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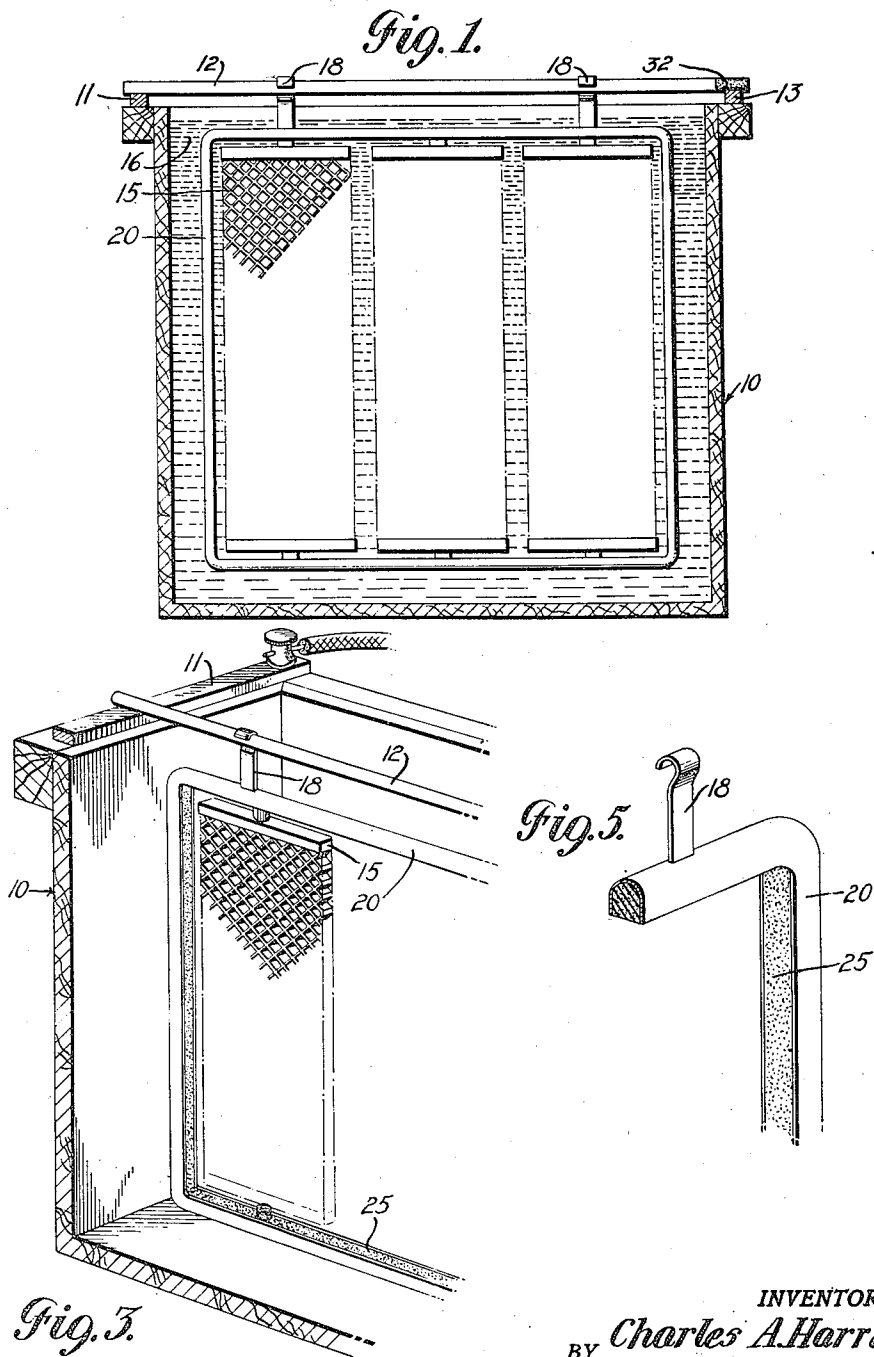
C. A. HARRISON

