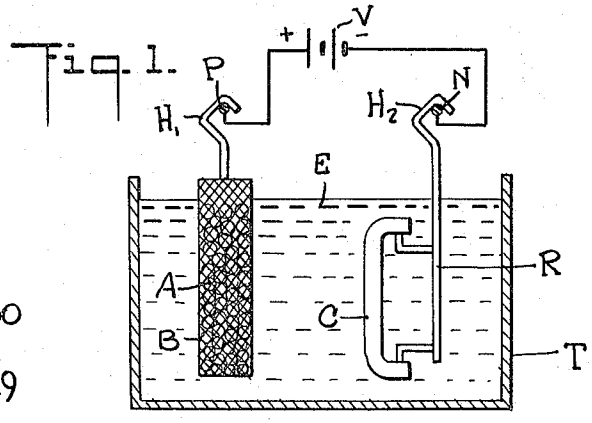
Jan. 24, 1967 C. T. WALKER 3,300,396

ELECTROPLATING TECHNIQUES AND ANODE ASSEMBLIES THEREFOR

Filed Nov. 24, 1965

Fig. 1.



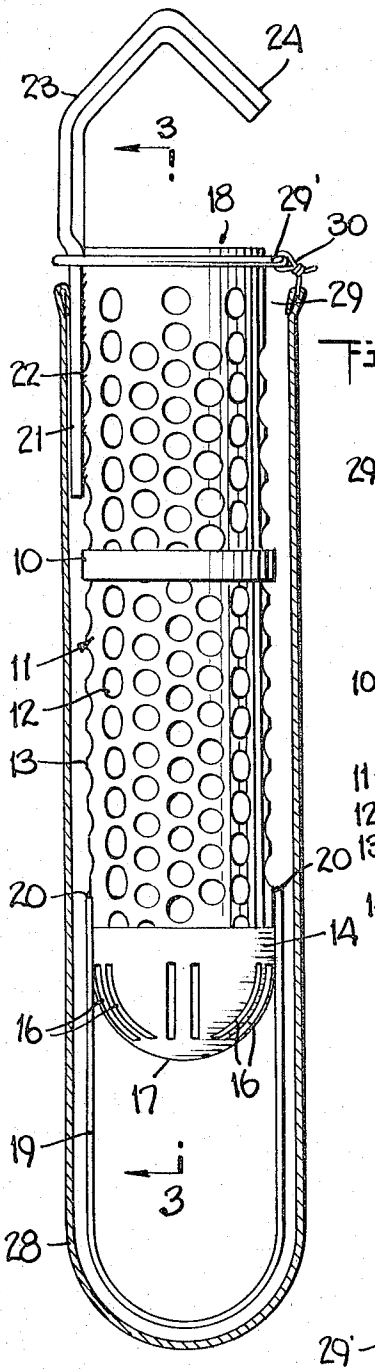


Fig. 2.

Fig. 3.

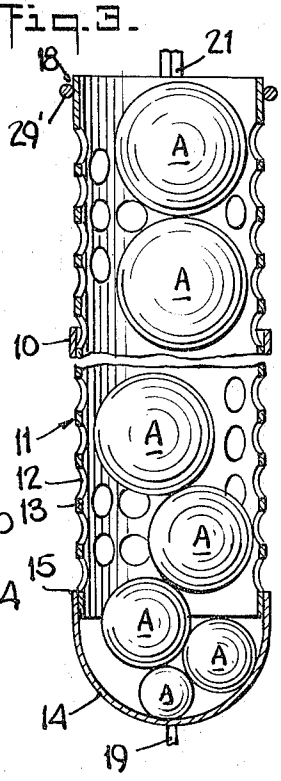


Fig. 4.

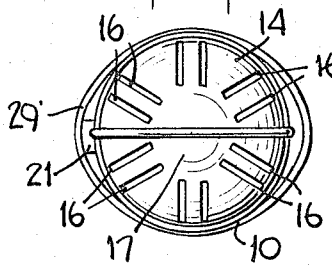


Fig. 6.

