(No Model.)

F. FARREL.

APPARATUS FOR AND PROCESS OF REFINING COPPER BY ELECTRICITY.

No. 485,618. Patented Nov. 8, 1892.

Fig. 1.

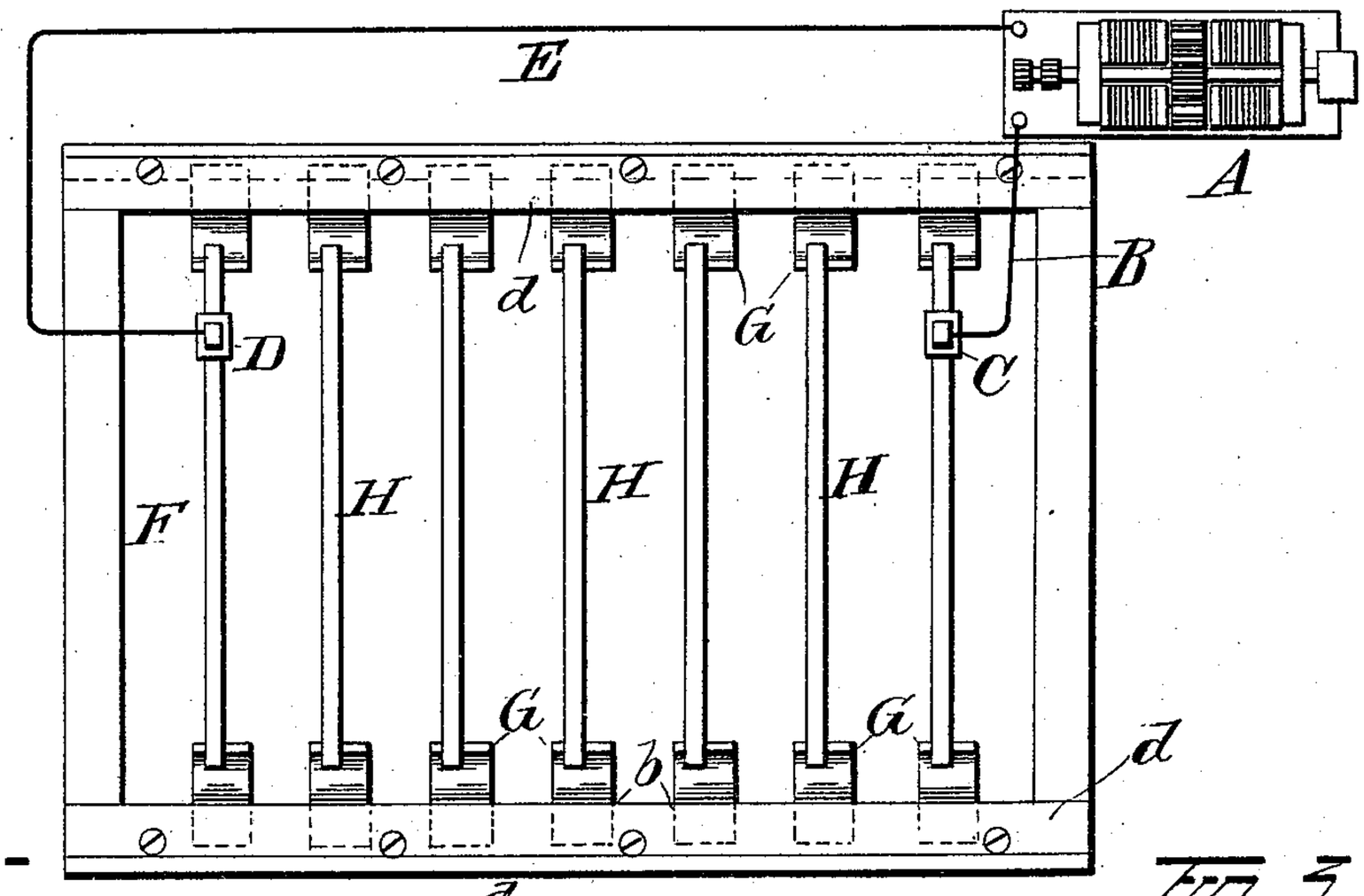


Fig. 2.

