M. PERREUR-LLOYD.

APPARATUS FOR THE ELECTROLYTIC PRODUCTION OF COPPER AND OTHER METALS.

APPLICATION FILED APR. 14, 1917.

1,262,248.

Patented Apr. 9, 1918.

3 SHEETS—SHEET 1.

Fig. 2

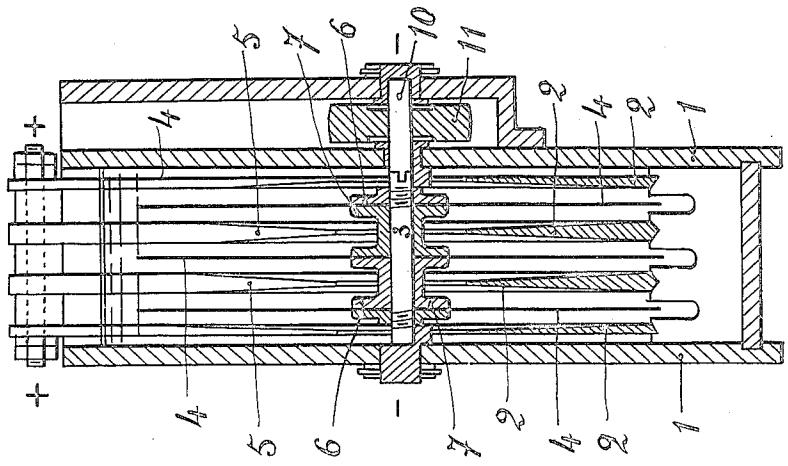
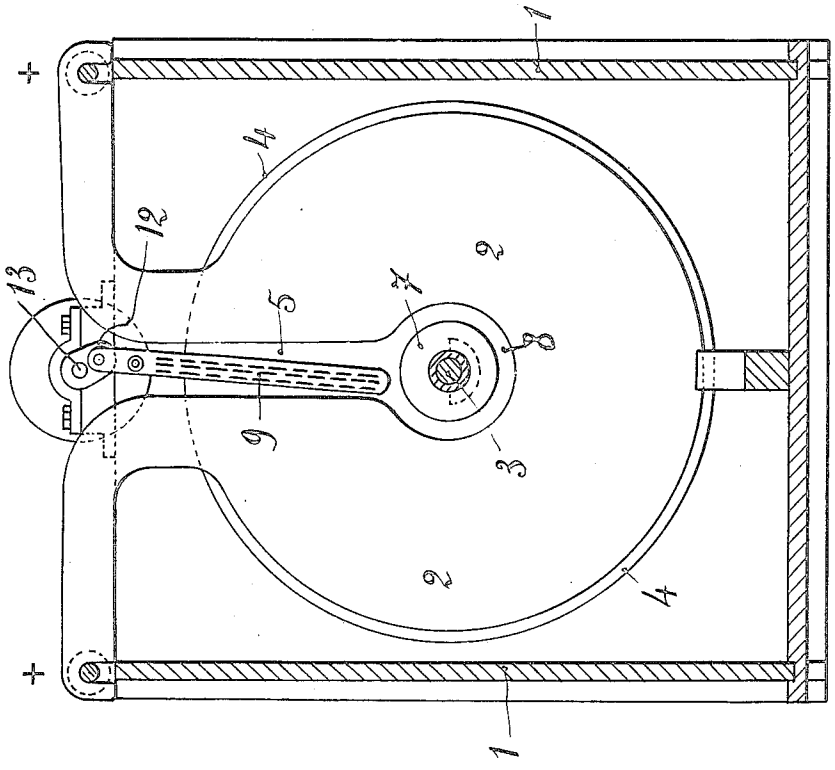