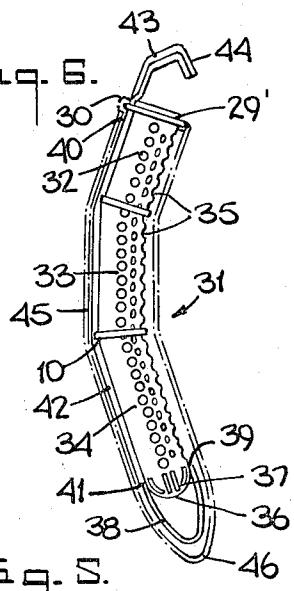
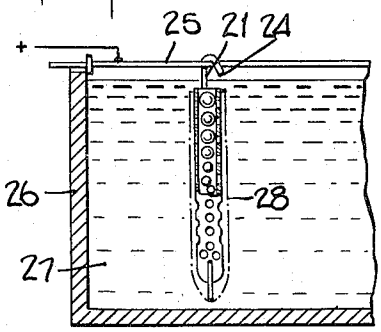


Fig. 5.



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ELECTROPLATING TECHNIQUES AND ANODE ASSEMBLIES THEREFOR

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Filed Nov. 24, 1965, Ser. No. 509,537
14 Claims. (Cl. 204—49)

This application is a continuation-in-part of my copending application Ser. No. 170,309, filed January 29, 1962, now abandoned, and entitled "Plating Anode."

This invention relates generally to electroplating techniques and more particularly to an electroplating process and to a system for carrying out the process, wherein an anode immersed in an acidic electrolyte is constituted by a replenishable pile of solid anodic pieces contained in a titanium basket which is rendered inert with respect to the electrolyte and yet serves to conduct current to the pieces.

Electroplating is the process of coating an article with a thin layer of a metal through electrolytic deposition. The article to be plated is immersed in an electrolytic bath and serves as the cathode in the electrolytic system. Also immersed in the bath is an anode composed of the plating metal. A low voltage is applied between the cathode and the anode, causing a current to pass through the electrolytic solution, which electrolyzes and plates the cathodic article with the anodic metal to the desired thickness. In this way articles may be plated with silver, copper, cadmium, nickel, and a variety of other metals. The present invention is primarily concerned with anode structures for electroplating nickel, copper and zinc.

The efficient electroplater seeks not only to carry out the process at low cost, but to produce platings which are uniform in thickness and of good quality. Three main factors are involved in attaining this purpose. These factors will now be considered separately.

The first factor is constant anode area. In the conventional bar-type anode used in electroplating, as the anode is consumed in the course of electroplating, the bar takes on the form of a spear or an irregular sponge-like mass whose over-all surface is much reduced with respect to the original anode. While at the outset of the plating process one may attain a fairly constant level of metal ions in solution, with the inevitable shrinkage of the anode in the course of dissolution, it is no longer possible to maintain optimum plating conditions.

As conventional anodes of the bar type corrode, they not only assume an irregular shape but they lose weight, and when the weight is reduced to about 10% to 40% of its original value, the anodes must be replaced. The plating operation must therefore be shut down to permit the used-up anodes to be pulled out and replaced with new anode bars. This is a costly and time-consuming operation, and it gives rise to expensive scrap losses.

The second factor is constant current flow. In order to realize platings of uniform quality and thickness, the intensity of current flowing through the system must remain unchanged in the course of operation. But with bar anodes, the effective resistance of the anode varies as the anode corrodes, and the level of current flow is therefore uneven.

The third factor is contamination. In order to produce smooth, clean platings of good quality it is essential that the electrolytic bath be free of foreign ions. But should the anode structure include contaminants which electrolytically dissolve into the bath, the resultant plating will be of poor quality.

To obviate the drawbacks incident to the use of bar anodes, it has been known to provide anode assemblies wherein the anodic metal in piece form is contained in

a plastic basket or a plastic-coated metallic basket. But since such baskets are electrically non-conductive, it becomes necessary, in order to electrify the structure, to place conductive strips or rod electrodes within the insulated basket to make contact with the anodic pieces therein.

