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METHOD OF PLATING

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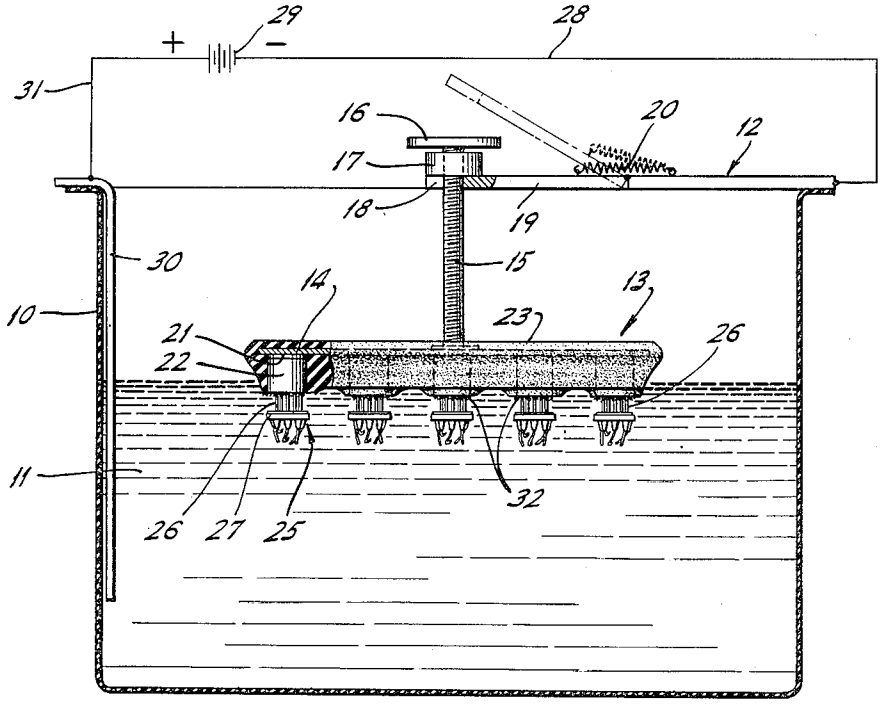

FIG. 1.

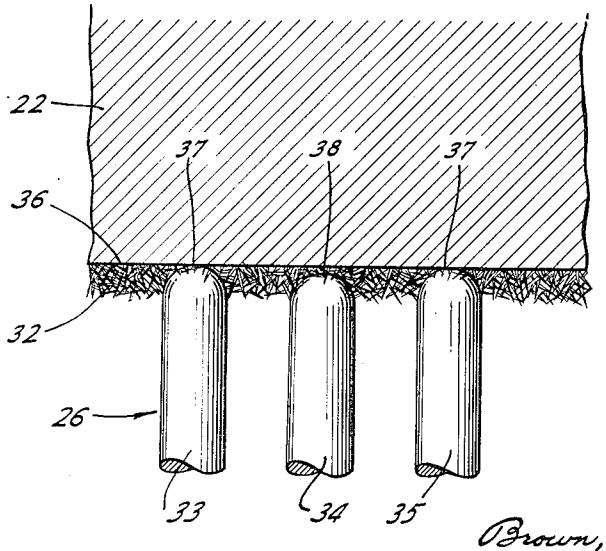

FIG. 2.

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METHOD OF PLATING

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The invention hereinafter described and claimed has to do with electrolytic treatment of small articles. More particularly it is concerned with electrolytic plating of mass produced, intricately formed, metallic articles by a method assuring uniform and adequate deposition of plating material over the articles being operated upon.

In many arts, and particularly in the art of manufacturing electronic equipment, it is desirable to plate or polish intricately formed parts used in such equipment. Frequently a highly conductive coating is desired, and for various reasons it is desirable that the coating be both adequate and of fairly uniform thickness. In the past this problem has presented many difficulties in the mass production of such parts which, because of tolerances necessary in mass production procedures, are seldom identical. This is true, for example, in the vacuum tube manufacturing art, and particularly in the mass production of sub-miniature tube bases, wherein the contact pins may be of various lengths. Many methods for uniformly coating such parts have been proposed, but none of these methods have proven to be completely satisfactory.