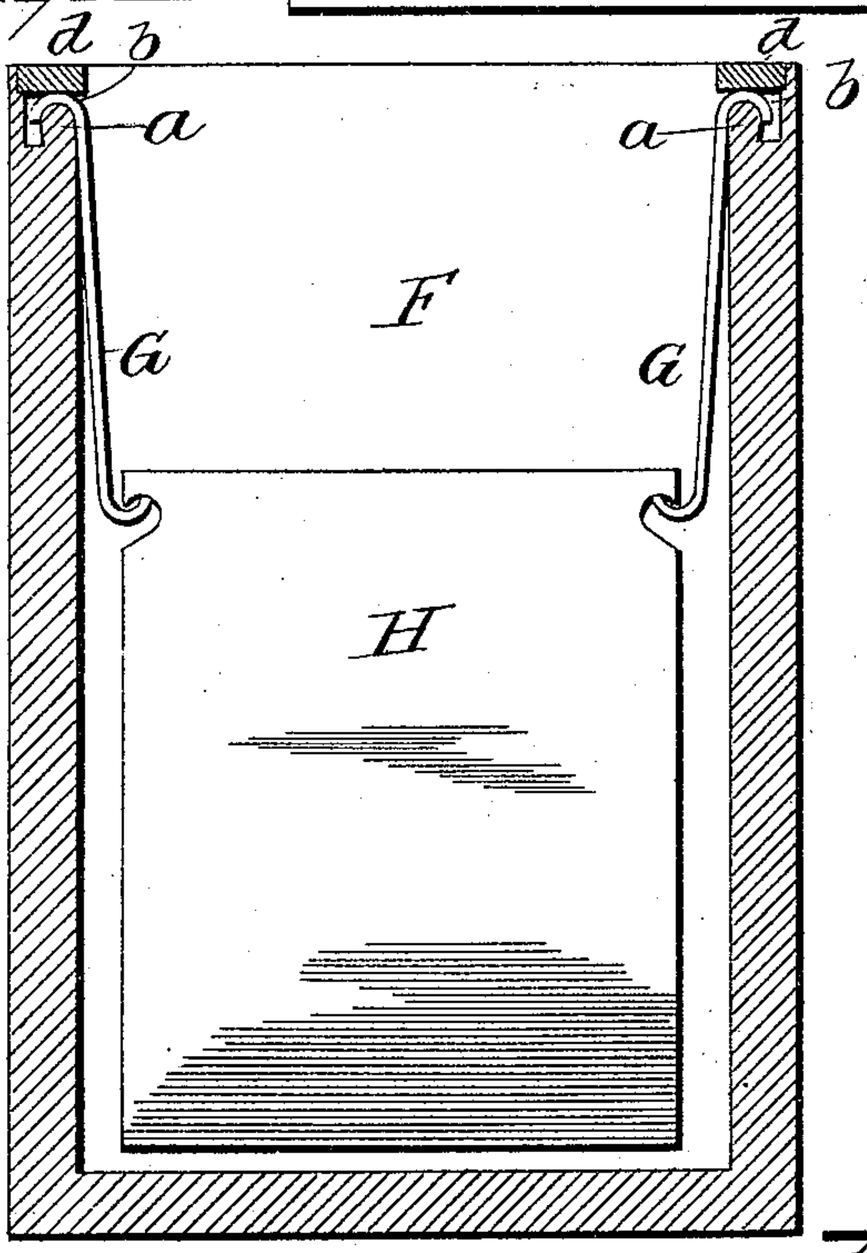


Fig. 3.