Such plastic basket arrangements have several serious disadvantages. The strips or electrodes used to conduct the current to the anodic pieces are themselves subject to chemical attack by the electrolyte and hence have to be replaced periodically. Moreover, the strips or electrodes have a relatively small surface area and afford a poor and varying electrical contact with the anodic pieces. In the case of plastic-coated baskets, should the plastic skin be damaged the underlying metal is exposed and subject to attack by the electrolyte, as a result of which the basket is gradually destroyed and the electrolyte contaminated.

It has also been proposed to provide anode baskets formed of an electrically conductive metal such as steel. The difficulty with such arrangements is that these basket metals are chemically reactive with the acidic electrolyte normally used in electroplating, hence gas is generated and foreign ions are dissolved in the electrolyte which degrade the quality of the plating. Furthermore, such baskets because they corrode, have a limited life and require replacement.

Accordingly, it is the principal object of this invention to provide an electroplating technique making use of an anode assembly in which anodic pieces are contained in a titanium basket which is permanently installed in the plating tank, and which overcomes the drawbacks inherent in prior art anodes.

It is also an object of the invention to provide an anode assembly of the above-described type which makes it possible to carry out plating operations without interruption and which produces metallic coatings of uniform thickness and of high quality.

More specifically, it is an object of the invention to provide a method and system for electroplating nickel, zinc or copper, making use of an anodic assembly constituted by a replenishable pile of anodic pieces contained in a titanium basket having an extended life, the anodic assembly and an article to be plated acting as a cathode, both being immersed in an acidic electrolyte, whereby when a voltage is applied between said assembly and said article, the resultant curent flow causes electrolytic dissolution of said anodic pieces but not of said basket, the anodic assembly being adapted to maintain the effective surface area of the anodic plating metal and the current distribution characteristic thereof substantially constant, the desired metal ions in solution being maintained at a substantially uniform level in the course of electroplating without contaminating the electrolyte by foreign metal ions.

It is also an object of the invention to provide in conjunction with an anode assembly of the above type a novel form of anode bag constructed of fiberglass or equivalent material which is adapted to collect carbon sludge, oxides or scale, or other impurities, and to prevent contamination of said electrolyte by said impurities.

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawings, wherein:

FIG. 1 schematically shows an electroplating system for carrying out a process in accordance with the invention;

FIG. 2 is a side elevational view of a titanium basket in accordance with the invention;

FIG. 3 is a fragmentary section taken on line 2—2 of

FIG. 2, and on a reduced scale, and showing ball anodes in the titanium basket to form the anode assembly;

FIG. 4 is a bottom plan view of the basket shown in FIG. 2;

FIG. 5 is a schematic illustration of the anode assembly shown in FIG. 2 as suspended within an electrolytic bath for a plating operation; and

FIG. 6 is a side elevational view on a reduced scale of a slightly different form of anode container particularly adapted for barrel plating.

Referring now to the drawings, and more particularly to FIG. 1, there is shown an electroplating system in accordance with the invention, the system comprising an anode assembly constituted by a replenishable pile A of anodic pieces which are vertically stacked within an apertured container or basket B, the assembly being almost fully immersed in an electrolytic bath E contained in a suitable tank T. Fully immersed in the electrolyte is the article C to be plated, the article acting as a cathode in the electroplating circuit or system.

Basket B is suspended from a conductive positive bus bar P by means of a conductive hook H_1, while article C is supported on an electrically-conductive rack R which is suspended by a conductive hook H_2 from a negative bus bar N. A source of D.-C. voltage V is connected between the negative and positive bus-bar conductors. The basket B is an elongated, open-topped structure formed of titanium, the basket having small closely-spaced openings along the length thereof. Hook H_1 for suspending the basket is preferably of the same material.

The anodic pieces are of a metal appropriate to the plating operation being carried out, and are preferably chosen from the group consisting of nickel, copper and zinc. Each of the anodic pieces is larger in dimension than the basket openings, but is smaller than the open top of the basket, so that one can deposit additional pieces therein to maintain the height of the pile and to hold the effective surface area of the anodic plating material substantially constant in the course of plating.