It is, therefore, the primary object of the present invention to provide an improved method of electrolytically treating articles of manufacture.

It is an important object of the invention to provide such a method suited to mass production procedures, and one whereby small, intricately formed, mass produced parts may be electroplated with a substantially uniform coating.

More specifically it is an object of the invention to provide an inexpensive method of providing a highly conductive coating upon the contact pins of mass produced tube bases.

In accordance with these objects the invention includes—stated generally—the concept of subjecting the articles to an electrolytic operation while carried upon supporting means having thereon a layer of metallic particles disposed to ensure adequate electrical contact between the support and the articles to be operated upon. In amplification of this brief description the invention is described in detail below, with reference to a specific illustrative embodiment.

In the drawings:

Figure 1 is a partially diagrammatic view showing apparatus for carrying out the method comprising the invention;

Figure 2 is a fragmentary view of a portion of the apparatus shown on a greatly magnified scale, and illustrating in more detail an important feature of this invention.

With detailed reference to the attached drawings, and more particularly to Figure 1 thereof, the numeral **10** designates an open top vessel partially filled with a suitable electrolyte, indicated by the numeral **11**. As, in the process under consideration, it is desired to silver-plate the articles being worked on, the solution preferably comprises silver cyanide, potassium cyanide, and potassium carbonate, but it must be understood that this is exemplary, and that use of other suitable solutions is contemplated. It is also to be understood that, while the following detailed description is in terms of an electroplating operation, in so far as the characteristic features of this invention are concerned, they are equally applicable to the electroplating art. Therefore the term "electrolytic treatment," as employed in this description and in the appended claims, is used generically to denote either electroplating or electropolishing operations.

Depending within the tank and supported by an articulated arm **12** is a member **13** having an article-supporting surface. Preferably this member, which serves as one electrode in the electroplating circuit, comprises a magnetic chuck for holding the articles during the plating operation, but, in a broader aspect of the invention, it is contemplated that the articles might be secured to said member by other than magnetic means.

Chuck **13** comprises a metallic base plate **14** secured by any suitable means, such as welding, to the lower end of a screw threaded shaft **15** topped by a disc **16**. Screw threaded upon shaft **15** is a nut **17** which, in cooperation with an open-ended slot **18** on the outer end of the movable portion **19** of arm **12**, provides means for supporting the chuck and adjusting its depth of immersion within the solution **11**. Articulation of arm portion **19** permits it to move upwardly when the chuck is lifted, thus facilitating movement of the chuck to and from the tank. Upward movement of portion **19** is facilitated by means of a coil spring **20**, one end of which is attached to the movable portion **19**, while its other end is secured to the stationary portion of the arm.

Permanently secured to the lower surface of the base plate **14** is a plurality of metallic discs, one of which is shown at **21**, and of which any desired number may be used, according to the size of the tank, the size of the chuck, and the number of work pieces to be handled simultaneously. Depending from each of the metallic discs and held thereto by magnetic attraction is a permanent magnet **22**. To insulate and prevent excessive plating of the chuck assembly, except for the lower planar surfaces of magnets **22** the lower end of the chuck is enclosed within a heavy rubber casing **23**.

Depending from each of the five magnets shown in this embodiment of the invention, and held thereto by magnetic attraction, is a sub-miniature tube base **25** having a plurality of contact pins **26** projecting through a glass disc **27**. These tube bases are illustrative of the type of articles which, normally, are difficult to plate, but which may be successfully plated by the method of this invention. It is understood, of course, that other intricately formed parts may be operated upon with equal ease.

As electrolytic plating of metallic parts is a well-known art it is not necessary to describe it in detail in this disclosure. Briefly, however, the necessary apparatus comprises a simple series circuit including a cathode, an anode, a source of electrical current, and the necessary connectors including the electrolyte between the cathode and anode. In the apparatus which performs the plating operation of the present invention, it will be noted that chuck **13** is connected through shaft **15**, arm **12**, and wire **28** to the negative side of a suitable source of electrical current **29**, and thus comprises the cathode of the circuit. The anode comprises a silver plate or rod **30** connected by means of wire **31** to the positive side of source **29**. The circuit is completed between the cathode and anode by means of electrolyte **11**.