Fig. 1



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Fig. 3

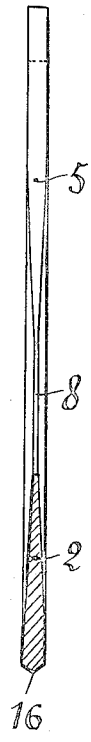
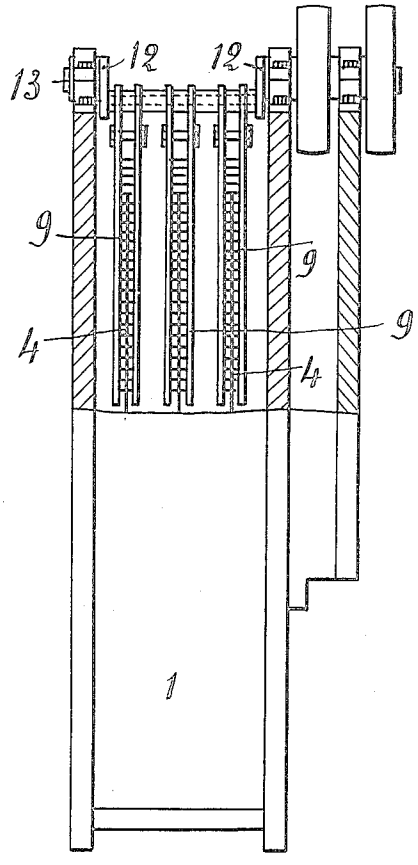


Fig. 4



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3 SHEETS—SHEET 3.

Fig. 5

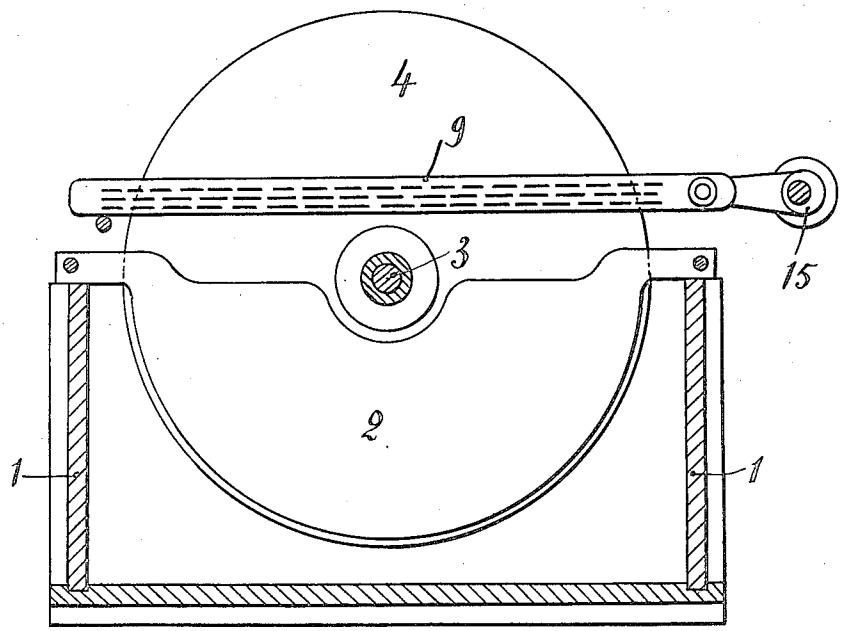


Fig. 7

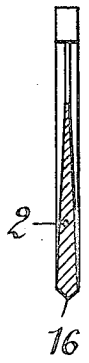
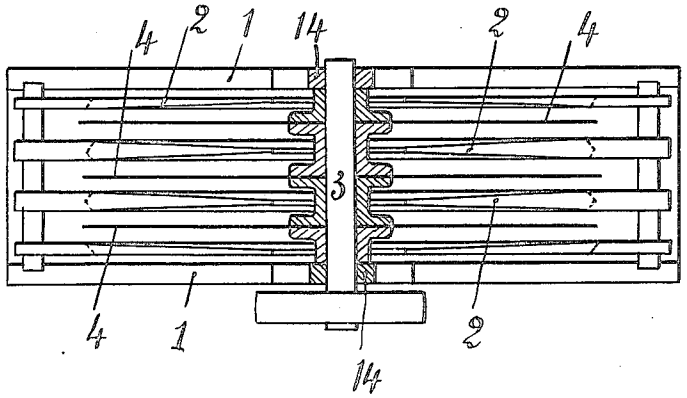


Fig. 6



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE ELECTROLYTIC PRODUCTION OF COPPER AND OTHER METALS.

1,262,248. Specification of Letters Patent. Patented Apr. 9, 1918.

Application filed April 14, 1917. Serial No. 162,212.

