(No Model.)

W. H. WIGGIN.

PROCESS OF AND APPARATUS FOR REFINING METALS ELECTROLYTICALLY.

No. 545,328. Patented Aug. 27, 1895.

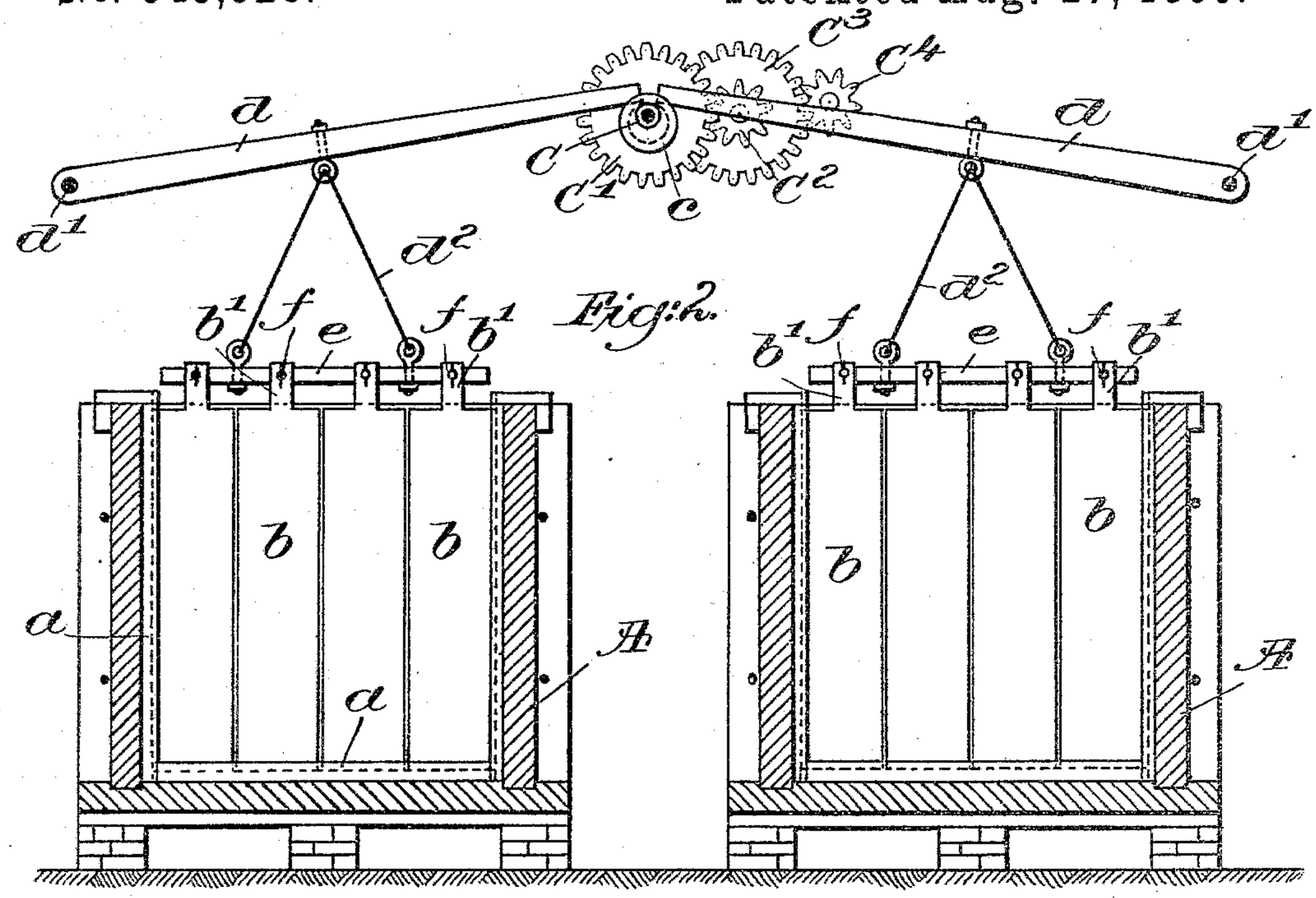

Fig: 2.

