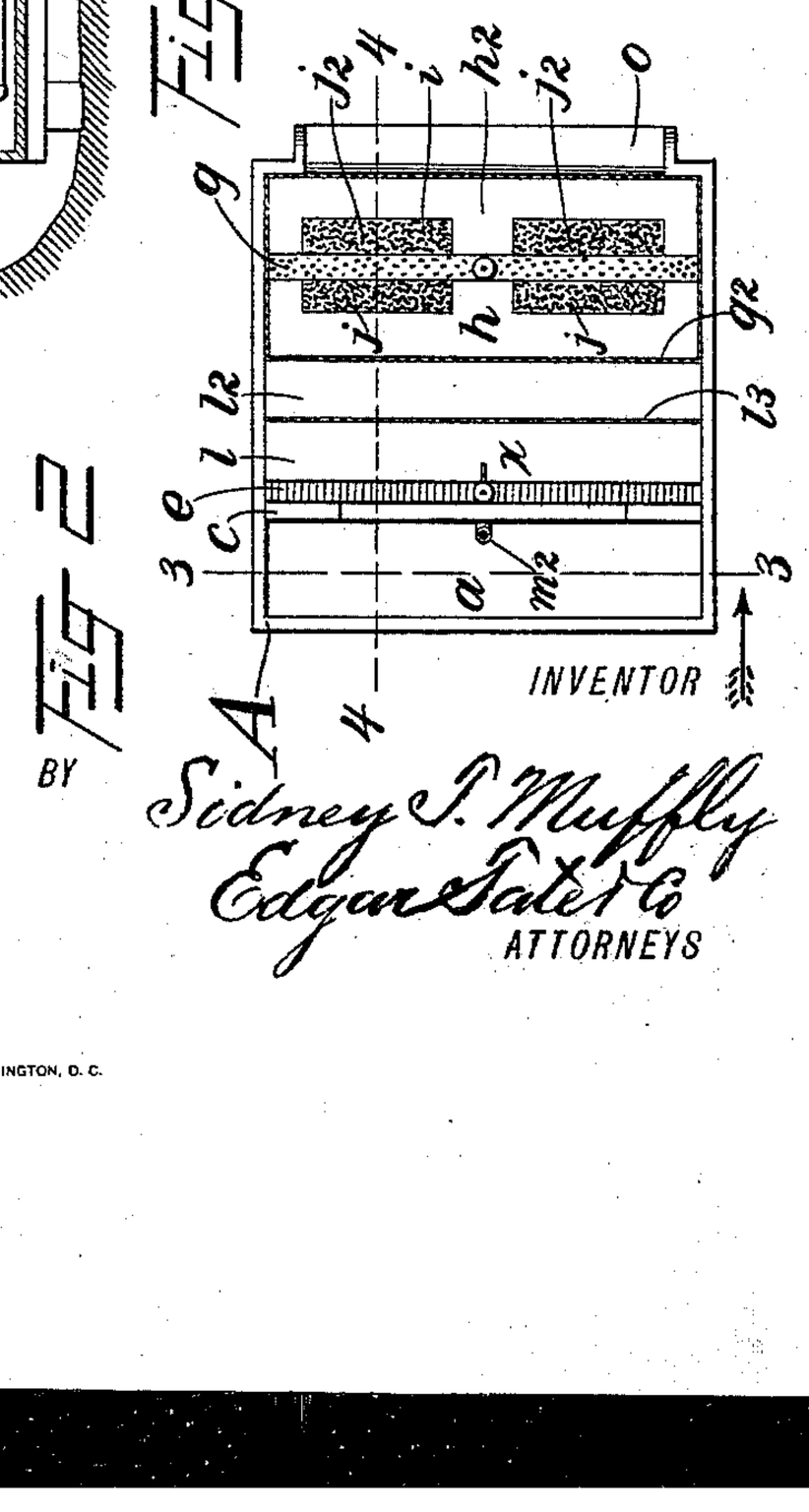
S. T. MUFFLY.