The electrolyte E is of an acidic composition appropriate to the plating operation. Various formulations for acid copper plating solutions are set forth in the 1961 edition of the "Metal Finishing Guidebook," published by Metal and Plastic Publications, Inc., of Westwood, New Jersey. In such acid copper-plating baths, it is the conventional practice to add sulphuric acid to reduce the resistivity of the bath. Acid bath formulations for zinc and nickel plating are to be found in the same guidebook.

In industrial nickel plating processes, there are at least thirteen types of electroplating bath soltuions, the choice of which depends on the type and thickness of the deposit required, the baths being generally acidic in character. Various nickel-plating baths are disclosed in "Practical Nickel Plating," publishing by International Nickel Company, Inc.

Titanium is an inherently active metal. It is found between magnesium and zinc in the electrochemical series. Titanium reacts with strong reducing acids, dry chlorine and other chemicals. Commercially available titanium is subject to rapid attack in environments containing hydrofluoric acid, phosphoric acid, formic acid, sulphuric acid, hydrochloric acid, trichloroacetic acid, oxalic acid or dry chlorine. However, it is ordinarily not corroded by nitric acid. Titanium does not have a high chemical resistance to the acids ordinarily used in nickel, copper and zinc plating, particularly sulphuric acid. However, it has been discovered that when used in the manner disclosed herein in an electroplating system, its corrosion resistance is enormously enhanced under anodic conditions, so that the titanium basket is unaffected by the plating operation and may be permanently installed.

With the flow of current from D.-C. source V between the cathode C and the anode assembly, an anodic film is formed on titanium basket B which affords corrosion resistance and electrcial insulation, the basket thereby being rendered anodically inert. Titanium acquires a thin, dense adherent oxide film which is chemically resistant to acidic electrolytes and has a high ohmic resistance.

Unlike aluminum, the anodic film formed on titanium does not continue to grow as a function of electrolysis time, but reaches a finite thickness for any given voltage:time ratio in an electrolyte of constant composition. However, even though the film on the titanium is an electrical insulator, current will pass at a contact point between the anodic film and another metal (zinc, copper or nickel) within the electrolytic circuit, so long as the other metal has a lower over-potential.

Thus the other metal will become anodic, the degree of contact with the titanium depending on the resistance offered by the oxide film thereon at the point of contact. But while this resistance is inversely proportional to the pressure of the contact point, relatively little pressure suffices to eliminate any significant film resistance. Such pressure exists by reason of the vertically stacked arrangement of anodic pieces. The anodic pieces A within the titanium basket are highly conductive and make contact at multiple points along the inner surface of the basket distributed along the length thereof.

In operation, the titanium basket B passes current to the anodic pieces A at the multiple points of contact, all other surfaces of the basket being rendered non-conductive by the anodic film formed thereon in the course of electroplating. In this way, substantially uniform current flow is maintained in the system while avoiding contamination of the electrolyte by the titanium.

Titanium is useful for basket structures for it is strong and tough, yet light in weight. Within the electrolytic system it is effectively non-reactive with respect to the electrolyte, and to this extent it has the advantages possessed by plastic or plastic-coated baskets. But unlike plastic or plastic-coated baskets, the titanium basket affords an electrically conductive path to the anodic pieces therein at the many points of contact with the inner surface of the basket, and it is not essential therefore, to provide separate conducting electrodes or strips.

Referring now to FIGS. 2 to 6 of the drawing, the actual structures of preferred embodiments of the anode assembly are illustrated. In one embodiment illustrated in FIGS. 1 and 2, the anode container, generally indicated at **11**, comprises an elongated insoluble metallic basket having a cylindrically-shaped body **13** constructed of commercially-pure titanium. The body **13** throughout its height and circumference has formed therethrough a plurality of equally spaced circular apertures **12** for communication with the electrolyte **27** within tank **26**, fragmentarily shown in FIG. 5.

A cup-shaped bottom closure **14** is suitably secured as by welding, as at **15**, FIG. 3, to the lower end portion of body **13**, there being a series of arcuate transverse slots **16** formed through said bottom closure, of a reduced dimension as compared with the diameter of the apertures **12**. The purpose of this is to provide a means of supporting all particles of dissolved anode and to prevent the cropping of anode particles into the electrolyte before a complete dissolution has taken place, as will be hereinafter described.