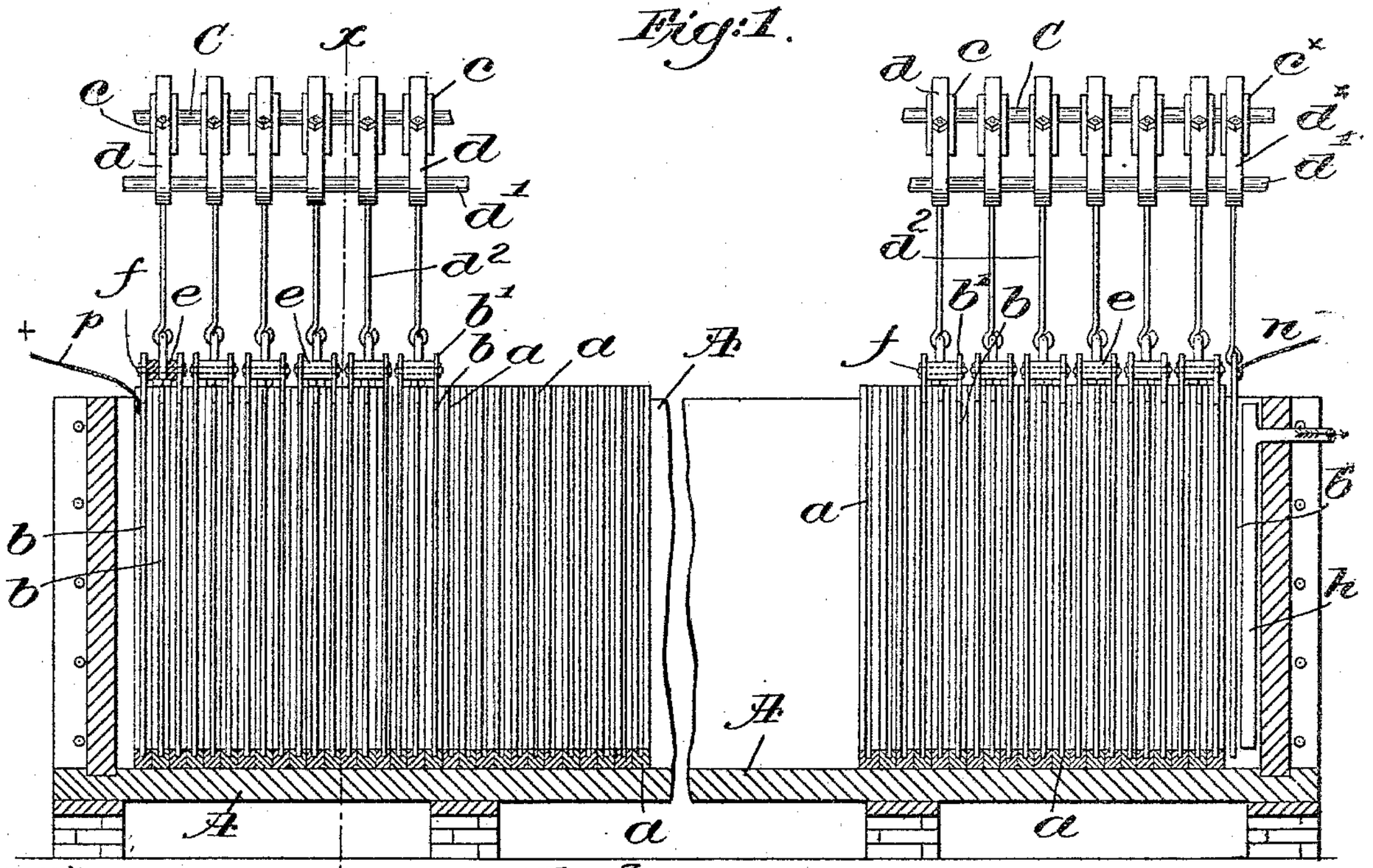

Fig: 1.

Witnesses

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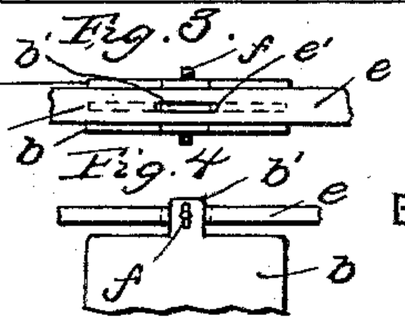
A C Harwood

Thomas J. Drummond



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PROCESS OF AND APPARATUS FOR REFINING METALS ELECTROLYTICALLY.

SPECIFICATION forming part of Letters Patent No. 545,328, dated August 27, 1895.