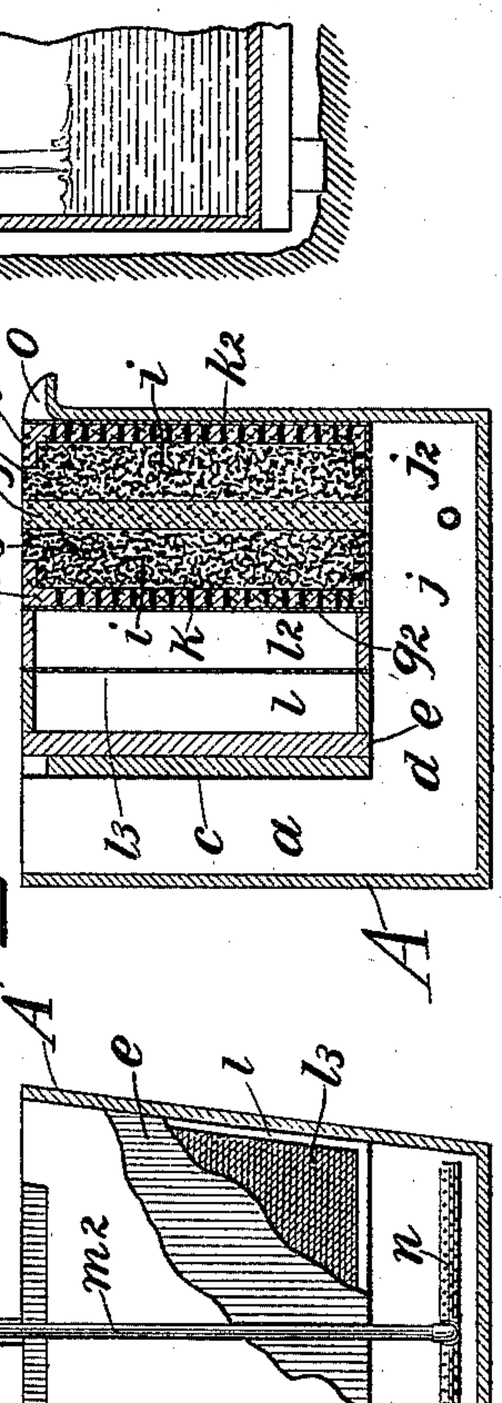
PROCESS OF PRECIPITATING METALS FROM SOLUTIONS CONTAINING SAME.

(Application filed Jan. 22, 1902.)

(No Model.)







UNITED STATES PATENT OFFICE.

SIDNEY THEODORE MUFFLY, OF BOWDRE, GEORGIA, ASSIGNOR OF ONE-HALF TO RUNYON PYATT, OF NEW YORK, N. Y.

PROCESS OF PRECIPITATING METALS FROM SOLUTIONS CONTAINING SAME.

SPECIFICATION forming part of Letters Patent No. 714,599, dated November 25, 1902.

Application filed January 22, 1902. Serial No. 90,751. (No specimens.)

To all whom it may concern:

Be it known that I, SIDNEY THEODORE MUFFLY, a citizen of the United States, residing at Bowdre, in the county of Hall and State of Georgia, have invented certain new and useful Improvements in Processes of Precipitating Metals from Solutions Containing the Same, of which the following is a full and complete specification, such as will enable those skilled in the art to which it appertains to make and use the same.

The object of this invention is to provide an improved process for precipitating metals from solutions of alkaline cyanids, bromids, chlorids, and hyposulfites, or, more particularly speaking, for precipitating gold and silver from solutions of cyanid of potassium by which said metals have been dissolved out of ores and the like.

The invention involves the use of an apparatus which is fully shown and described herein and which is made the subject of a separate application filed of equal date herewith, Serial No. 90,750, and in the drawings forming part of this specification, in which the separate parts of my apparatus are designated by suitable reference characters in each of the views, Figure 1 is a sectional side view of the complete apparatus which I employ; Fig. 2, a plan view of a box or case forming part of said apparatus, a number of which are employed; Fig. 3, a section on the line 3 3 of Fig. 2, and Fig 4 a section on the line 4 4 of Fig. 2.

In constructing an apparatus for carrying out or putting in practice the invention which forms the basis of this application I employ a plurality of boxes or cases A, B, C, D, and E, five of which are shown, but any desired number of which are employed, and said boxes or cases are all of the same shape and are open at the top and preferably square at the top, the fronts and backs being vertical and the sides inclined toward the base.

In Fig. 1 of the drawings a box or case A is shown with the side thereof adjacent to the observer removed, and for the purposes of this description I have selected this box or case as a basis, all the others being of the same form and construction.

The box or case A has two compartments a and b and a transverse partition c, which does not extend entirely to the bottom of said box or case, whereby an open space or way d is formed at the bottom of said partition and by means of which the compartments a and b are in communication.

In the compartment b and adjacent to the partition c is placed a vertically-arranged anode-plate e, of iron, platinum, or other suitable metal, which is connected by a circuit-wire x with a battery-cell y or other source of electricity, and placed in the side of the compartment b is a mattress-cathode f, consisting of a cellular porous carbon plate g, placed between two cellular porous carbon casings h and h^2, between which is placed a packing i, of filiform lead and zinc composition, said composition consisting of an alloy of twenty parts of lead to eighty parts of zinc or such other proportions as will best turn to a fine fibrous condition.