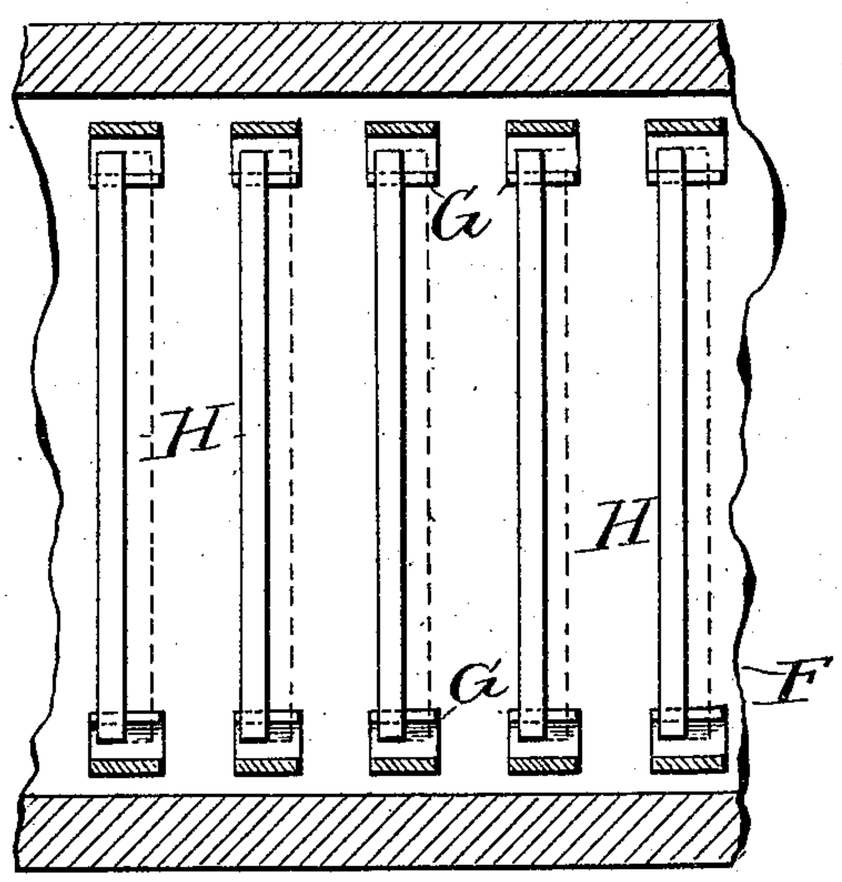
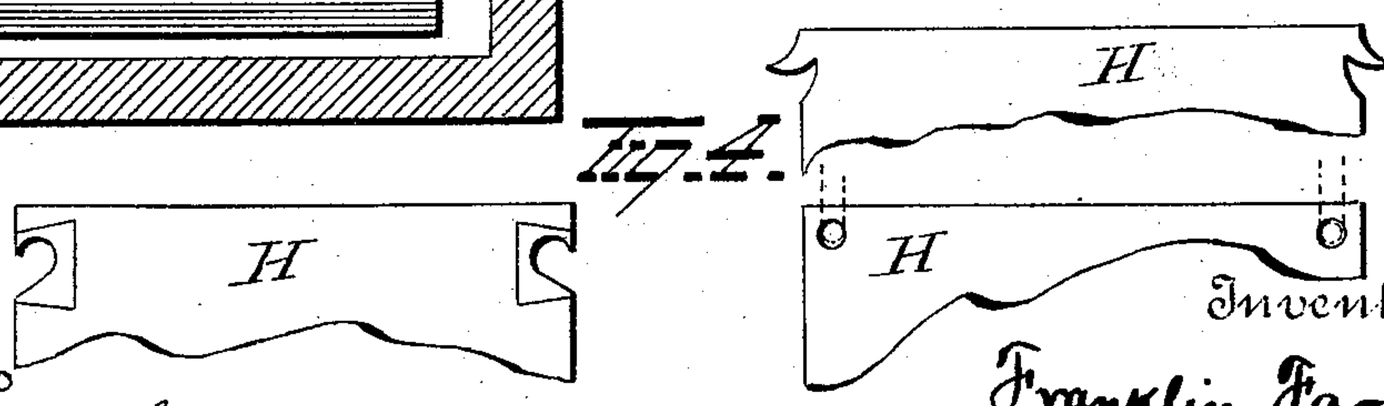


Fig. 4.



Witnesses
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FRANKLIN FARREL, OF ANSONIA, CONNECTICUT.

APPARATUS FOR AND PROCESS OF REFINING COPPER BY ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 485,618, dated November 8, 1892.

Application filed April 26, 1892. Serial No. 430,690. (No model.)

To all whom it may concern:

Be it known that I, FRANKLIN FARREL, of Ansonia, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Apparatus for and Process of Refining Copper by Electricity; 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.

My invention relates to a process of and apparatus for separating precious metals from baser metals and also for separating foreign matter from metals generally by electrical action.