Application filed May 22, 1894. Serial No. 512,077. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. WIGGIN, of Worcester, county of Worcester, State of Massachusetts, have invented an Improvement in the Process of and Apparatus for Refining Copper or other Metals Electrolytically, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to a process of and apparatus for refining metals, and particularly copper, electrolytically, whereby the metal to be refined is completely and rapidly purified. A copper of the highest conducting power is in great demand for the manufacture and equipment of electrical apparatus, and it can be obtained only by removing all impurities—such as silver, arsenic, &c., or other foreign substances—therefrom. A series of electrodes or plates made of the impure metal to be refined have been placed in a bath filled with an electrolytic solution and subjected to the action of an electric current. The impure electrodes are thereby decomposed, and the pure metal is carried from the anode side of one plate to and deposited upon the cathode side of the next preceding plate, the impurities settling to the bottom of the bath, and the operation is continued until it is advisable to remove the plates and substitute new ones. In order that the deposition of the pure metal may be evenly distributed, it has been found necessary to maintain the same density of the electrolytic solution throughout the bath, and to this end the solution has been kept in circulation by various means. While this circulation or diffusion of the solution largely increases the rate of deposition, the bubbles of gas which form during the decomposition gather upon the surface of the plates or electrodes, and the circulation of the solution does not thoroughly remove them, and so, too, the foreign substances will form a film on the plates, the portion so covered in either case retarding the action of the solution upon the electrodes.

My invention has for its object a process of and apparatus for refining metals, and especially copper, electrolytically, wherein the bubbles of gas or other substances which may gather upon the surface of the electrodes are constantly removed therefrom, causing a more rapid deposition of the pure metal and maintaining a more homogeneous density in the electrolyte.

In accordance therewith my invention consists in the process of refining copper and like metals, which consists in suspending plates of the impure metal in a vertical position in an electrolyte, dissolving pure metal from the anode side of one plate and depositing it upon the cathode side of the next plate by electrolytic action, and maintaining the plates free from bubbles of gas or impurities by constantly agitating the plates in vertical planes, substantially as will be described.

Other features of my invention will be hereinafter described, and particulary pointed out in the claims, the apparatus herein shown forming a part of my invention.

Figure, 1 in side elevation and partial section, broken out centrally, represents one form of apparatus whereby my process may be carried out. Fig. 2 is a sectional view taken on the line *x x*, Fig. 1, looking toward the left. Figs. 3 and 4 are enlarged detail views in plan and elevation, respectively, of the attaching devices for the plates or electrodes.

Referring to Figs. 1 and 2, I have shown two parallel tanks A, of any suitable size and construction, having secured to their inner side walls guides or channels *a* to receive in them and maintain in place the side and lower edges of plates or electrodes *b* of the material to be purified, hereinafter to be described. The guides or channels at their upper ends overlap the tops of the tank-walls, such construction assisting in retaining the guides in proper position.

In Fig. 2 the guides are shown as placed side by side and close together, except near the central part, where some of them are omitted to show the tank-wall beyond. An actuating-shaft C, having a series of cams *c* thereon, is extended between and above the two tanks, while a series of levers *d* are pivoted at their outer ends on shafts *d'*, the inner ends of the levers resting on the cams *c*, as clearly shown in Figs. 1 and 2. Each lever has suspended therefrom by connections d^2 a yoke *e*, to which is attached one or

more of the plates or electrodes *b* of the material to be purified, and the connections d^2 may be of insulating material, or they may be insulated from the levers *d* to prevent escape of the current. The impure metal, such as copper, is formed into flat plates *b*, preferably having an ear *b'* at its upper end, and the plates are arranged, as best shown in Figs. 1, 3, and 4, side by side in groups of three, and secured to the yoke *e* by a pin *f* of insulating material, to prevent short-circuiting, extended through an opening in each ear and through the yoke, which latter is slotted (see Fig. 3) at *e'* to permit the passage of the ear of the center plate of the three.

In the drawings, Figs. 1 and 2, each yoke is supposed to support twelve of these plates or electrodes, their lower edges resting in the guides or channels *a* at the bottom of the tank A, the upright edges of the outermost plates of each row of four resting in the side guides, the plates being such a size that free circulation of the electrolytic fluid between and around them is permitted.