Except for the plurality of slots **16**, shown in FIG. 2, as well as FIG. 4, the wall of the closure is imperforate, as indicated at **17**, in order to support and confine the stack of anode balls designated by the letter A, FIG. 3. The body **13** at its upper end is open, as indicated at **18**, and is thus adapted for projection thereinto of a series of anode elements A, which are normally arranged in a stack, such as shown in FIG. 3.

In starting a plating operation, for example, the body **13** is filled with anodes A of spherical form, such as anodes constructed of solid nickel, which anodes are of a diameter slightly less than the internal diameter of the body **13** which defines a portion of the container **11**.

During the plating operation, corrosion of the anodes takes place at an increased rate as the depth of the container increases, with the result that the anodes at the lower portions of the container gradually are reduced in diameter, as shown in FIG. 3. This characteristic provides a simplified means by which the anode area may be maintained constant by the addition into the said container of more anodes as needed so as to maintain a constant stack of anodes within the said container.

All that is necessary is the introduction at the end, of a new anode ball when required, through the upper open end 18, shown in FIG. 3. The U-shaped bail 19, also constructed of commercially pure titanium, is centrally aligned with and secured over the bottom closure 14–17, as by the commercially pure titanium welds 20, and depends from the said closure for the purpose of supporting a sludge-collecting bag 28, as hereinafter described.

An upright bar 21, constructed of commercially pure titanium, extends axially along an outer wall of the body 13 adjacent its upper end and is fixedly secured to said body by a series of welds of commercially pure titanium, as indicated at 22. The bar 21 extends above the top of the said body, and thereover is inclined inwardly and upwardly as at 23, and reverse-curved downwardly as at 24 to define a supporting hook. The entire container assembly 11 may be suspended from the electrode 25 across the top of the tank 26. A suitable source of electrical potential is applied to the said electrode in a manner well known in the art, as schematically shown in FIG. 5.

As forming a part of the present invention, and as particularly directed to the anode container 11, there is provided a sludge-collecting bag constructed of fiberglass. The said bag completely encloses the cylindrical body 13, and is spaced therefrom, particularly with respect to the lower closure end of the body, by means of the bail 19, above described. During the plating process, carbon sludge or other impurities will drop into bag 28. It is the primary purpose of the bag to collect the sludge particles and prevent their dropping into the electrolyte 27.

The bag 28 at its upper end 29 extends substantially up to the upper open end 18 of body 13 and is supported thereon by drawstring 30 which is secured to a tie bar mounted on the upper end portion of container 13. This provides an effective means of securing the bag over the anode container for use during the plating operation. The bar 29′ is also made from commercially pure titanium and welded in place with commercially pure titanium.

It is contemplated that the present anode container 11, FIG. 2, is particularly adapted for nickel plating employing solid nickel anode balls A, and wherein all of the parts which make up the container, namely body 13, closure 14, bail 19, bar 21, hook 23–24, and tie bar 29′, are made entirely of commercially pure titanium. The result is that the anode container does not dissolve in the electrolyte, and may be used continuously for many years.

It is contemplated that the present anode container may be used for other forms of plating employing ball anodes of copper, tin, brass, cadmium, and zinc, for illustration.

A slightly different form of the present invention is shown on a reduced scale in FIG. 6, which is particularly adapted for barrel plating and wherein the anode container 31, is generally arcuate in shape. This is for the primary purpose that the parts of the container 31 and the anodes contained therein will be at a substantially constant radius with respect to the center of rotation of the barrel or drum to be rotated in the electrolyte within a plating tank similar to tank 26, shown in FIG. 5.

Here also, container 31 is of an insoluble metal of commercially pure titanium. The body of the container is of a generally cylindrical shape and includes a series of longitudinal angularly-related body sections 32, 33 and 34, which as assembled form an arc to conform to the general curvature of the plating barrel employed for the purpose mentioned.

The rear wall portions of each of the body sections 32, 33 and 34 are imperforate throughout a portion of their transverse circumference, normally less than one-half thereof. The aligned body sections have front walls that have formed therethrough a series of rows of transverse apertures 35, which extend substantially throughout the height of said sections to provide communication with electrolyte 27 within tank 26.

