No. 760,023. PATENTED MAY 17, 1904.

A. SCHWARZ.

APPARATUS FOR THE ELECTROLYTIC REFINING OF METALS.

APPLICATION FILED NOV. 22, 1902. RENEWED NOV. 20, 1903.

NO MODEL.

Fig. 1,

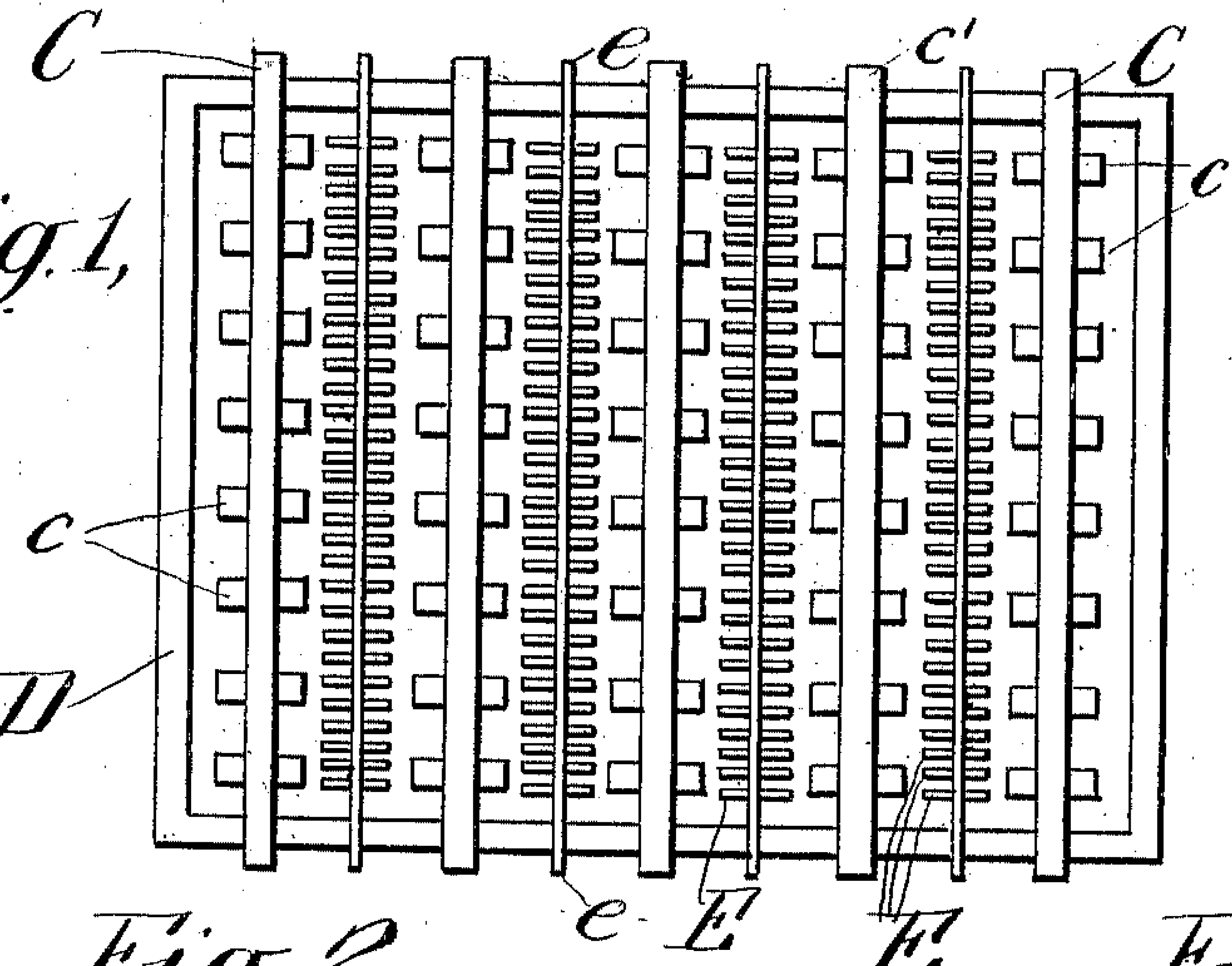


Fig. 7,

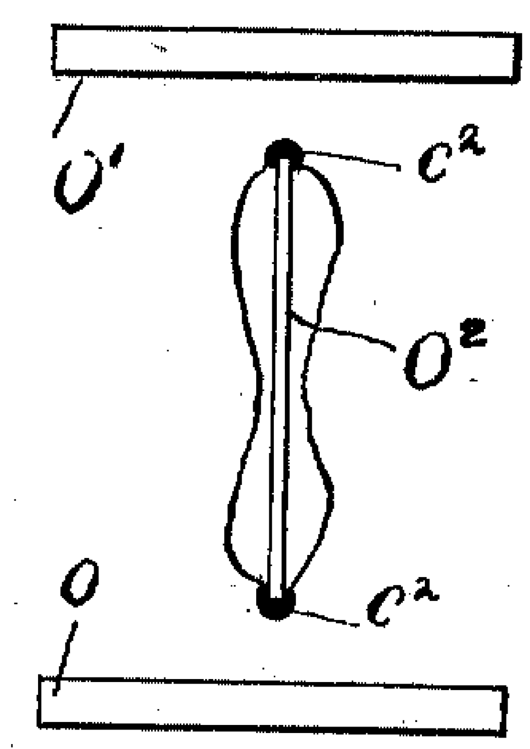


