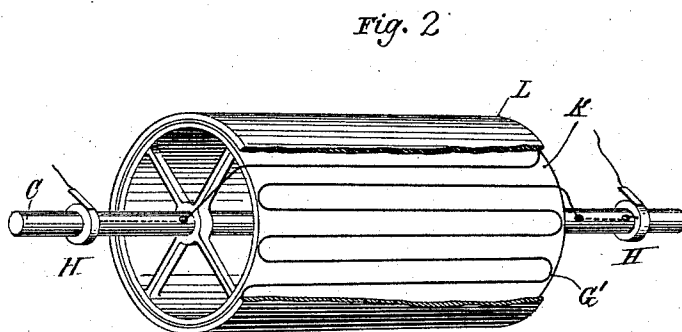
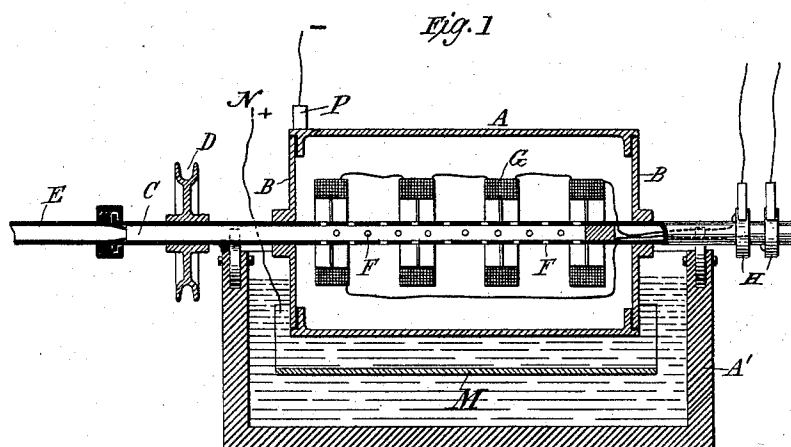


(No Model)

C. R. FLETCHER.
PROCESS OF AND APPARATUS FOR ELECTROREFINING COPPER OR OTHER
METALS.

No. 586,171.

Patented July 13, 1897.



Witnesses:
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UNITED STATES PATENT OFFICE.

CHARLES R. FLETCHER, OF BOSTON, MASSACHUSETTS.

PROCESS OF AND APPARATUS FOR ELECTROREFINING COPPER OR OTHER METALS.

SPECIFICATION forming part of Letters Patent No. 586,171, dated July 13, 1897.

Application filed January 27, 1892. Serial No. 419,417. (No model.)

To all whom it may concern:

Be it known that I, CHARLES R. FLETCHER, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for the Electrorefining of Copper or other metals, and in the Process of Electrodeposition, of which the following is a specification, reference being had to the accompanying drawings, forming a part of the same.

My invention relates to an electrolytic process and apparatus for the electro refining and deposition of metals—such, for example, as copper—in the form of slabs, bars, strips, sheets, and irregular forms from impure metals—such, for example, as crude ingot copper, blister or black copper. The process and apparatus may, however, be employed for the deposition of other metals; also, in the electroplating of metals upon hollow or tubular forms of cathodes, as will be explained.

The invention relates, especially, to a method of combined and continuous application of heat and electricity to the cathode, as will be explained, and to the construction of the electrolytic cathode to carry out this process.

At many times attempts have been made to produce copper and other metals by electrodeposition in the general process called "electrolysis," so that the resulting copper, commonly called "electrolytic copper," or other metals shall be in a state of compact, homogeneous, malleable, and ductile metal. At present the electrolytic copper or other metal is produced in a crystalline brittle form quite unlike the metal produced by melting and subsequent cooling in proper molds. To produce copper and other metals in the reguline condition, the process has been either very slow or complicated, and then the deposited metal has lacked important desired qualities.

My invention simplifies the conditions of the electro process and furnishes means whereby the electrodeposition of metals can be carried on with great rapidity consistent with the production of smooth malleable and ductile copper and other metal, and whereby metal may be produced of standard chemical purity, highest electrical conductivity, nor-

mal tensile strength, and of higher specific gravity than hitherto.

My invention consists, first, in an electrolytic process combined with a method of heating the hollow cathode or preferably the cylindrical rotating cathode, whereby during the electrodeposition upon the cathode-surface there is maintained a continuous evolution of heat within the metallic cathode, which is conducted from within outward, hence upon and through the electrodeposited metal. It is thereby that under appropriate conditions relating to the maintenance of the electrodeposition, which varies according to the metal deposited, I am enabled to produce the results which I have specified as being so long a desideratum.