2,044,431

METHOD OF ELECTROPLATING METAL

Filed March 5, 1932

2 Sheets-Sheet 1



INVENTOR
BY *Charles A. Harrison,*

Bean & Brooks, ATTORNEYS

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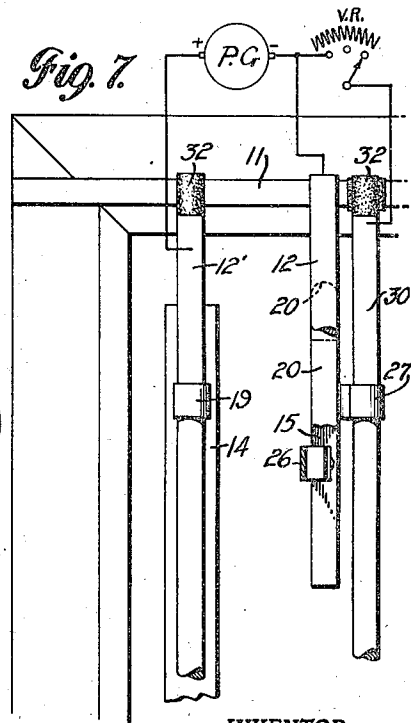
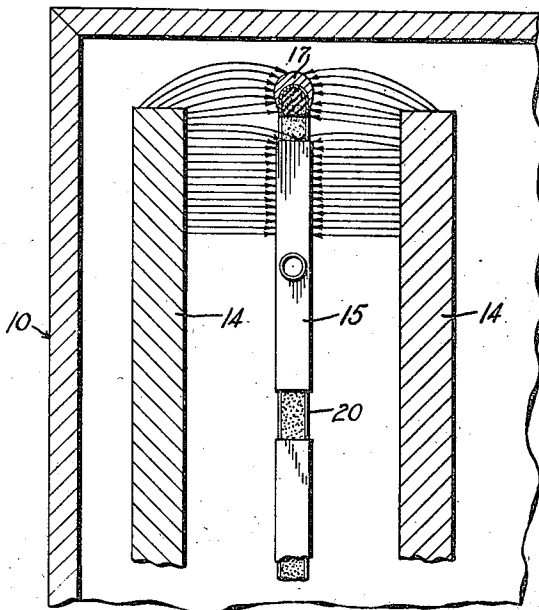
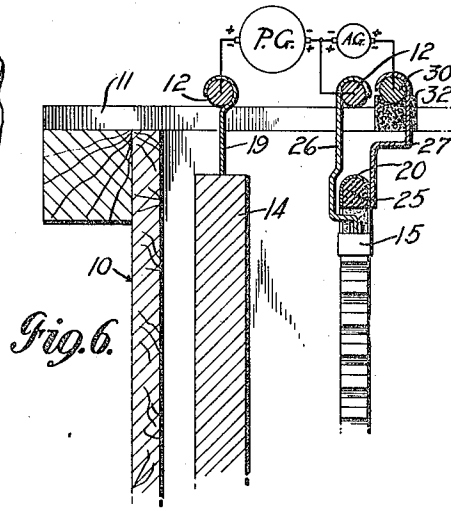
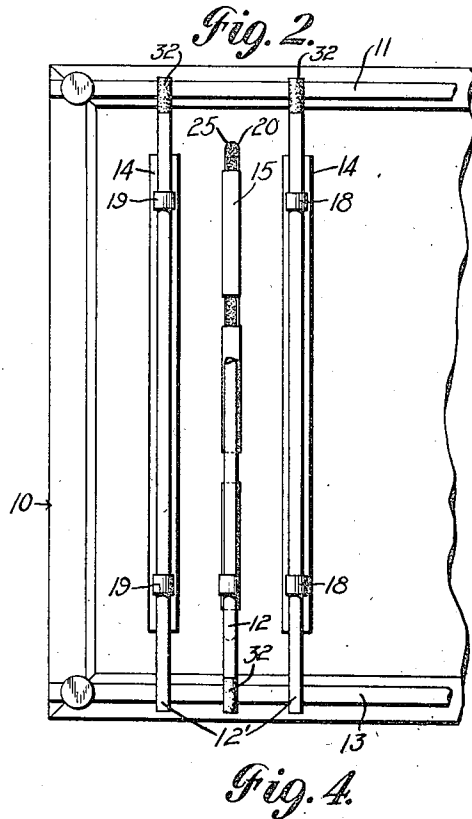
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INVENTOR
BY *Charles A. Harrison,*