Fig. 2,

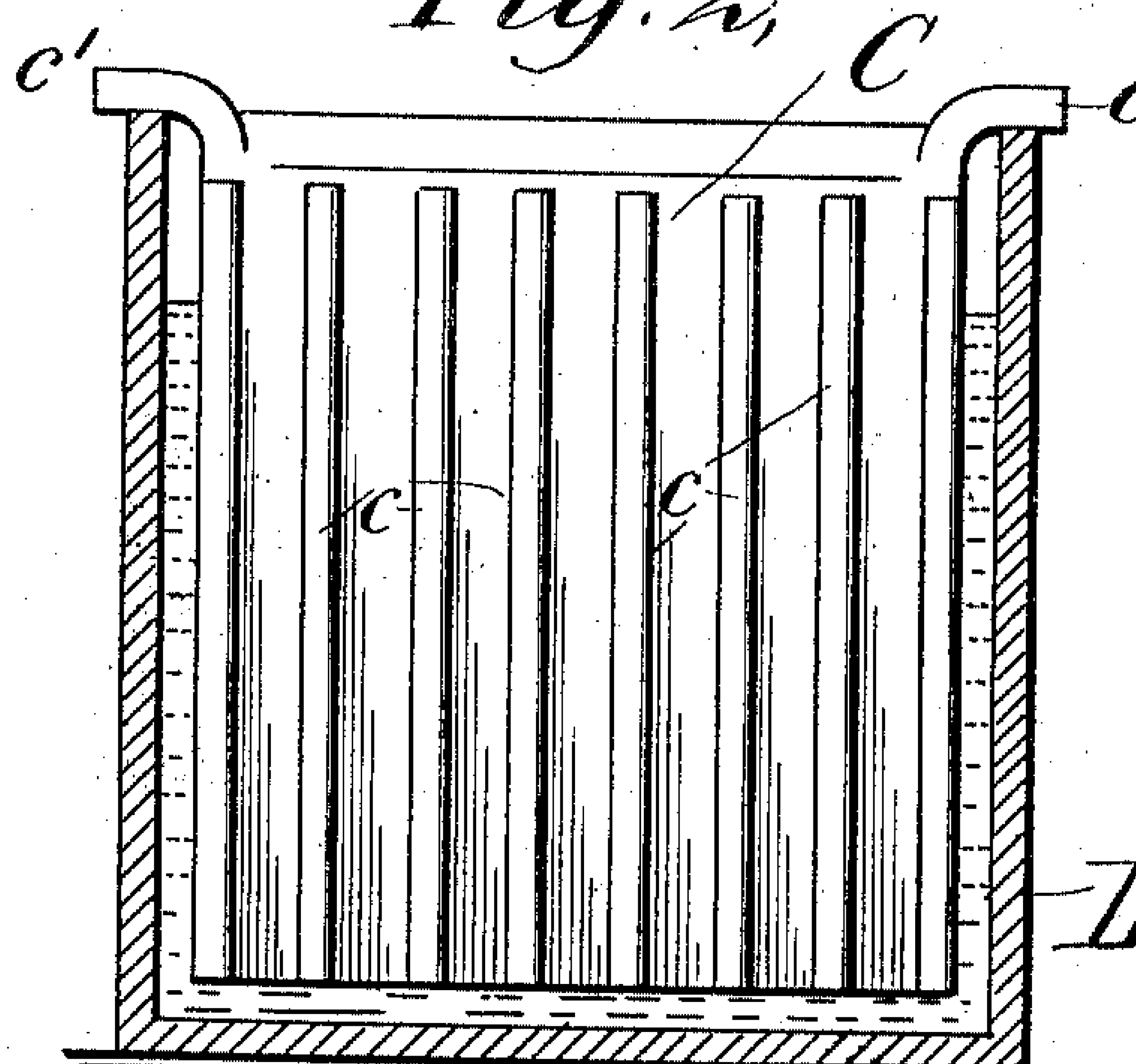


Fig. 3,

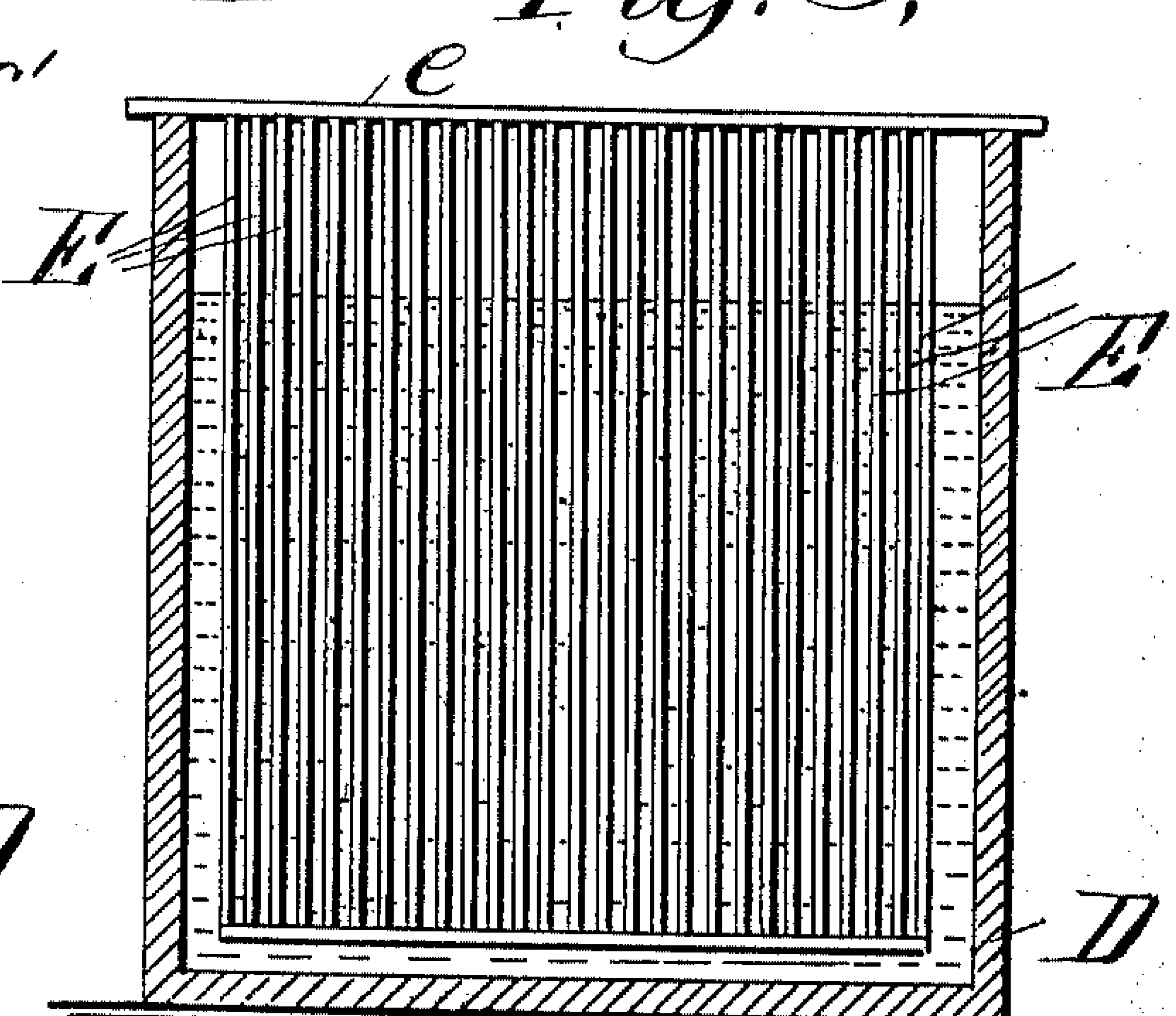


Fig. 5,

