(No Model.)

C. R. FLETCHER.

METHOD OF AND APPARATUS FOR ELECTRO DEPOSITION OF METALS.

No. 485,343. Patented Nov. 1, 1892.

Fig 1.

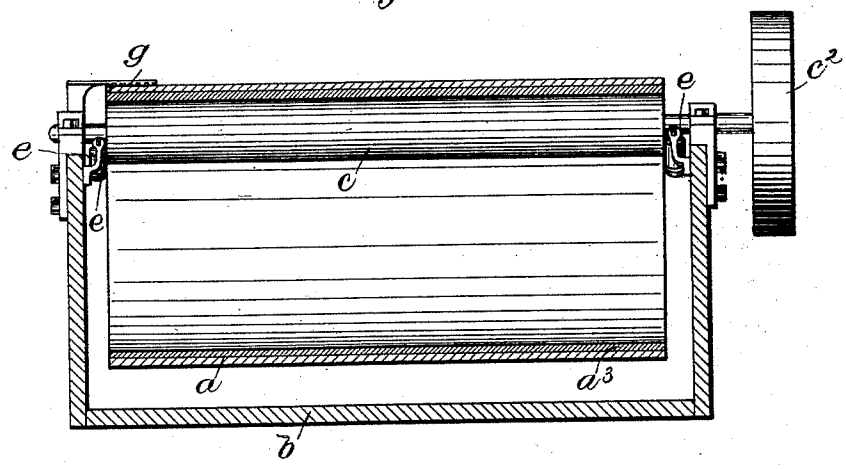


Fig. 2

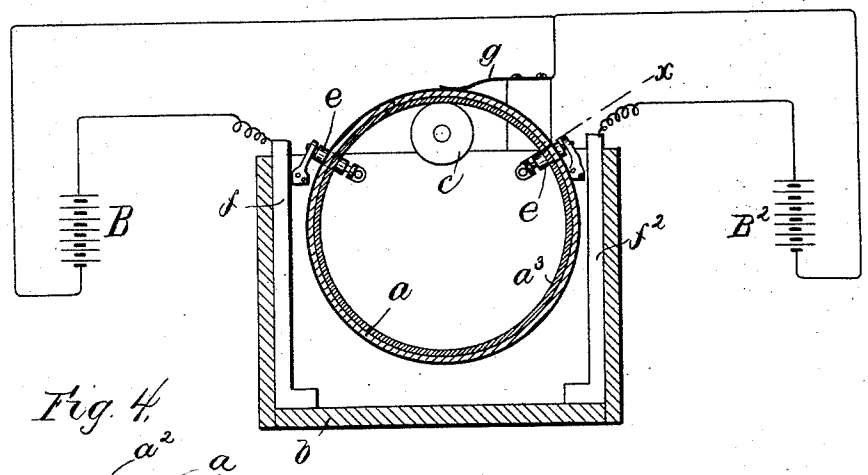


Fig. 4.

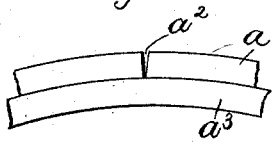
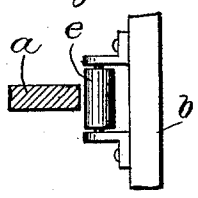


Fig. 3.



Witnesses
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UNITED STATES PATENT OFFICE.

CHARLES R. FLETCHER, OF BOSTON, MASSACHUSETTS.

METHOD OF AND APPARATUS FOR ELECTRO-DEPOSITION OF METALS.

SPECIFICATION forming part of Letters Patent No. 485,343, dated November 1, 1892.

Application filed October 5, 1891. Serial No. 407,681. (No model.)

To all whom it may concern:

Be it known that I, CHARLES R. FLETCHER, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Methods of and Apparatus for Electro-Deposition of Metals, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The object of my invention is to produce sheets of metal by electro-deposition; and the invention consists in certain details of construction of the apparatus employed and also in a novel method of applying the electric current, whereby an improved quality or structure of the metal sheets is obtained.

The invention is shown embodied in an apparatus employing a revolving cathode and two or more separate anodes and a source of electricity such that the density or quantity of current per unit of area is greater between one of the anodes and the cathode than between the other anode and the cathode. The cathode is preferably in the form of a hollow cylinder, which is slowly revolved in the electrolytic solution, so that different parts of its surface are presented successively and repeatedly in proximity to the anodes, and a uniform deposition is thus formed upon the surface of said cathode. I have discovered that the quality or structure of the metal depends to a certain extent upon the density of the current employed, the structure being apparently crystalline in nature and the size of the crystals varying with the density of the current, and I believe this to be the explanation of what I observed to be the fact, namely, that a more uniform and stronger deposit is produced by using two currents of different density, which apparently causes an interlacing of crystals of different size, the result being that the sheet is more perfect and of higher tensile strength than when produced by a single current passing through the electrolytic solution.

It has been proposed to produce an electro-deposit upon a moving cathode by the employment of currents of different density in conjunction with anodes located to co-operate with different parts of the cathode on which the deposit is formed, the movement of said cathode being so slow that the complete deposit at each point is produced in a single movement of the cathode past the anodes, the result being that substantially two distinct coatings are made—first by the current of one density and the second on the outside of the first by a current of different density. Such mode of operation and the result produced thereby is essentially different from that forming the subject of the present invention, in which the movement of the cathode is such that the deposit formed opposite each anode during a single passage does not produce a distinct coating, and it is only by the repeated passages of the different parts of the surface of the cathode past the anodes that a coating is built up which is a substantially-homogeneous union of the two deposits having a grain or texture which results from the intimate intermingling of the two deposits and is totally distinct in character from a deposit composed of two distinct layers or coatings, each having a characteristic grain or texture distinguished from the other, owing to the difference between the currents employed for producing the said coatings.