Bean & Brooks. ATTORNEYS

UNITED STATES PATENT OFFICE

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METHOD OF ELECTROPLATING METAL

Charles A. Harrison, Lockport, N. Y., assignor to
Anaconda Copper Mining Company, New York,
N. Y., a corporation of Montana

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5 Claims. (Cl. 204—6)

The present invention relates to a method of and apparatus for completely coating an article or object with a uniform deposit of metal, and more particularly to a method wherein the complete and uniform coverage or deposition is produced by electrodeposition.

It has been well known in the plating art that a coating produced upon an object by electrodeposition is in general not of uniform depth or thickness throughout the total surface of the object covered, but that the depth of the coating or plating upon certain portions of the object is of materially greater depth or thickness than at certain other portions; this increase in thickness or "build-up" is particularly noticeable upon the edges or extremities of the object being coated.

Where maximum cathodic current densities are used commensurate with the formation of a smooth coherent deposition of metal upon the mid-portion of the cathode or object to be plated, the edge portions or extremities are found to be plated or coated with a non-coherent, dendritic, or crystalline deposit, or an excessive quantity of metal forming or producing a bulbous effect at these portions. Although this effect is produced upon the extremities of most materials subjected to cathodic deposition, it is more particularly disadvantageous in the plating of certain types of work, as for instance in the coating of cores in the production of radiator units wherein the build-up on the edges is particularly disadvantageous.

Several attempts have been made to overcome this particular difficulty, all of which have resulted in but indifferent success. It has been proposed to protect the edge portion of the object to be plated with a non-conducting shield or shroud. This type of operation has not eliminated the difficulty as the build-up upon the extremities is merely spread out over a larger area. Other suggestions have been brought forward but none of them comprehend a plating method whereby the total surface of the finished product is provided with a coating. Thus, it has been proposed to cut off that portion of the object upon which the built-up deposit has accumulated or, to obtain the same effect by coating the extremities of the object to be plated with a metallic enclosure, plate this composite electrode, and after the plating operation, remove the metallic enclosure with the built-up portion thereon. These latter methods, of course, leave the extremities uncoated and in many types of work this particular operation is of no avail since

it is desired to coat the entire exterior surface with metal.

The present invention, therefore, comprehends a method of coating the entire exterior surface of the object to be plated and at the same time, avoid the disadvantageous build-up which is normally encountered upon the extremities of such objects. This and other objects of the invention will be more clearly understood from the following description and will be pointed out with particularity in the claims appended hereto.

In the drawings:

Fig. 1 is a cross section through a plating bath in which is shown a cathode arrangement for use with my method of plating.

Fig. 2 is a fragmentary plan view of the invention.

Fig. 3 is a fragmentary perspective of the invention.

Fig. 4 is an enlarged fragmentary transverse section showing the disposition of an anode and cathode.

Fig. 5 is an enlarged fragmentary drawing of the cathode frame.

Fig. 6 shows another mode of connecting the object to be plated and the frame in electrical contact.

Fig. 7 shows another form of electrical connection.

A container for an electrolytic bath is shown generally at 10 made of any desirable composition depending upon the type of electrolyte in the bath and upon the temperature at which the bath is maintained. The container is equipped with the usual means for conveying current to and from the bath, as for instance the bus bars 11 and 13 with which electrical contact is made to supply electrical energy to the electrodes. The support member 12, having electrical contact with the bus bar 11, is provided to support an electrode such as the cathode 15 and to lead electrical energy to it. Another main line or bar 13 is provided for electrical contact with the support bar 12' which supports the other electrode of the cell, as for instance the anode 14, (Fig. 2).

The cathodic portion is hung from bar 12 into the electrolytic bath 16 by means of the hooked strap members 18 while the anode is hung from bar 12' by the hooked members 19.