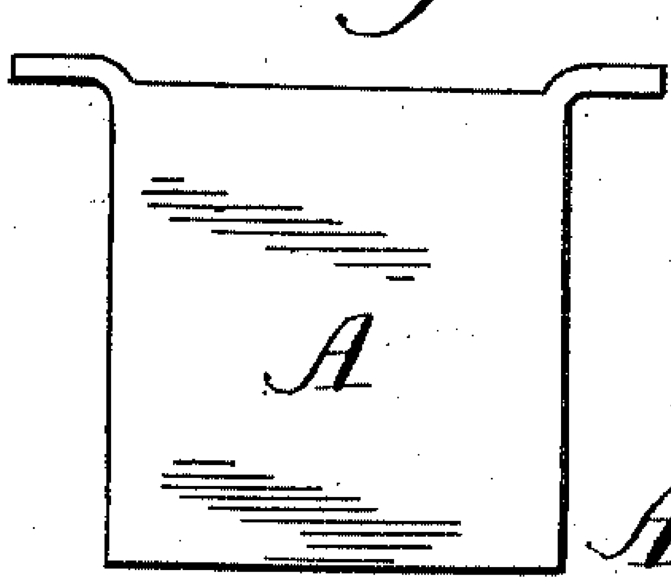


Fig. 4,

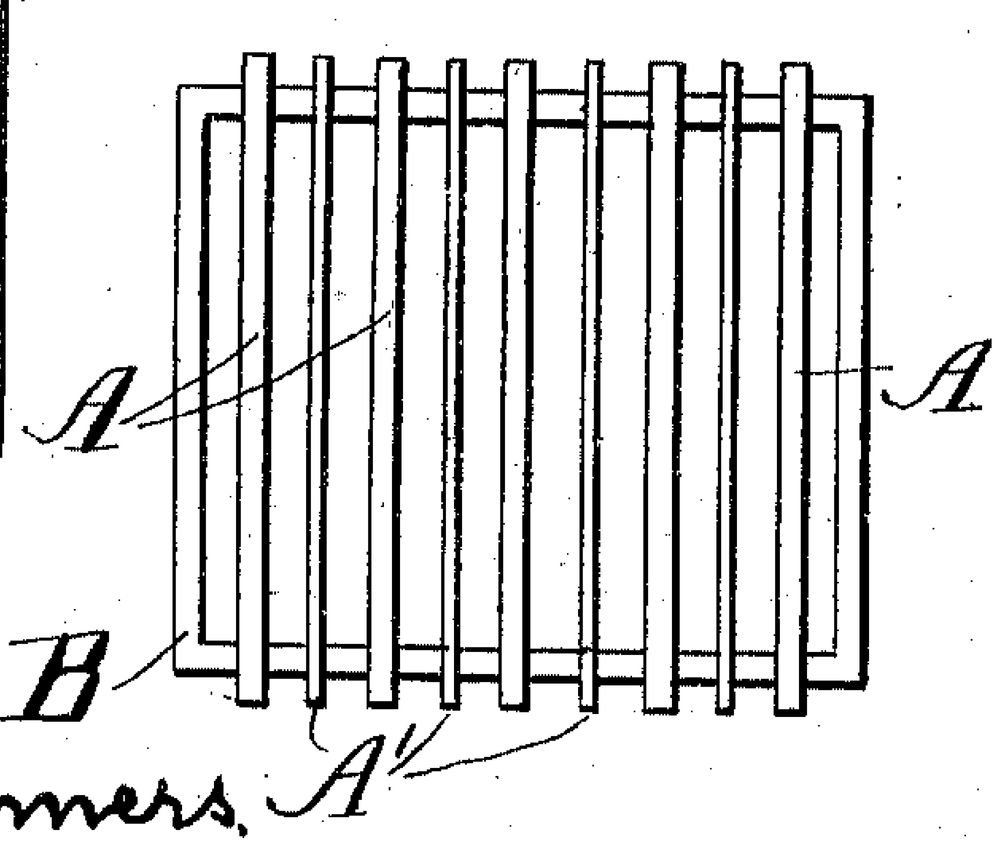
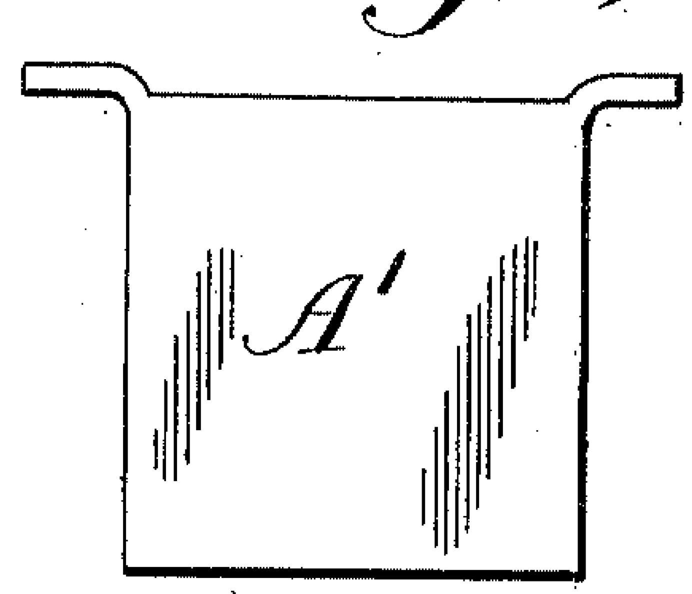