In particular accordance with this invention, the lower exposed surface of each magnet is provided with a layer of small, loose magnetizable metallic particles **32**, for example iron or nickel filings. This is more clearly illustrated in Figure 2 which shows, on a greatly magni-

fied scale, fragmentary end portions of three contact pins 26 of a tube base depending from one of the magnets 22. The particles, like the tube bases, are held to the chuck by magnetic attraction.

It will be noted—still with reference to Figure 2—that many of the particles are in contact with and surround the ends of pins 26, which for the purpose of clarity are further identified in this view by numerals 33, 34, and 35. The layer of particles is not of sufficient density to prevent the ends of the pins—where they are of equal length, as is the case with pins 33 and 35—from being drawn into direct contact with the lower, article-supporting surface 36 of the magnet, as indicated at 37.

Where the pin is of insufficient length to contact the magnet directly (see end 38 of pin 34) and because of this normally would not be plated, the metallic particles bridge the gap between the end of the pin and the magnet, thus providing a completely satisfactory conductive path between pin 34 and the chuck. It is seen, therefore, that the metallic particles assure good electrical contact between all the pins and the magnet with the result that the current density is substantially equal through each of the pins.

As the plating material deposited upon each of the pins, or other parts being plated by this or any other electrolytic plating method, is exactly proportional to the product of the current multiplied by the time during which it flows, that is, to the quantity of electricity passing through the electrolyte, it is obvious that an increase in the current passing through the pins results in a decrease in the time required to deposit a coating of the desired thickness.

In the practice of the present invention the metallic particles permit a maximum quantity of electricity to pass through each pin, regardless of its area of direct contact with the cathode, thereby substantially reducing the treating time and thus affording a distinct advantage over prior methods. This advantage is of course in addition to the aforementioned elimination of untreated areas.

I claim:

1. The method of electrolytically treating electrically conductive ferromagnetic articles, which comprises, subjecting the articles to an electrolytic operation while carried by magnetic supporting means upon which is provided a layer of loose electrically conductive ferromagnetic particles disposed to ensure a conductive path between said articles and said supporting means.

2. The method of electrolytically treating a ferromagnetic multiple-pin tube base, said method comprising: subjecting the pins to an electrolytic operation while carried by magnetic supporting means comprising one of the electrodes of the circuit and upon which is provided a thin layer of loose minute ferromagnetic metallic particles, said particles providing contact between the supporting means and said pins and ensuring that the current density through each of said pins will be substantially equal regardless of the area of direct contact of said pins with said supporting means.

3. The method of electrolytically treating ferromagnetic articles carried by an electrically conductive magnetic member having an article-supporting surface, which method comprises: providing upon said surface a plurality of loose electrically conductive ferromagnetic particles of very small size as compared with the size of the articles to be plated, said particles being disposed to provide enhanced electrical contact between said surface and the articles supported thereon; and subjecting said articles to an electrolytic operation in which said member serves as one of the electrodes in the circuit.

4. The method of electrolytically treating ferromagnetic articles carried by an electrically conductive magnetic member having an article-supporting surface, which method comprises: providing upon said surface a layer of loose electrically conductive ferromagnetic particles of very small size as compared with the size of the articles to be plated, said layer of particles being interposed between said surface and portions of the articles to be treated and ensuring good electrical contact between said surface and the articles supported thereon; and subjecting said articles to an electrolytic operation in which said member serves as one of the electrodes in the circuit.

5. The method of electrolytically treating ferromagnetic articles, which method comprises: providing an article-supporting member which includes a magnet and which has a surface upon which said articles are supported by magnetic attraction; providing upon said surface a plurality of electrically conductive ferromagnetic loose particles of very small size as compared with the size of the articles to be plated, said articles being disposed to ensure an adequate conductive path between the article-supporting surface of said member and the articles supported thereon; and subjecting said articles to an electrolytic operation in which said member serves as one of the electrodes in the circuit.

6. The method of electrolytically treating ferromagnetic articles, which method comprises: providing an article-supporting member which includes a magnet and which has a surface upon which said articles are supported by magnetic attraction; providing upon said surface a layer of loose nickel filings, said filings contacting both said articles and said surface to ensure an adequate conductive path therebetween; and subjecting said articles to an electrolytic operation in which said member serves as one of the electrodes in the circuit.

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