In the processes ordinarily employed for refining copper by electrical action the anode and cathode plates are coupled up with a dynamo or other source of electrical energy and are arranged near the ends of the tank, and consequently as far apart as the length of the bath will permit. Between them are arranged a number of plates of the metal which is to be treated for the purpose of refining it or separating its constituent parts. The anode-plate of each bath will generally be of the same character as the plates of the metal to be treated. Assuming that the anode-plate of each bath is of copper combined with a greater or less percentage of precious metals and other foreign matter and that the plates to be treated are the same, the solution in the bath will be a copper solution—as, for instance, a sulphate of copper solution. The cathode-plates are made of copper or other suitable material. The plates of the metal to be treated are cast or rolled and are arranged as close together in the baths as they can be located without danger of contact and are supported so as to be elevated above the bottom of the tank. These plates are ordinarily supported in grooves formed in wooden strips attached to the inner walls of the tank, such grooves being closed at the bottom, so that they serve to support the plates above the bottom of the tank and also retain them against lateral displacement. When the plates are supported in this manner, their main portions, which extend across the baths between the grooves and which are subject to electrolytic action, will not rest upon anything beneath them. The current from the dynamo-electric machine passes to the anode-plate of the electrolytic bath and flows thence in the same manner from one to another of the plates and ultimately to the cathode-plate of the bath, from whence it returns to the dynamo-electric machine, or when a number of such tanks are employed the current passes through all of them in the manner described. The current first passes to the anode-plate, and from thence through the solution to the plate to be treated, and from the latter through the solution to the next plate, and so on through the several plates in series to the cathode-plate, from whence the current returns to the dynamo or to another bath, if a number are connected in series in the same circuit. The current in flowing from the anode-plate through the bath to the first one of the plates to be treated decomposes the solution, causing the adjacent sides of the plates to be attacked, which results in the reduction of the cathode-plate and the deposition of pure copper on the side of the next adjacent plate nearest the anode-plate. The opposite side of this plate is reduced, and pure metal is deposited on the adjacent side of the next plate. In this way the sides of all the plates nearest the cathode-plate will be reduced, while pure copper will be deposited on the sides of all the plates nearest the anode-plate. The precious metals and other foreign matter will fall to the bottom of the bath and may be taken therefrom as occasion may require. By the employment of an apparatus thus constructed the portions of the plates within the grooves in the sides of the tank are not subjected to the action of the solution, and hence will remain intact, while the anode side of the exposed portion of the plate will be attacked and the pure copper therefrom deposited on the adjacent exposed portion of the surface of the next plate, thus gradually changing the position of the bodies or exposed portions of the plates by taking the copper from the anode sides of the plates and depositing it on the cathode sides of the plates next in advance. When the plates are removed, the unexposed ends thereof, or rather the ends which were concealed within the grooves and not exposed to the action of the solution, are still in their original impure condition and

are in a plane to one side of the plane of the body of the plate, and hence such remaining portions have to be removed and thrown into the scrap for remelting. In the treatment of large quantities of impure copper the loss occasioned by the remelting of the portions of the plates not acted upon forms a large item of expense.

The object of my invention is to provide an improved process and means whereby every portion of the plates of impure and unrefined metal will be acted upon and refined, so that there will be no scrap portions left to be remelted, as in the process now employed.

In the accompanying drawings, Figure 1 is a plan view of an electrolytic bath or tank embodying my invention. Fig. 2 is a view in transverse section of same. Fig. 3 is a view in horizontal section of the bath, showing in full lines the position of the plates at the commencement of the operation and also by dotted lines the change in position of the plates at the completion of the operation; and Fig. 4 shows modified forms of ears or projections on the plates by which they are supported.

A represents a dynamo, the positive pole of which is connected by wire B within the anode C of the bath. The cathode D is connected by wire E with the other pole of the dynamo.

Numerous means for securing the plate-supporting devices to the tank can be resorted to; but I prefer the devices shown in Fig. 2, which consist of hooks preferably secured to the upper side edges of the tank, as shown in said figure. The tank F is provided at the inner edges of its sides with the bearing-seats *a*, preferably curved in the arc of a circle for the reception of the upper curved ends *b* of the hooks G. The curved grooves or seats *a* are longer than the curved ends *b*, so that the lower hooked ends of the hooks or supports G can be moved toward and away from the plates which are to be suspended therefrom. The hooks G, which are made of hard rubber, metal covered with hard rubber, or any other non-conducting acid-proof material, are located on opposite sides of the tank, as shown, and are held in place against displacement by the strips *d*, which latter rest flush with the upper surface of the sides of the tank. These strips, while they prevent displacement of the hooks, do not prevent their free movement toward and away from the plate, as above indicated.

Between the anode and cathode plates of the bath are arranged the plates H of the metal which is to be treated for the purpose of refining it or separating therefrom the precious metals. These plates are arranged as close together in the bath as they can be without danger of contact and are supported wholly from above by the arrangement to be now described, so that their lower ends are above the bottom of the tank, thus allowing of a free circulation of the solution under the plates and at the same time exposing the entire surface of the plates to the action of the solution. By this arrangement at the completion of the operation there are no parts of the original plates of impure metal remaining which must be removed from the comparatively-pure plate formed by deposition.