The gear C' is engaged by a pinion C^2, rotated by or secured to a larger gear C^3, which in turn meshes with a driving-pinion C^4, so that rotation of the driving-pinion will impart rotation to the operating-shaft C, causing the cams *c* thereon to act upon the levers *d*, raising and lowering them alternately on their points of support *d'* and raising and lowering the yokes *e* and their series of attached plates or electrodes *b* in the electrolytic solution, a quick shaking movement being given to the plates, shaking off therefrom any adhering bubbles of gas or particles of impure matter which would tend to adhere to the plates during the action of the electric current, thereby maintaining the surface of the plates in condition to be acted upon continuously by the electrolytic solution, and obtaining a rapid and even deposition of the pure metal, as will be described, while subjected to the action of the electric current.

Referring to Fig. 1, the positive pole of a dynamo or other source of electricity is connected by wire *p* to the endmost plate or electrode *b* of the series, while the negative pole of the source of electricity is connected by wire *n* to a plate $b^\times$, of preferably pure copper, at the other extremity of the bath, such plate, however, being connected to a lever $d^\times$, resting at its inner end on a cam $c^\times$ on the operating-shaft C, so that the said plate is agitated during the process as are the impure plates *b*. As shown herein, the positive connection with the source of electricity is at one end of the tank and the negative connection at the other, the electric current passing successively through the solution and each plate of the series; but it is obvious that a different system of connections could be devised—as, for instance, every other plate in the series might serve solely as a cathode, it being connected with the anode plates of the impure metal—as shown in United States Patent No. 467,484, so long as the agitation of the plates is maintained.

In carrying out my invention in the apparatus hereinbefore described the tanks or baths A are filled with the electrolytic solution and the plates or electrodes *b* are immersed therein and held in place by the guides or channels *a* throughout the length of the tank.

The combined action of the solution and electric current decomposes the impure electrodes, and the pure metal is carried forward from the anode side of one plate and deposited upon the cathode side of the next preceding plate, the impurities settling to the bottom of the tank, from which they may be removed at desired intervals. The action of decomposing one plate and depositing upon the next is continued for a sufficient length of time, whereupon they are removed and new plates substituted.

In purifying or refining copper by this method the plates which are taken out consist of chemically-pure copper, which may be at once worked into wire, bars, or any other desired form. The electrolytic solution may be kept in circulation by introducing it at the top of one end of the tank and permitting it to flow out from the bottom at the other end—as, for instance, through the escape-pipe *h*—from whence it may be pumped back again to the first tank of the series to again flow through them. Throughout the operation the agitation of the plates is maintained as described, resulting in a very marked increase in the rapidity of the operation and a more thorough and effective purification of the metal to be refined.

The positive pole of the source of electricity is connected by wire p^{20} to a spring-like contact p^{21}, bearing against the endmost plate or electrode *k* of the series, while the negative pole is connected by wire n^{20} to a similar spring-contact n^{21}, bearing against the electrode at the other end of the series, the contacts being properly insulated from the tank, to which they may be attached, as shown.

My invention is not restricted to the precise construction and arrangement herein shown, as it is obvious that the same may be altered without departing from the spirit and scope of my invention so long as the plates or electrodes of the metal to be purified are constantly agitated in vertical planes during the action of the electric current while immersed in the electrolytic solution.

I claim—

1. The herein described process of refining copper and like metals, which consists in suspending plates of the impure metal in a vertical position in an electrolyte, dissolving pure metal from the anode side of one plate and depositing it upon the cathode side of the next plate by electrolytic action, and maintaining the surfaces of the plates free

from bubbles of gas or impurities by constantly agitating the plates in vertical planes, substantially as described.

2. In an apparatus for refining copper and like metals by electrolysis, a tank for the electrolyte, and a movable yoke to support plates of the impure metal vertically therein, combined with an actuating shaft, and insulated connections between it and the yoke, whereby the latter is moved to constantly agitate the plates in vertical planes in the electrolyte, substantially as described.

3. In an apparatus for refining copper and like metals by electrolysis, a tank for the electrolyte, guides or channels therein, a movable yoke, and plates of the impure metal supported thereby and directed by the guides or channels, combined with an actuating shaft, and insulated connections between it and the yoke, whereby the latter is moved to agitate the plate in the electrolyte, substantially as described.

4. In an apparatus for refining copper and like metals by electrolysis, a tank for the electrolyte, a series of yokes above the tank, and retaining pins adapted to pass through ears on plates of the impure metal and connect them to yokes, combined with an actuating shaft, and connections between it and said yokes, whereby rotation of the shaft raises and lowers the yokes to agitate the plates in the electrolytic solution, substantially as described.

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

WILLIAM H. WIGGIN.

Witnesses:

CHARLES A. MERRILL,

EDYTHE GROUT.