Fig. 6,



WITNESSES:

Otto F. Osmers.

Grace L. Heasley

INVENTOR

Alfred Schwarz

BY Charles D. Jones

his ATTORNEY

No. 760,023. Patented May 17, 1904.

UNITED STATES PATENT OFFICE.

ALFRED SCHWARZ, OF NEW YORK, N. Y., ASSIGNOR TO THE GENERAL METALS REFINING COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

APPARATUS FOR THE ELECTROLYTIC REFINING OF METALS.

SPECIFICATION forming part of Letters Patent No. 760,023, dated May 17, 1904.

Application filed November 22, 1902. Renewed November 20, 1903. Serial No. 182,022. (No model.)

To all whom it may concern:

Be it known that I, ALFRED SCHWARZ, a subject of the Emperor of Germany, and a resident of New York city, New York, have invented certain new and useful Improvements in Apparatus for the Electrolytic Refining of Metals, of which the following is a specification.

My invention relates to apparatus for the electrolytic refining of metals.

Heretofore in the commercial and practical work of refining metals by electrolysis, so far as I am aware, the customary and usual practice has been to arrange the anodes and cathodes alternately and substantially parallel with one another in the bath, one cathode being placed between two anodes, so that it receives metal on one side from one anode and on the other side from the other anode. The anode usually employed is in the form of a casting of the metal to be refined and the cathode a plain sheet of the same metal as that to be deposited or a plain sheet from which the deposited metal may be stripped or removed. When using a plain sheet as the cathode with, for example, a depositing-surface of about one square foot with sixteen amperes and 0.3 volts, there will be deposited from a normal copper-sulfate solution about sixteen ounces of copper in twenty-four hours, or, in other words, one ampere per twenty-four hours produces about one ounce of copper. If it is desired to increase the amount of metal deposited on a square foot of cathode-surface, it can be done in either of two ways—first, an increase both in the number of amperes and volts; second, an increase of surface with an increase of amperes—without increasing the voltage. As by the law of Faraday the number of amperes is directly proportionate to the product of metal, if the density of the current is decreased the product will be diminished. By methods obtaining at present in practical work it has been found desirable to employ only a medium current density, a high density—that is, about sixteen amperes—resulting in deteriorated product and causing impurities, such as arsenic, to deposit along with the metal. A medium current density avoids that danger and insures a homogeneous, dense, and pure product.

The present invention consists in a construction which increases the amount of metal deposited for a given tank capacity and to obtain such increase without the dangers and disadvantages of high-current density. These objects I attain by employing a plurality or comparatively large number of cathode-plates for a given tank capacity and by arranging such plates substantially parallel to one another and at an angle to the face of the anode.