The carbon casings h and h^2 are provided in the top and bottom portions thereof with recesses j and j^2, and the sides and ends thereof are perforated, as shown at k and k^2. The carbon cathode-plate g and the carbon casings h and h^2, with the filiform packing i, are inclosed in a cover g^2, of cotton cloth or other suitable fabric, and these parts form the mattress-cathode f, with which is connected a leading-wire x^2, which is also connected with the battery y or other source of electricity with which the first-named wire x is connected. The said cathode-plate g and cathode-casings h and h^2 are composed of carbon derived from destructive distillation of tar, resin, oil, or other suitable powdered carbon product containing the smallest per cent. of ash and mixed with a suitable cementing compound to be molded in and retain the form shown and described.

Between the anode e and the mattress-cathode f is a space inclosed by frames l and l^2, said frames being composed of glass, porcelain, or other suitable substance that is a non-conductor of electricity, and between these frames is preferably placed a screen l^3, composed of any suitable fabric.

It will be observed that each of the boxes or cases A, B, C, D, and E is provided with one of the batteries y, and the corresponding parts of each of these boxes or cases are con-

nected with the corresponding battery, as hereinbefore described, and as shown in Fig. 1, and said batteries are provided with a suitable support y^2, which may be located at any desired point. I also provide an air-pipe m, which is provided with a plurality of branches m^2 equal in number to the boxes or cases A, B, C, D, and E, and referring to the box or case A, one of these branch pipes m^2 extends downwardly through the compartment a, and is connected with a perforated cross-pipe n, located in the bottom of the compartment b beneath the mattress-cathode f, and these pipes are intended to supply air under pressure to the space beneath the said cathode, as hereinafter described.

It will be observed that the boxes or cases A, B, C, D, and E are arranged in a horizontal line, and each of said boxes or cases is slightly lower than the one to the left thereof, and each is provided at the front thereof—the term "front" being applied to the right-hand side or end of said boxes or cases—with an overflow o, whereby the contents of each of said boxes or cases may be discharged into the adjoining box or case at the front or right-hand side thereof, and said boxes or cases may be interchanged, as hereinafter described, whenever desired.

The upper edge portion of the partition c is recessed, as shown at c^2, to prevent the overflow of the solution at the outer sides of the box or case, and the anode e and mattress-cathode f may be arranged as described and multiplied in each box or case. The object of the fabric screen l^3 between the frames l and l^2 is to arrest any slime or other objectionable substance from imperfectly-filtered solutions, also precipitated base elements or anions detached from the anode e.

The pipe m is in practice connected with a blast-engine to supply air under pressure, which may be either hot or cold, as desired, and in order to create the most effective temperature.

The operation is as follows: A solution of cyanid of potassium or other suitable solution containing gold and silver in a solvent state is placed in a storage-tank 2 and flows therefrom through a pipe 3, provided with a controlling-valve 4, into the compartment a of the box or case A and passing under the partition c rises through the mattress-cathode f and flows over the apron o into the next box or case B, and said solution passes in the same manner through the boxes or cases B, C, D, and E and flows from the last of said boxes or cases into a tank 5, where it is strengthened to a proper standard by the addition of fresh cyanid of potassium for further use in leaching ore. The electric currents for the purpose of electrolytic decomposition and precipitation are supplied through the leading-wires x and x^2 from the batteries y, which are sufficient in number and strength to produce the requisite electromotive force to accomplish the best result in the shortest time—that is, the most perfect electrolysis or rapid precipitation of gold and silver from solution. By means of the electrolytic field confined in the insulating-frames l and l^2, which are placed between the anode e and the mattress-cathode f, I provide for the free circulation of the compressed air through the solution and for the free penetration thereby through the mattress-cathode f, and thus supply an abundant amount of oxygen to enable the molecules of the solution to more rapidly exchange their atoms. In the cellular porous form of the carbon plate g and carbon casings h and h^2 I provide relatively numerous electrolytic circuits in which the electric currents can be greatly multiplied. For instance, while a large or strong electric current, as in other apparatus, may pass through the electrodes and electrolytic solution in a constant direction my apparatus has the additional advantage of many small electrolytic circuits being locally maintained within the mattress-cathode by chemical reaction on the filiform packing i and also continuously increasing the electrolytic conduction by depositing gold and silver cations in the many cells in the carbon plate g and carbon casings h and h^2, thus keeping the electrolytic action more constant than with the use of ordinary exposed cathodes, where corrosion by salts of base metals and slimes of imperfectly-filtered solutions cover the surfaces of cathodes and affect the state of the electrolytic balance. From time to time, as required, a supply of the partly-soluble filiform alloy packing i is added to the compound cathode f through the recesses j and j^2 to replace the portion which has gone into solution or molecular exchange for the gold and silver atoms precipitated within the cathode f. Through the parts g, h, h^2, and i, constituting cathode f, and fabric covering g^2 the solution filters and circulates in the inclosed electrolytic field within the insulating-frames l and l^2 between the iron-plate anode e and the compound cathode f, and the fabric filter-screen l^3 between the insulating-frames l and l^2 prevents the passage of the base elements or detached anions from anode e to cathode f, and thus injure the same by corrosion.