A cup-shaped bottom closure 36 of commercially pure titanium is secured over the end of the lowermost section 34. A plurality of transverse slots 37 are formed therethrough, being of a reduced dimension as compared with the diameter of apertures 35.

U-shaped bail 38 of commercially pure titanium is centrally aligned with and at its free ends secured over closure 36 by the commercially pure titanium welds 39. Said bail is aligned centrally with respect to the longitudinal axis of bottom section 34 and depends therefrom, providing a support for the sludge-collecting fabric bag 46, preferably constructed of fiberglass, as best shown in FIG. 6.

The elongated backing bar 42 of commercially pure titanium is arranged axially along body sections 32, 33 and 34 centrally of their rear walls, extends down to point 41 adjacent bottom closure 36 and is fixedly secured to said body sections as by a series of commercially pure titanium welds. Bar 42 extends to the top of the uppermost body section at 40 and thereabove is inclined upwardly and inwardly at 43, and is reverse-curved downwardly at 44 to provide a supporting hook by which the assembled anode container 31 may be suspended over conducting bar 25, shown in FIG. 4, for the purpose of immersing the container within the electrolyte 27, for illustration. A series of spaced reinforcing bands 10 of commercially pure titanium is secured to container 31.

The entire anode container is enclosed by sludge-collecting bag 46, whose central portion 45 loosely sursounds the body of the container and extends upwardly to the upper open end of uppermost section 32 and is tied thereto by drawstring 30, which engages the bar 29′, as shown in FIG. 2. The advantage of this construction is that bag 46 does not contact the anodes within anode container 31.

In the illustrative embodiment of the invention, the anodes employed within anode container 31 are of the same form as indicated at A in FIG. 3, and these balls of nickel, for example, are dropped down into said body sections and stacked therein to the upper open end of the uppermost body section. Here also in FIG. 6, all the parts of the anode container, including the body sections 32, 33, 34, bottom closure 36, bail 38, bar 42, hook 43–44, tie bar 29′, and bands 10, are constructed entirely of commercially pure titanium.

As the nickel anode balls A corrode, and to a greater extent towards the lower portion of the container, additional nickel anodes are added at the upper open end of the uppermost section 32 of the container, as needed. This maintains a constant anode area and thus accomplishes the intended result, namely uniform plating. This uniformity is furthermore achieved by the fact that the nickel anode balls corrode uniformly throughout their entire surface and are productive of furnishing maximum surface contact with the electrolyte.

Another advantage is that anodes A are completely used up within the container and completely go into solution during the electrolytic plating operation. Furthermore, polarization of the anode elements A is prevented by using the anode container, the sludge-collecting bag does not cling to or engage the elements. The use of nickel balls as anode elements, as compared with the conventional bar type of anode, provides at least an additional 30% anode area.

While there have been shown and described preferred embodiments of electroplating techniques and anode assemblies therefor in accordance with the invention, it will be appreciated that many changes and modifications may be made therein without, however, departing from the essential spirit of the invention as defined in the annexed claims.

What I claim is:

1. An electroplating system for plating an article with a plating metal selected from the group consisting of nickel, copper and zinc, said system comprising:

(A) a tank adapted to contain an electrolytic solution for electrolytically dissolving the selected plating metal, said solution having an acidic composition which is chemically reactive with titanium,

(B) a conductive member disposed above said tank for suspending an anode assembly in said solution,

(C) an anode assembly adapted to maintain the effective surface area of the anodic plating metal and the current distribution characteristics thereof substantially constant whereby the desired plating metal ions in solution are maintained at a substantially uniform level in the course of electroplating without contamination of the bath by foreign metal ions, said assembly comprising:

(a) an elongated open-topped basket formed of commercially pure titanium, said basket having a plurality of small, closely-spaced openings along the length thereof,

(b) a conductive hook attached to said basket for suspending the anode assembly in said electrolyte from said member and for conveying electrical current thereto,