My invention will be understood by reference to the accompanying drawings, in which—

Figure 1 is a top view of an electrolytic tank having anodes and cathodes arranged therein according to my invention. Fig. 2 is a side view of an anode that may be employed in my system. Fig. 3 is an edge view of the cathode-plates shown suspended in the tank. Fig. 4 is a top view of the present method of arranging anodes and cathodes in the electrolytic refining of metals. Fig. 5 is a side view of a plain anode as ordinarily used. Fig. 6 is a side view of a plain sheet-cathode as ordinarily employed, and Fig. 7 is a detached view.

Similar letters of reference in the several views indicate similar parts.

Referring to Figs. 4, 5, and 6, A designates the anodes, and A′ the cathodes, suitably suspended in an electrolytic tank B and provided with the usual wire connections. In this the common method of arranging the electrolytic tank for the refining of metals, and particularly copper, the anodes A are arranged alternately with the cathodes A′ and substantially parallel therewith. The anodes A as usually employed are in the form of a solid casting or plate of the impure metal. The cathodes A are usually plain sheets of pure copper, if that is the metal to be refined, or a plain sheet from which the metal may be stripped or removed by well-known methods. In the arrangement shown in Fig. 4 the amount of current that can be safely employed is about sixteen amperes per square foot of cathode-surface. Beyond this there is danger of depositing arsenic, antimony, and other impurities along with the copper or other metal being deposited, thus deteriorating the quality of the deposited metal for commercial purposes. For the purpose of comparison with my invention it may be assumed that each cathode A′ is one foot square, so that the two sides present a total depositing-surface of two hundred and eighty-eight square inches and that copper is the metal to be refined. It is impossible with a given tank capacity to increase the amount of cathode-surface by placing additional cathode-sheets between any two of the anodes. In other words, by present methods only one cathode-sheet can be placed between two anodes. It results from this that the capacity of any electrolytic bath is limited to about sixteen ounces of copper for twenty-four hours per square foot of cathode-surface.

In Fig. 1 I have illustrated my arrangement of the cathode-surfaces relatively to the anodes. Instead of placing the anodes and cathodes substantially parallel with one another I place a large number of cathode-plates between any two anodes and arrange such plates substantially parallel with one another and at an angle to the face of the anodes. The anodes C may be of any usual form, or they may be of the form which offers an increased surface, such as shown in Fig. 2, in which the casting is made with projecting ribs *c*. The anodes C are cast with or may be provided with projecting lugs *c′* to serve the purpose of supporting the anode on the top edge of the tank D. The cathode-plates E are suspended at their upper ends from a suitable support *e*, adapted to rest upon the upper side edges of the tank D. Under conditions of practical copper refining I have found it practical to employ as many as forty-eight cathode-plates, each twelve inches long and one inch wide, giving twenty-four square inches depositing surface for each plate or a total of one thousand one hundred and fifty-two square inches as compared with a single cathode-plate with a total depositing-surface of two hundred and eighty-eight square inches, as heretofore employed, within a corresponding section of the tank, or to make my meaning more clear it may be assumed with reference to Fig. 4 that the distance between any two of the anodes A is three inches and that a given cathode A′ is placed substantially midway between said two anodes and that the cathode is one foot square or presents a total depositing-surface of two hundred and eighty-eight square inches. Without disturbing the relative positions of the two anodes and still maintaining them three inches apart I can, according to my invention, place forty-eight plates between two anodes, as shown in Fig. 1. This is accomplished by cutting a single cathode A′ of Fig. 4 into twelve plates, each one inch wide. By arranging these twelve plates each one inch apart on the support, so that they are at right angles to the anode, I can place between each cathode-plate three other plates of like dimensions—that is, I can by arranging the cathode-plates as shown in Fig. 1 utilize four plates, each one foot square, in the same space or section of the tank heretofore given to one cathode-plate of one square foot, as in Fig. 4. The cathode-plates will thus be spaced apart about one-quarter of an inch, thus allowing for the free circulation of the solution and for the growth of the metal deposited. The edges of the cathode-plates would be one inch distant from the anode-faces, thus preserving the same economy of space within the tank and resulting in a fourfold increase in the amount of depositing-surface. With such an arrangement as I have described I have deposited on one thousand one hundred and fifty-two square inches of surface in twenty-four hours with sixty-four amperes and .3 volts sixty-four ounces of copper from a normal copper-sulfate solution. When the anode and cathode are placed parallel with each other, the metal being deposited is built up toward the anode and the space between the anode and cathode often becomes bridged, thereby short-circuiting the current. An advantage of importance possessed by placing the cathode at an angle to the anode is that the flow of current is more or less parallel to the cathode and the deposit is built up in a direction parallel to the anode and not toward the anode, thus removing all liability of bridging and the danger of short-circuiting.