To all whom it may concern:

Be it known that I, MARCEL PERREUR-LLOYD, a citizen of the Republic of France, residing in Boulogne-sur-Seine, Seine, France, have invented certain new and useful Improvements in Apparatus for the Electrolytic Production of Copper and other Metals, of which the following is a specification.

The object of the present invention is to provide new apparatus for effecting the electrolysis of metallic solutions in general, copper, nickel, gold, silver, iron and so forth with production of compact deposits and with employment of strong currents. The apparatus is simple in construction, occupies relatively small space and is of high efficiency.

Electrolysis with soluble anodes has been applied with success in the past few years, especially for the refining of copper.

The electrolysis of poor and impure solutions of copper and other metals with insoluble anodes has, however, not been attained with industrial success. The electrolytic apparatus of the present invention allows of effecting practically the electrolysis of metallic solutions in general.

Whatever the electrolyte used, the various electrolytic apparatus hitherto employed can be considered as falling into two distinct classes. In the one class the anodes and the cathodes are stationary in the baths and are formed of parallel plates; this allows of obtaining a very large surface in a relatively small space and consequently of reducing the electric resistance of the apparatus.

With these apparatus the electrolysis of poor solutions of copper only gives unsound deposits, impregnated with sulfur, spongy copper and all kinds of impurities.

The great advantages offered by this class of apparatus are their low internal resistance, the small space occupied, their simplicity and small cost. These various advantages can be obtained with the electrolyzing apparatus of the present invention.

In the second class of apparatus moving cathodes, and in particular cylinders, have been employed, to allow of renewing the solution in contact with the cathode and of accelerating the rapidity of the deposition. Use has been made of vertical or horizontal cylinders, disks and the like, and it has been found that in the electrodeposition of metals, and especially copper, a deposit which is spongy for a given current strength per square meter of cathode becomes compact when the speed of movement of the cathode becomes sufficiently high. For example, with an impure solution containing 1 per cent. of copper, 4 per cent. of iron, zinc, etc., 2 to 5 per cent. of sulfuric acid, etc., and a current of 250 amperes per square meter, the deposit is compact when the circumferential speed of the cathode cylinder attains 2 meters per second; the deposit keeps compact for some hours and then gradually becomes granular and finally becomes contaminated with impurities and inutilizable. It will be seen hereinafter how this latter defect may be obviated. The important fact is that in the electrolysis of any metallic solutions it is necessary for obtaining compact deposits that the surface of the cathode shall move in the electrolyte with a speed proportional to the strength of the current employed.

In general, apparatus with moving cathodes present a high electric resistance and occupy considerable space; they are very expensive and necessitate large installations for small productions. The apparatus of the present invention aims to avoid these disadvantages.

In this apparatus the cathodes are constituted by disks mounted on a shaft and rotating more or less rapidly, according to the nature of the electrolyte, opposite stationary anodes. The anodes may be of any suitable material, for example lead, carbon, fused magnetite, etc.

The accompanying drawings illustrate by way of example apparatus constructed in accordance with the invention.

Figure 1 is a longitudinal section of an apparatus in which the disks are entirely immersed in the electrolyte.

Fig. 2 is a cross section thereof.

Fig. 3 is a vertical section of an anode.

Fig. 4 is another cross section showing the wipers for removing the hydrogen bubbles from the surface of the deposited metal.

Fig. 5 is a longitudinal section representing a modification of apparatus in which

the disks are only partially immersed in the electrolyte.

Fig. 6 is a plan thereof.

Fig. 7 is a cross section of the anode employed in this construction.

Referring first to Figs. 1 to 4 the chief points of the apparatus are as follows:—

(1) The anodes arranged in a tank or vessel 1 are formed by disks 2 of a truncated conical form (similar to a lamp shade or a Chinese hat). Between the shaft 3 carrying the cathodes 4, and the upper part of the periphery they are gapped or cut away as at 5 to permit the shaft and the disks 4 forming the negative pole to be lifted out when it is desired to remove the deposit.

This opening 5 also serves to accommodate the wipers or rubbers hereinafter mentioned and which serve for removing the bubbles of hydrogen formed on the surface of the cathodes 4.