(c) a replenishable pile of solid anodic metal pieces filling said basket and vertically stacked therein, each of said pieces being of larger dimension that the basket openings but being smaller than the open top of the basket so that additional pieces can be deposited therein to maintain the height of the pile and to hold substantially constant the effective surface area of the anodic plating metal in the course of electroplating,

(d) said anodic metal pieces being highly conductive and being selected from said group, said pieces making contact at multiple points along the inner surface of said basket distributed along the length thereof,

(D) and means to impress a voltage between an article immersed in said solution and said conductor to produce a current flow causing a non-conductive protective film to form on the surfaces of said basket which renders it inert with respect to said solution and avoids contamination thereof, said basket passing current to said pieces at said multiple points of contact therewith to maintain a substantially uniform current flow to produce a metallic coating on said article of good quality.

2. A process for electroplating an article with a coating of an anodic metal selected from the group consisting of nickel, copper and zinc, the steps comprising:

(a) immersing an open-topped apertured basket formed of titanium in an acidic electrolyte having a composition with respect to which titanium is chemically reactive,

(b) filling said basket with a pile of solid pieces of the selected anodic metal, said pieces having dimensions smaller than the open top of said basket but larger than the apertures therein,

(c) immersing said article in said electrolyte,

(d) applying a direct voltage between said article and said basket which is positive at said basket but negative at said article to cause a current flow therebetween resulting in the formation of an insulating film on the surface of said basket rendering it inert with respect to said electrolyte, said current flowing into said pieces at their points of contact with the inner surface of said basket to effect dissolution of said pieces and concurrent plating of said article, and

(e) replenishing the pieces of anodic metal to maintain the height of the pile in said basket and to hold substantially constant the effective surface area of the anodic metal in the course of plating.

3. An anode for use in electrolytic plating baths comprising an elongated container having a hollow body, the wall of the body throughout substantially its height and circumference having a plurality of spaced apertures therethrough, a cup-shaped bottom closure at the base of said body, the body being open at its top adapted for projection thereinto of a series of anode elements, there being a series of apertures formed through said bottom closure, an upright bar extending axially along the outer wall of the body adjacent its upper open end and fixedly secured thereto, said bar extending above the body and reverse-curved thereover to form a hook adapted for hanging over the electrode rod of a plating tank, a U-shaped bail centrally aligned with and secured over said bottom closure and depending therefrom, said anode elements consisting of a plurality of balls of nickel of a diameter less than said container diameter arranged in a vertical stack in said body and resting on the bottom closure, said balls as they gradually dissolve and more progressively downwardly being retained by said bottom closure, and a sludge-collecting fabric bag loosely enclosing said body and bail and at its upper end tied adjacent the open end of said container.

4. In an anode for use in electrolytic baths for barrel plating, an elongated insoluble metallic container having a tubular body including a series of longitudinal angularly related body sections forming an arc, said body sections having longitudinally aligned imperforate rear walls extending transversely throughout less than one-half the section circumference and longitudinally aligned front walls having substantially throughout their height a plurality of apertures therethrough, a cup-shaped bottom closure of an insoluble metal secured over the end of the lowermost section, the uppermost section at its top being open and adapted for projection therethrough of a series of anode elements, there being a series of apertures formed through said bottom closure, an elongated backing bar of an insoluble metal arranged axially along said body sections centrally of their rear walls and fixedly secured thereto, said bar extending above the uppermost section and reverse-curved thereover forming a hook adapted for hanging over an electrode rod of a plating tank.

5. In the anode of claim 4, a U-shaped bail of an insoluble metal centrally aligned with and at its free ends secured over the lowermost section of said body depending therefrom, and a sludge-collecting fabric bag loosely enclosing said body and bail at its upper end tied adjacent the open end of said container.

6. In the aonde of claim 4, the metal defining said container, bottom closure and backing bar being commercially pure titanium.

7. In the anode of claim 4, a U-shaped bail centrally aligned with and at its free ends secured over the lowermost section of said body and depending therefrom, and a sludge-collecting bag loosely enclosing said body and bail and at its upper end tied adjacent the open end of said container, the metal defining said container, bottom closure, backing bar, and bail being commercially pure titanium, said bag being constructed of fiberglass.