The general manner in which the metal is deposited by the present arrangement is shown in Fig. 7, in which O O′ designate two cathodes, and O^2 a single cathode-plate set at an angle to the anodes. While the depositing metal is thickest toward the side edges of the cathode, there is no building up of the metal toward the anodes, and hence the danger of short-circuiting above referred to is avoided. To prevent the deposition of metal on the edge of the cathode near the anode, said edge may be covered by some insulating material, as shown at c^2.

By arranging the plurality of cathode-plates at an angle to the anode the combined surfaces of said plates may easily be made to exceed the surface of the anode. By thus making the depositing-surface larger in area than the anode-surface I am able to compensate for the difference in resistance between the anode and the electrolyte and the cathode and the electrolyte. In other words, all the effective work of the current is provided for by the relatively larger surface of the cathode without waste of current.

Instead of arranging the anode and cathode surfaces at an angle to each other I may subdivide the anode in the same manner as described with respect to the cathode and place the anode-sections so that they run in the same direction as the cathode-plates. Such an arrangement would give substantially the same increase of deposit over the old method of refining, as it would present the same conditions as shown in Fig. 1 to permit the current from the anode to deposit the metal on both sides of the cathode.

While I have described the tank with forty-eight cathode-plates arranged between any two anodes, I have done so merely as an exemplification of my invention and not intending thereby to limit myself to that number or to the exact size of the plates described. The plates may be of any area up to within practical working limits. Also while I have described the cathode-plates at an angle to the anodes I have found that by placing the cathode-plates at right angles to the anodes gives the best working conditions.

While I have shown in Fig. 1 a tank with a series of anodes and cathodes, it is obvious that my invention may be carried out with a single anode and a single set of cathode-plates, the latter arranged at an angle to the anode, inasmuch as the principle of my invention—that is, of presenting both sides of the cathode-plate to receive the deposit—will be involved.

By the expression "at an angle to the face of the anode" or similar phrase used in this specification is meant that the cathode-plates are arranged at an angle to the main body of the anode.

The present invention differs from others in that it is designed for the commercial separation of metals from their impurities whereby a more even deposit is obtained and burning of the deposited metal prevented, and it supplies a larger cathode-surface for a given tank capacity than has been heretofore attained.

What I claim, and desire to secure by Letters Patent, is—

1. In an electrolytic apparatus for the refining of metals, the combination of a cathode of large surface for a given tank capacity consisting of a plurality of substantially parallel plates, and a soluble anode, the said cathode-plates being spaced apart and arranged at an angle to the face of the anode so that there will be a free circulation of the solution whereby the metal will be deposited on both sides of the cathode-plates.

2. An electrolytic apparatus for the refining of metals, comprising a series of soluble anodes, and a series of cathodes of large surface for a given tank capacity, the anodes and cathodes being arranged alternately, and the said cathodes being spaced apart and set at an angle to the anodes so that there will be a free circulation of the solution whereby the metal will be deposited on both sides of the cathode.

3. An electrolytic apparatus for the refining of metals, comprising a series of soluble anodes, and a series of cathodes of large surface for a given tank capacity, the anodes and cathodes being arranged alternately and each of the series of cathodes consisting of a plurality of plates spaced apart and set at an angle to the anodes so that there will be a free circulation of the solution whereby the metal will be deposited on both sides of the cathodes.

4. An electrolytic apparatus for the refining of metals comprising a series of soluble anodes, and a series of cathodes of large surface for a given tank capacity, the said cathodes being spaced apart so that there will be a free circulation of the solution, the total amount of active surface of the cathodes being greater than the total amount of active surface of the anodes within a given tank-space.

5. An electrolytic apparatus for the refining of metals comprising soluble anodes, and a series of cathodes of large surface for a given tank capacity, the said cathodes being spaced apart so that there will be a free circulation of the solution, the relative amounts of active surface of each of said elements being such that for each square foot of active anode-surface there will be substantially two square feet of active cathode-surface within a given tank-space.

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

ALFRED SCHWARZ.

Witnesses:
GRACE L. HEASLEY,
OTTO P. OSMERS.