(2) The cathodes 4 are complete disks and rotate opposite the anodes 2. These cathode disks are formed of suitable metal and are clamped upon the shaft 3 by means of nuts 6 and distance collars 7 (Fig. 2).

The deposit is removed when it has attained the desired thickness.

The reasons for the truncated conical form given to the anode 2 are as follows:—

When an impure metallic solution, for example of copper, is electrolyzed, it is found as above mentioned that for a given current strength only the deposit is compact (and this only during a limited time) if the speed of the cathode attains a given value.

When for example the cathode is formed of a cylinder rotating opposite anodes surrounding it more or less, it is easy to arrange for the surface of the cathode to travel uniformly at a sufficient speed for the deposit to become compact.

But it is no longer the same if cathodes are employed in the form of disks mounted on a horizontal shaft, and yet this latter arrangement is the best from the point of view of internal resistance of the apparatus, space occupied, cost of apparatus and so forth.

Consequently it is necessary in this case to make the anodes of such a form that the strength of the current shall be proportional to the speed of the different parts of the surface of the cathode. By placing opposite the cathode disks 4 anode disks 2 whereof the center is farther away from the cathodes than the periphery, the electric resistance will be greater at the center than at the periphery and therefore the current strength will be smaller at the center.

It will at once be understood that by regulating or arranging the slope or conical inclination of the anode with respect to the cathode, an apparatus can be constituted such that for all parts of the cathode the strength of the current, and therefore the amount of desposit, may be proportional to speed of movement of said parts, and in this way the current strength can be regulated so that the deposit remains compact over its whole surface. More particularly the faces of the anode disks 2, opposite the cathodes 4, are sloped or shaped similarly to a lamp shade or a Chinese hat, the concavity facing toward the cathodes. The central part of the anodes is left free or cut away at 8, and thus the deposition only takes place on the cathodes 4 from say about seven to ten centimeters from the shaft 3.

Supposing as an example that a cathode disk of 80 cm. diameter is employed, the total useful surface of the cathode will be about one square meter. The cathode may be placed at a distance from the anodes of for example about 10 mm. at the periphery and about 40 mm. at a distance of 10 cm. from the shaft. If the cathode is rotated at 100 revolutions per minute the speed at the periphery will be four times as great as that at the part which is 10 cm. from the shaft.

With a cathode of the foregoing dimensions, for a current strength of 4 amperes per square dcm. for example, passing at the periphery between the anode and the cathode, only one ampere will pass at the center, and thus the deposit will be as regular at the shaft as at the periphery.

The more or less sloped or conical form of the anodes is variable according to the nature of the electrolytic deposits. It may be obtained by casting pieces of truncated conical form; or by superposing annular bands of equal thickness the number of the bands superposed increasing as the shaft is receded from; or in any other suitable way.

The construction or arrangement of the anodes in sloped or Chinese hat form allows of obtaining compact deposits all over the surface of the cathode disks, but as already mentioned deposits which are compact at the commencement gradually become coarse and inutilizable. This deterioration arises from the bubbles of hydrogen when settle on the cathodes and give rise to roughnesses, nodules, etc., by becoming gradually inclosed in the deposit. The latter becomes more and more rugose and the surface more and more irregular, and finally impurities, dusty matters, particles of electrolyte, etc., are inclosed in the deposit which becomes valueless.

To obviate these drawbacks it is necessary to brush the surface of the deposit during its formation, with a material which is not liable by its deterioration or wear to introduce the impurities into the deposit and which will completely remove the hydrogen bubbles all over the surface of the cathode.

The rubbers may be formed of paddles, pallets, or the like of soft and fibrous wood,

such as cotton wood, cocoatnut tree fibers, etc., which rub lightly on the surface of the electrolyzers. Gelatin may be previously dissolved in the electrolytic bath, and this adhering to the rubbers will constitute a filament or film on the rubbing faces of the rubbers.

If gelatin is dissolved in a bath of copper and the bath is electrolyzed, the deposit, as is known, will become closer or more compact, but the deposit will nevertheless retain its irregularity.

If on the contrary, the action of the rubbers is combined with that of the gelatin dissolved in the bath, the fibers of the wood or of the rubbers will apply the filaments of gelatin upon the deposit, wipe the latter and remove the bubbles of hydrogen.