8. In an anode for use in electroplating baths, an elongated insoluble metallic container having a tubular body, the wall of the body throughout substantially its height and circumference having a plurality of equally spaced circular apertures therethrough, a cup-shaped bottom closure of an insoluble metal at the base of said body, the body being open at its top adapted for projection thereinto of a series of spherically-shaped solid nickel anodes, there being a series of apertures formed through said bottom

closure, a hook of insoluble metal secured to the wall of said body on one side and extending axially thereof, overlying and spaced above the open end of said body adapted for hanging over an electrode rod of a plating tank, a U-shaped bail centrally aligned with and secured over the said bottom closure and depending therefrom, said container including said body, bottom closure, hook and bail being constructed of commercially pure titanium, and a sludge-collecting bag of fiberglass loosely enclosing the body and bail and at its upper end tied adjacent the open end of said container.

9. In the anode of claim 3, and a reinforcing band of insoluble metal secured around said body intermediate its ends.

10. In the anode of claim 4, and series of longitudinally spaced reinforcing bands of insoluble metal secured around said container.

11. In the anode of claim 4, a U-shaped bail of an insoluble metal centrally aligned with and at its free ends secured over the lowermost section of said body and depending therefrom, a sludge-collecting fabric bag loosely enclosing said body and bail at its upper end and tied adjacent the open end of said container, a tie bar secured to and adjacent the upper end of the uppermost body section, and means fastening the upper end of said bag to said tie bar.

12. In an anode for use in electrolytic plating baths, an insoluble metallic container having a hollow elongated body, the wall of the body throughout substantially its height and circumference having a plurality of spaced apertures therethrough, a cup-shaped bottom closure of insoluble metal at the base of said body, the body being open at its top adapted for projection thereinto of a series of anode elements, there being a series of elongated slots formed through said bottom closure, and an upright bar of insoluble metal extending axially along the outer wall of the body adjacent its upper open end and fixedly secured thereto, said bar extending above the body and reverse-curved thereover to form a hook adapted for hanging over an electrode rod of a plating tank, a U-shaped bail of insoluble metal centrally aligned with an secured over said bottom closure and depending therefrom, and a sludge-collecting fabric bag loosely enclosing the body and bail and at its upper end tide adjacent the open end of said container.

13. In an anode for use in electrolytic plating baths, an insoluble metallic container having a hollow elongated body, the wall of the body throughout substantially its height and circumference having a plurality of spaced apertures therethrough, a cup-shaped bottom closure of insoluble metal at the base of said body, the body being open at its top adapted for projecting thereinto of a series of anode elements, there being a series of elongated slots formed through said bottom closure, and an upright bar of insoluble metal extending axially along the outer wall of the body adjacent its upper open end and fixedly secured thereto, said bar extending above the body and reverse-curved thereover to form a hook adapted for hanging over an electrode rod of a plating tank, a U-shaped bail of insoluble metal centrally aligned with and secured over said bottom closure and depending therefrom, and a sludge-collecting fabric bag loosely enclosing the body and bail and at its upper end tied adjacent the open end of said container, the metal defining said container body, bottom closure, bar, hook and bail being commercially pure titanium, said sludge-collecting bag being formed of fiberglass.

14. In an anode for use in electrolytic plating baths, an insoluble metallic container having a hollow elongated body, the wall of the body throughout substantially its height and circumference having a plurality of spaced apertures therethrough, a cup-shaped bottom closure of insoluble metal at the base of said body, the body being open at its top adapted for projection thereinto of a series of anode elements, there being a series of elongated slots formed through said bottom closure, and an upright bar of insoluble metal extending axially along the outer wall of the body adjacent its upper open end and fixedly secured thereto, said bar extending above the body and reverse-curved thereover to form a hook adapted for hanging over an electrode rod of a plating tank, a U-shaped bail of insoluble metal centrally aligned with and secured over said bottom closure and depending therefrom, a sludge-collecting fabric bag loosely enclosing the body and bail at its upper end tied adjacent the open end of said container, a tie bar secured to and adjacent the upper end of said body, and means fastening the upper end of said bag to said tie bar.

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