From the foregoing description it will be seen that the cathode which I employ is composed of two or more elements or metals separate in the electromotive scale, one of said elements being in the form of a plate or electrode and the others being preferably filiform and intermixed to form a compound element subject to "local action" and in or among which filiform elements the said plate is located. It will also be seen that the boxes or cases A, B, C, D, and E constitute cells, into and through which the solution compound is passed, and any desired number of these cells may be employed, as will be readily understood, and the shape thereof may also be varied, all that is necessary in this connection being that the form, construction, and

arrangement of said cells shall be such as to permit of the placing therein of the separate parts or elements herein described, so as to accomplish the result specified. The boxes or cases are also so arranged that no portion of the solution may flow from one onto the next without having to rise and pass through the mattress-cathode *f*, and after the electrolysis of the solution is finished the carbon plate *g* and carbon casings *h* and h^2 are incinerated, the ashes containing the gold and silver added to the product of the filiform packing *i*, together with washings of the mattress-cover, and the product is smelted into bullion in the usual way. The box or case A is then refitted with a new mattress-cathode *f* and placed at the right-hand end of the series, and the other boxes or cases are moved up and the box or case B, containing some gold and silver, is the first box or case in the electrolysis of the next solution.

In the form of cathode I employ I secure a greater area for the depositing of metals than can be proportionately obtained in any apparatus using an ordinary solid plate cathode, and because of this advantage I am able to use a current in one direction of greater electric energy, and thus secure a greater current density and efficient potential difference between the electrodes, thus more readily polarizing the molecules of the solution and causing them in the quickest possible time to deposit their non-metallic atoms in contact with the anode and their gold and silver atoms in contact with the cathode.

By means of the partly-soluble filiform packing *i* within the mattress-cathode *f* I obtain increased chemical action that materially assists in preserving a constant conduction of the atoms from molecule to molecule through the electrolytic field until they come in contact with and are eventually set free at the anode and cathode.

In the use of air-currents of effective temperature I provide abundant oxygen to exchange more rapidly for the gold and silver atoms in the molecules of the solution, and in limiting the electrolytic field between the electrodes *e* and *f* in one compartment *b*, with independent electrical connections *x* and x^2 with the battery *y* or other source of electricity, I secure a more perfect polarization of the solutions. By confining the electrolytic field within the insulating-frames *l* and l^2, with the fabric filter-screen l^3 between them I prevent floating non-metallic precipitates at the anode *e* from passing through and corroding the cathode *f*, which results in a purer gold and silver product and more effective chemical action. In this method as a whole I secure a perfect and constant polarization of the compound molecules of the solution and a more rapid and complete deposition of the gold and silver atoms at the cathode.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The herein-described electrochemical process for precipitating gold or other metals from solutions, consisting in obtaining secondary or increased electrochemical action by passing a solution of requisite temperature combined with warm air to supply oxygen into and through a filiform and partly-soluble composition of lead and zinc inclosed in a porous cellular casing of carbon, together with a suitable plate-anode and comprising electrodes having connection with a source of electricity, substantially as shown and described.

2. The herein-described electrochemical process for precipitating gold or other metals from a solution, which consists in passing the solution at a requisite temperature into an electrolytic field between electrodes in combination with a warm-air current, and preventing the floating therefrom of corroding non-metal precipitates through the solution, substantially as shown and described.

3. The herein-described electrochemical process for precipitating gold or other metals from solutions, which consists in passing a solution at a requisite temperature in connection with warm-air currents into an insulated inclosed electrolytic field between electrodes, with means to prevent the floating therefrom of corroding non-metal precipitates the passing of the said solutions and air through a filiform and partly-soluble composition of lead and zinc inclosed in a porous cellular casing of carbon connected with a source of electricity, substantially as shown and described.

4. The herein-described electrochemical process for precipitating metals from solutions which consists in passing the solution in connection with warm-air currents into an insulated inclosed electrolytic field between electrodes, and preventing the floating therefrom of corroding non-metal precipitates, and the passing of said solution and air through a filiform partly-soluble composition of lead and zinc inclosed in a porous cellular casing of carbon, and adding to such solution free cyanid of potassium, substantially as shown and described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of the subscribing witnesses, this 17th day of January, 1902.

SIDNEY THEODORE MUFFLY.

Witnesses:

PATRICK NEWTON PARKER,

ANDERSON GLENN DORSEY.