The rubbers may also be formed of organic membranes which do not dissolve little by little, such as insolubilized or parchmented skins. Such skins are made by immersion in aldehyde or acetone or analogous substance. In any case these rubbers must be formed of substances less hard than the electrolytic deposit, in order not to burnish or have a rolling out action of the same, which would lead to disaggregation and a formation of pulverulent copper; the purpose is simply to remove the bubbles of hydrogen by applying the gelatinous or albuminoid filaments on the surface of the cathodes.

In the apparatus shown in Figs. 1 to 4, an opening 5 is provided in the anodes 2 to allow of removing the disks 4 from their shafts 3 mounted with a groove and tongue joint on the shaft 10 carrying the driving pulley 11. In this opening 5 rubbers 9 are arranged which may be of any kind, but in particular may be brushes formed of insolubilized skins, etc.

A vertical to and fro movement is imparted to these brushes by any suitable mechanical movement and they rub on the disks against which they bear more or less strongly. The mechanical drive of the brushes may for example be in the form of cranks 12 mounted on a shaft 13. As the cathode disks 4 rotate fairly rapidly, the combination of the motions of the disks and the brushes have for result that all parts of the disks are perfectly wiped and smoothed, and thus the deposit can be brought to the desired thickness, say several millimeters, without its surface ceasing to be absolutely regular.

The apparatus thus constituted allows of obtaining perfect deposits with any metallic solutions. The internal resistance of the apparatus can be reduced as desired by increasing the number of disks or their dimensions and by bringing them closer together, and the deposits are kept absolutely compact owing to the form of the anodes and the action of the brushes. Moreover the apparatus occupies very little space, the cost of installation is small and the upkeep of the apparatus very simple.

When the solutions employed are such as attack the metal bearings, as for example when poor copper solutions charged with ferric salts are electrolyzed, or again when there is risk of contaminating the purity of the electrolyte by their attack and it is necessary to maintain this purity to obtain good deposits, it is desirable to have the bearings outside the electrolyte liquid, as illustrated for example in the construction shown in Figs. 5 to 7.

In this case anodes 2 are employed, likewise of sloped or truncated conical form, but they are in the form of semi disks entirely immersed in the solution. The anodes 2 are cast in the form shown and the apparatus is mounted like an accumulator. The negative electrodes are constituted by the disks 4 which are half immersed in the electrolyte liquid and are fixed on a shaft 3 rotating on the bearings 14 arranged outside the liquid on the sides of the vessel 1. The rubbers 9 are arranged on each side of the cathodes 4 and are rotated by an eccentric 15 and connecting rod.

The anodes 2 are cast with a form edged off or reduced at 16 (Figs. 3 and 7) to avoid liability of the deposit becoming too thick and nodulous on the edges of the cathode disks 4. It is to be understood that the truncated conical anodes of Chinese hat or sloped form which have been described may likewise be employed in the case of apparatus in which diaphragms are interposed between the anodes and the cathodes.

Conversely to what has been described the cathode disks might be constructed or arranged truncated conical or Chinese hat or sloped form, but in this case the anodes would be plane.

In the system of apparatus described the homogeneity of the composition of the electrolyte may be insured by the speed of rotation of the cathode disks or by simply blowing air in at the bottom of the apparatus or by both means in combination.

Any desired number of cathodes and anodes may be employed.

Claims:

1. An electrolytic apparatus comprising two relatively rotative disk electrodes, the form of the electrodes being such that the strength of the current passing between the electrodes shall be proportional to the relative speed of the different parts of the surfaces of the electrodes.

2. An electrolytic apparatus according to claim 1, an electrode being formed with a recessed or indented face, the space between two electrodes being substantially conical.

3. An electrolytic apparatus according to

claim 1, one of the electrodes having a radial gap permitting insertion or withdrawal of the rotary electrode.

4. An electrolytic apparatus according to claim 1, one of the electrodes having a radial gap permitting insertion or withdrawal of the rotary electrode, and a wiper arranged in said gap.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

MARCEL PERREUR-LLOYD.

Witnesses:
CHAS. P. PRESSLY,
RENÉ BARDY.