The plates H, which may be cast or rolled, preferably the latter, are provided at or near their top side edges with ears adapted to be engaged by the hooks G. These ears can be formed by casting, rolling, swaging, or by cutting or slitting the sides or top of the plate and forcing outwardly the portion between the edges of the plate and the slits, or by cutting out and inserting an ear or support, or by simply forming holes in the plate. The lower ends of the hooks G, or the parts thereof on which the ears or projections on the plates H rest, are greater in width than the thickness of the plate, so that as the ear or support is attacked and eaten away on one side it is re-formed by the deposit of pure metal on the opposite side, and hence the supports or hooks are made of a width sufficient to form bearings for the ears formed by the process of deposition. If desired, instead of providing hooks, continuous ledges of a non-conducting acid-proof material could be employed as bearings for the ears or projections from the plates; but I prefer the hooks, as they permit of the more ready introduction and removal of the plates and permit of the employment of plates of unequal widths.

If holes are formed in plates H, the lower bent ends of the hooks should be at right angles to the position shown in Fig. 2 and of course should project beyond the plates a distance approximately the thickness of the plate to support the plate when the process of deposition has been completed.

Means for keeping up a circulation of the solution form no part of my present invention; but it is evident that the liquid can be kept in motion, if necessary, as the plates are suspended above the bottom of the tank and spaces are left at the side edges. With my devices and process the entire plates are subjected to the electrolytic action, and as the anode sides of the plates (the ears or projections of the latter included) are reduced by the action of the current and solution the deposit of the cathode side compensates for the loss, and hence when the plates are removed after the completion of the operation they are of approximately the thickness of the original plates.

From the foregoing it will be understood that by my improved process and apparatus every particle of the plate of impure metal is acted upon, all of the copper being deposited upon the cathode side of the next adjacent plate, while the foreign matter and impurities fall to the bottom of the tank. The refined metal reduced from one plate being deposited upon the cathode side of the next adjacent plate will operate to reproduce a fac-

simile of the original impure plate, and hence if the latter is provided originally with supporting-shoulders the refined plate will also be formed with supporting-shoulders, and owing to the fact that the supporting-hooks are made of sufficient length to serve as supports for the refined plates as well as for the impure plate such supporting-shoulders will be formed over the hooks, and hence the latter will support the completed plates of refined metal. Whatever shape may be given the impure plate to insure its being supported such shape will be reproduced in the refined plate, so that the latter will be supported by the same devices which are employed for supporting the impure plates.

It is evident that numerous slight changes and alterations might be resorted to in the relative arrangement of parts herein shown without departing from the spirit and scope of my invention. Hence I would have it understood that I do not wish to limit myself to the exact construction of parts herein shown; but,

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

1. The method of refining copper by electrical action, which consists in suspending plates of impure copper in vertical or substantially-vertical series in an electrolytic bath and wholly submerging them therein and providing a free circulation of the bath around and in contact with the top, bottom, and sides of the plates, then passing a current of electricity through the plates in series, and forming by electro-deposition plates of refined metal, the bearing-surfaces of such refined plates being formed upon and supported by the devices by which the impure plates were originally supported, substantially as set forth.

2. The combination, with an electrical refining-tank and supports of sufficient width to serve as a support for an impure plate and for a refined plate, of a vertically or substantially-vertically arranged series of impure plates wholly submerged in the electrolytic bath and supported therein by said supports, the construction being such that the top, bottom, and side edges of the plates are in contact with the bath, and electrical connections for electrically connecting the plates at the opposite ends of the tank with the poles of a current-generator, whereby the current may be passed through the plates in series, substantially as set forth.

3. An electrolytic apparatus consisting of a tank, supports having hooked ends depending from the sides of the tanks and adapted to engage seats or shoulders at or near the upper ends of the impure plates, said hooked ends being sufficiently wide to afford a support not only for the impure plates, but for the refined plates, the supporting seats or shoulders of which are electrically deposited on said hooked ends, and suitable electric conductors for connecting the plates at the opposite ends of the tank with the poles of a current-generator, whereby the current may be passed through the impure plates in series, substantially as set forth.

4. An electrolytic apparatus consisting of a tank, supports depending from the top thereof, said supports having hooked lower ends of sufficient width to support not only the impure plates, but the refined plates as well, and electrical connections for connecting the plates at the opposite ends of the bath with the poles of a current-generator, in combination with impure plates, each of which is provided with outwardly-projecting ears, which are adapted to rest upon the hooked ends of the said supports, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

FRANKLIN FARREL.

Witnesses:

ALMON FARREL BOWEN,

PETER TOMLINSON.