The apparatus which embodies the second part of my invention comprises a tank or vat for containing an electrolytic or conducting solution, one or more cathodes for receiving a deposited metal, and one or more anodes which are dissolved by the action of an electric current and transferred to and deposited on the cathode or cathodes, the general object being to obtain pure from impure metal, and the special object being to obtain the deposited metal in a condition when the several physical properties before mentioned present themselves. In the manner of heating of the cathode and construction most convenient to carry out this continuous-heating process lies the subject of this part of my invention. When liquids pass from the liquid to the gaseous state, a large amount of heat, as is well known, is absorbed. When, on the contrary, the vapor passes back into the state of liquid, it gives out a definite amount of heat. This latent heat I find most convenient for the heating of the cathode, and in carrying out my process I preferably use the vapor of water, (steam.)

Another plan is to arrange resistance-coils inside the cathode form or cylinder, and by means of electricity heat is produced in these coils. I am enabled thus to produce equally satisfactory results on the cathode. I heat, if steam is used, the cathode form or cylinder to a temperature depending upon the metal deposited and the nature of the solution. In the case of copper I raise the tem-

perature usually from 180° to 212° Fahrenheit. By this means all gases which may collect upon the cathode are driven off, and thus polarization is also diminished. When desirable to heat the steam or vapor to a temperature above the boiling-point of water, I do so by means of the electroheated resistance-coils within the cathode, and this superheating of vapors by this means I also claim as part of my invention. It will be seen that I also indirectly heat the solution by these means which, of course, I do not claim as new, except in the manner of heating the electrolyte.

In the drawings hereto annexed, Figure 1 is a vertical central section of an apparatus constructed and adapted for carrying out my invention, and Fig. 2 is a perspective view of a modified form of cathode.

In carrying out my invention I prefer to use a cylindrical cathode A, mounted in a tank A' and capable of rotation therein, as by this means attention can be more conveniently given to the deposited metal which continuously appears in view, also more powerful currents of electricity may be brought to bear upon small surfaces of metal and the rate of deposit hastened, and all conditions embraced in my invention more accurately carried out.

The cathode is or may be prepared in the usual manner, but I prefer to use an iron pipe covered with electrotype metal, which is turned down on the surface so as to prepare it for receiving a deposit of metal smoothly if sheets are to be made, or otherwise, according to the desired form of the deposit. The heads or ends B of the pipe or cylinder are then inserted and the joints then soldered.

The shaft or axis C of the cylinder I make of a metallic pipe or tube provided with a pulley D and connected with a steam-pipe E, from which the steam is introduced into the hollow cathode through pin-holes F, bored through that portion of the hollow axis which is within the cathode. I also mount on this shaft within the hollow cathode resistance-coils G, connected by insulated wires that pass through the hollow shaft with collecting-rings H, mounted on the end of said shaft. These rings in turn are connected with a suitable source of current, and when sufficient electricity is passed through the coil they are heated.

In some cases the cylindrical cathode may be made without heads, as shown in Fig. 2. In such cases I employ a wooden or other insulating cylinder or tube K, around the surface of which are arranged flat heating-coils G'. Over the surface thus wired I secure in any proper manner a sheet of electrotype metal L as a cathode to receive the deposit. There are several convenient methods of thus heating the interior of metallic cathodes and from within outward, when the desired continuous radiation of heat through and out

from the metallic cathode is sustained during the deposition of metal upon the same.

The electric currents and circuits to sustain the deposition upon the cathode may be applied as usual, and the general electrolytic process it is otherwise unnecessary to describe, as it is well understood and varies with the metal under treatment.

I have shown in the drawings an ordinary form of anode M in a vat or tank in proximity to the rotating cylindrical cathode. One terminal of the source of electricity is connected with the anode through an insulated conductor N and the other to the cathode through a brush P, that bears upon its surface.

There are several important advantages in the process and apparatus herein described, which are embraced chiefly in the resultant metal deposited under the conditions above set forth, the properties of which are those more or less of pure metal which has been melted and then cast, while it is free from the impurities arising from coal or manipulation due to melting and casting. Thus by my invention I obtain electrodeposited metal in sheets suitable for immediate use or strips, bars, and forms ready either for use or for all mechanical purposes. I obtain pure deposited metal directly, which heretofore has only been accomplished by various mechanical and other steps in addition to the electrodeposition.

What I claim is—

1. The improvement in the art of depositing metals by electrolysis which consists in dissolving by an electric current an anode immersed in an electrolytic bath and depositing the metal upon a cathode supported in the bath, and maintaining in the interior of the cathode during such deposition a source of artificial heat, whereby the heat is conducted outward through the metal as it is deposited.

2. An apparatus for refining and depositing metals by electricity comprising in combination a tank or vat, one or more anodes and a hollow revolving cathode mounted on a hollow shaft connected with a source of steam, as set forth.

3. The method, herein described, of heating the cathode of an electrodeposition-tank, by introducing steam into the hollow interior of the same, and superheating the steam by passing a current of electricity through resistance-coils contained within said cathode.

4. The combination with a hollow rotating cathode of a source of steam connected with the interior thereof, electric heating-coils contained within the cathode and electrical connections therefrom to a source of electric current, as set forth.

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