The material or object to be plated as cathode 15, is connected in electrical contact with the source of current through the supporting member 12 resting upon bus bar 11, the object 15 serving as a cathode of an electrolytic cell. Upon passage of current through a suitable electrolyte

contained within the cell, metallic material is deposited upon the cathode and depending upon the current density at the cathode, forms a smooth adherent and coherent plate, or as a loose friable or dendritic deposit as the case may be. In the prior art processes, however, where a suitable cathode current density has been employed, the deposit upon the cathode is smooth and adherent and in fairly uniform thickness except at the edges or extremities of the object where the excessive build-up occurs.

I propose to place an additional electrically conducting object adjacent the extremities of the articles to be plated, and maintain this additional electrically conducting member at the cathode potential whereby current flowing from the anode to the cathode will flow both through the object to be plated and through the additional electrically conducting member which is adjacent the extremities of the object to be plated and spaced therefrom at a predetermined distance. Thus, a frame member 20 surrounds the object to be plated or cathode, that is, the cores or grids 15, and is spaced from the grids a predetermined distance. Current flows through both the grids 15 and the frame 20 since they are in electrical contact with the supporting member 12, and therefore these members have the same electrical potential with respect to the anode.

It will be noted that so long as the frame is at exactly cathode potential, metal will be plated from the bath upon the cathode or grids 15 and the auxiliary electrically conducting member, that is the frame member 20, simultaneously. Should, however, the frame member be held slightly more positive than the cathode, that is, positive with respect to the cathode in the same sense that the anode is positive with respect to the cathode in potential between that of the anode and cathode but nearer in value to the latter, the frame is going to receive metal but as it is slightly positive with respect to the cathode it will plate copper to some extent upon the cathode. On the other hand should the frame be held more negative than the cathode, metal would deposit both upon the cathode and the frame while metal would be plated upon the frame from the cathode.

In a condition of operation which I desire to obtain, I maintain the auxiliary electrically conducting frame member 20 at a potential which is substantially cathode potential and thereby cause metal from the anode 14 to pass into solution in the electrolyte 16 and deposit out upon both the grid 15 herein, and upon the auxiliary electrically conducting frame member 20 and prevent any excessive build-up of plated metal upon the edges or extremities of the object to be plated, in this instance the grids 15. By so conducting the plating I have made it possible to prevent the excessive build-up upon the edges of the article, and in fact have been able to plate the metal more rapidly upon the frame member than upon the edges, or even to remove metal from the edges of the cathode and cause the plating at these points to be of less depth or thickness than the plating upon the main portion or mid-portion of the cathode.

In Fig. 4 anodes are indicated at 14 and the cathode at 15 with an electrically conducting frame member 20, also at cathode potential, placed adjacent the extremities of the cathode 15 and spaced a predetermined distance therefrom. The passage of the electric current is indicated generally by means of arrows and is shown as

passing in substantially straight lines from the anode to the cathode at the mid-section of the cathode while the current is shown flowing in bowed or arcuate lines from the anode to the extremities of the portion at cathode potential with deposition of large quantities of metal 17 at the portions adjacent the edges or extremities of the portions acting as true cathode, that is, the cathode grid 15 and frame 20. It is readily seen, therefore, that the inter-position of the frame member 20 adjacent the edge portions or extremities of the cathode will receive the bowed or arcuate portion of the current or that portion of the current which causes the excessive build-up of metal at this point on the cathode and will thereby shield the extremities of the cathode and prevent the formation of loose and flocculent deposits, or of dendritic deposits.

In Figs. 6 and 7 is shown a disposition of frame member 20 and cathode 15 wherein these members are not in contact but wherein the members 15 and 20 have electrical contact with the support bars 12 and 30. The cathode 15 is hung by strap member 26 from the supporting bar 12 and the frame 20 by an independent strap member 27 from the bar 30 thus avoiding contact between the frame 20 and the cathode 15.