Figure 1 is a longitudinal section of an apparatus for electrolytic deposition embodying this invention; Fig. 2, a transverse vertical section thereof; Fig. 3, a sectional detail on line *x*, Fig. 2, showing one of the guides for the movable cathode; and Fig. 4, an enlarged sectional detail of a portion of the revolving cathode.

The apparatus comprises a cathode *a*, properly supported to be immersed in the electrolytic solution in a tank or reservoir *b*, said cathode being shown in this instance as cylindrical in shape, although that shape is not essential in carrying out the process forming the subject of this invention. The said cathode *a* is supported upon a roll *c*, mounted in suitable bearings on top of the tank *b*, and caused to rotate by means of the pulley c^2, which may be driven by any suitable power, so as to cause the cathode to turn slowly in the solution and present the different portions of its surface successively and repeatedly therein. Suitable guide-rolls *e* are also provided, being supported in bearings on the ends of the tank in proper position to engage the ends of the cathode and prevent the same from moving longitudinally with relation to

its driving and supporting roller *c*, thus causing the said cathode to have steady and uniform movement which cannot otherwise be attained.

The tank *b* contains two or more separate anodes *f f*², so arranged that the different portions of the surface of the cathode are presented in proximity to said anodes successively and repeatedly during the movement of said cathode.

As shown in Fig. 2, two separate sources of electricity B B² are connected in circuit—one with the anode *f* and the other with the anode *f*²—the opposite pole of each of said generators being connected with the cathode *a* by means of a brush or other suitable contact-maker *g*. The cathode *a* is also shown as so supported as to be nearer to the anode *f*² than to the one *f*, so that the electrolytic liquid forces more resistance to the current between the anode *f*² and the cathode than between the anode *f* and the cathode. Thus in accordance with the well-known law that the current is directly proportional to the electro-motive force and inversely proportional to the resistance, it follows that if the batteries or generators are equal, so that the electro-motive force of the two is the same, the current will be less where the resistance to the current is greater—that is, at the anode which is at the greatest distance from the cathode; or if, on the other hand, the anodes were at equal distance from the cathode the current might be varied by making one battery or generator more powerful than the other. By this arrangement of the anodes and cathode relative to the resistance of the liquid by varying the capacity of the generators B B², or by both of these expedients the result is attained that a current of greater density passes between one of the anodes, as *f*, and the cathode *a* than between the other anode and the cathode, the result being a difference in the quality or fineness of the deposit produced opposite each anode which, owing to the fact that all parts of the cathode are presented successively and repeatedly to each anode, causes an intermingling or overlying of such deposits giving a far better structural quality to the sheet of metal deposited than is attained by the deposition produced by a single current. The deposition is continued until the coating on the cathode is brought up to the desired thickness when the coating or sheet may be stripped from the cathode and will constitute a sheet of great purity and very perfect grain or structure, having in most cases greater tensile strength and a more beautiful texture than electro-deposits made by the usual plan.

In order to afford a good surface for the metal deposit, which will be perfectly uniform and smooth, so that the deposited sheet will be unbroken and smooth, the cathode *a* is preferably constructed as follows: A large plate of electrotype metal—an alloy of lead—is cast on an open iron mold, said plate being of the dimensions required for the cathode. The said plate is then passed under rolls to impress and densify the alloy, and is then bent by passing through bending-rolls in the well-known manner into cylindrical form, the ends of the plate meeting along one edge of the cylinder, but having a V-shaped gap between them, as shown at *a*², Fig. 4. The said cylinder is then mounted on rollers *a*³ of wood or other insulating material and turned in a lathe to true and finish its outer surface, when it is ready to be mounted on the roller *c* and used in the apparatus, as before described.

It is obvious that the invention, so far as relates to the mode of deposition by two or more currents of different density, is not limited to the specific construction of the apparatus, it being necessary only that the cathodes or anodes should be movable relative to one another, so that the different parts of the surface of the cathode are exposed successively and repeatedly to the action of the different currents; but it is believed that the cylindrical form and rotary movement of the cathode constitute the most efficient means for attaining this result.

I claim—

1. The herein-described improvement in the art or method of electro-deposition, which consists in forming the deposit upon a cathode the surface of which is continuously and repeatedly moved through the depositing solution, the said deposit being formed by the action of two or more currents of different density, whereby the grain or texture of the deposit is characterized by the intermingling of the portions deposited by the different currents, substantially as described.

2. The combination of the revolving cylindrical cathode with two or more separate anodes arranged opposite different portions of said cathode and electric generators so proportioned to the resistance between the respective anodes and the cathode, as described, that currents of different density are produced between said anodes and adjacent portions of the surface of the cathode, substantially as and for the purpose described.

3. The combination of the hollow cylindrical cathode *a* with its supporting and driving roller *c* and the guide-rolls *e*, co-operating with the ends of said cylindrical cathode, substantially as described.

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

CHARLES R. FLETCHER.

Witnesses:

JOS. P. LIVERMORE,

JAS. J. MALONEY.