In order to obtain a variation of the potential existing between the anode 14 and the cathode grid 15 and the anode and the frame member 20, an auxiliary control generator of the type indicated in Fig. 6 at A. G. is inserted in the line between the main plating generator P. G. and the frame member 20. By a suitable choice of such generator the frame 20 may be made either positive or negative with respect to the grid 15. According to the hook up in Fig. 6 the anode 14 is connected in the line through the bus bar 13, (not shown), and the grid 15 to bus bar 11, electrical contact being made with the frame member 20 from the auxiliary generator A. G. It is to be noted that the frame 20 and grid 15 are spaced from one another and that a supplemental support bar 30 is used from which the frame 20 is suspended by the hooked strap member 27, the bar 30 being insulated from the bus bars 13 and 11, as by means of insulating and support members such as indicated at 32.

In Fig. 7 another form of hook up is shown where a variable resistance, shown generally at V. R. is inserted in the line from the plating generator P. G. to the support member 30 which serves to convey electrical energy through the strap members 27 to the frame 20. The grid 15 has a direct connection with the plating generator P. G. and hence there is a difference of potential not only between the anode 14 and the cathode 15, but between the cathode 15 and the frame 20. By cutting out the resistance V. R. the electrical hook-up then becomes essentially the same as indicated in the figures other than Fig. 6 and Fig. 7 where there is the same potential existing between anode 14 and cathode 15 as between anode 14 and frame 20.

It is to be noted that throughout the several views the support bars 12 and 12' are indicated as being provided with an insulated end, as at 32, so that these bars may be the more readily supported by suspending them transversely of the plating tank and supporting them upon the bus bars 11 and 13.

The auxiliary electrically conducting frame member or shield may be formed of any suitable electrically conducting material, but I have found that a U or channel shaped member of stain-

less steel provided with a non-conducting core 25 is suitable since the exterior of the frame member of this composition is not prone to rust or deteriorate due to the action of the chemical materials which may be contained in the electrolytic bath. Further, such a frame member may be specially treated upon the conducting exterior thereof in order to prevent too great adherence between the deposited metal and the metal of the frame member by coating the exterior of the frame member with a suitable chemically inert substance such as vaseline or high boiling hydrocarbon oil or grease. The deposited metal may be removed readily from the frame as highly purified material and used as such.

It will be seen that the invention effectively protects the extremities of an object to be plated from the build-up which is normally encountered in electrolytic plating but permits the deposition of a substantially uniform deposit upon the entire surface of the object in one operation.

What is claimed is:

1. The method of plating an object with metal uniformly by electrodeposition which comprises attaching the object as an electrode to a source of current, immersing the object in an electrolyte and placing an electrically conducting member at the extremities of the object, said member being spaced from the object and having a potential less than the cathode potential.

2. In a metal plating operation the method of controlling the plating of an object over a predetermined area thereof which comprises attaching the object as a cathode to a source of current whereby metal deposits on the object, immersing the object in an electrolyte and placing an electrically conducting member adjacent the portion of the object where the plating is to be controlled, said member being spaced from the object and having a cathode potential less than the potential of the cathode and plating metal from the anode upon the object and said member.

3. The method of depositing upon an object by electrodeposition a layer of metal of substantially uniform thickness which comprises immersing the object in an electrolyte in a cell containing an anode, connecting said object to a source of current to act as cathode in the cell, placing an electrically conducting member at the extremities of said object and out of the direct path of current flow from the anode to the object through the electrolyte, said member being out of electrical contact with said object, and maintaining said member at a potential less than the cathode potential of said object.

4. In a metal plating operation, the method of controlling the deposition of metal on a predetermined area of an object, which comprises immersing the object in an electrolyte in a cell containing an anode, connecting said object to a source of current to act as cathode in said cell, placing an electrically conducting member adjacent said area on said object and out of the direct path of current flow from the anode to said area through the electrolyte, said member being out of electrical contact with said object, maintaining said member at a potential less than the cathode potential of said object, and withdrawing current from the cell both through said object and through said member to cause metal to be deposited on both said object and said member.

5. The method of depositing upon an object by electrodeposition a layer of metal of substantially uniform thickness which comprises immersing the object in an electrolyte in a cell containing an anode, connecting said object to a source of current to act as cathode in the cell, placing an electrically conducting member at the extremities of said object and out of electrical contact with said object, and maintaining said member at a potential less than the cathode potential of said object.

CHARLES A. HARRISON.