Aug. 28, 1956 G. A. SHEPARD ET AL 2,760,929

ELECTROPLATING APPARATUS

Filed Oct. 6, 1952 2 Sheets-Sheet 1

Fig. 1

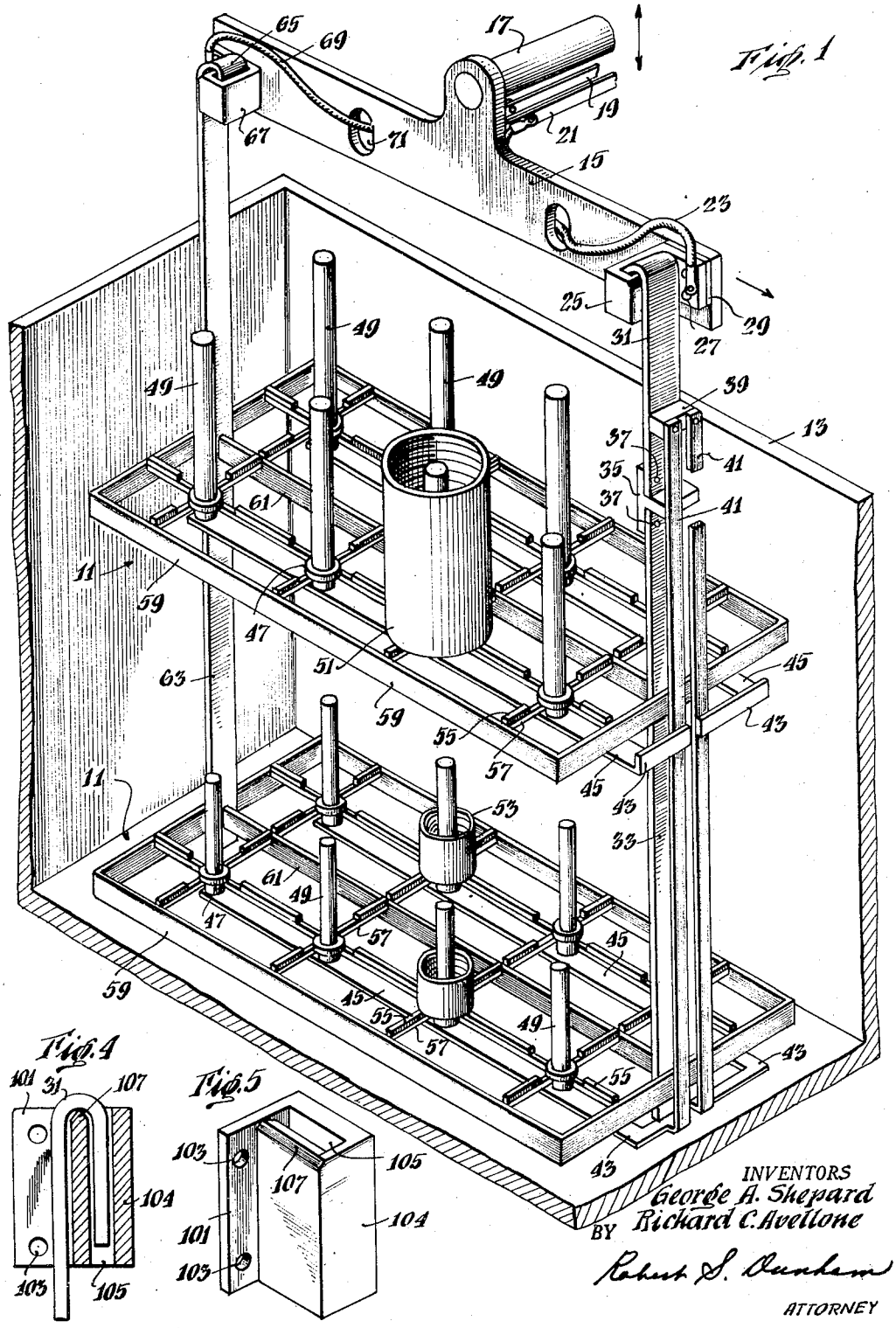

Fig. 4

Fig. 5

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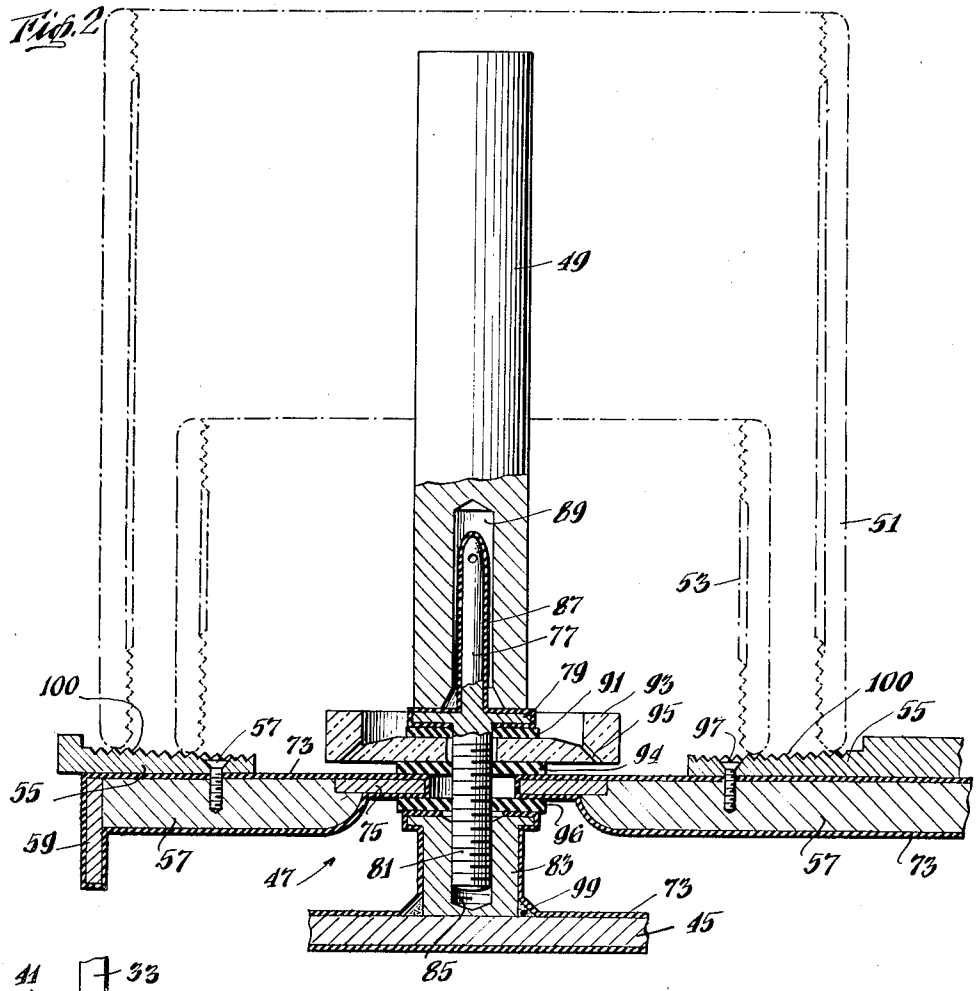
Fig. 2



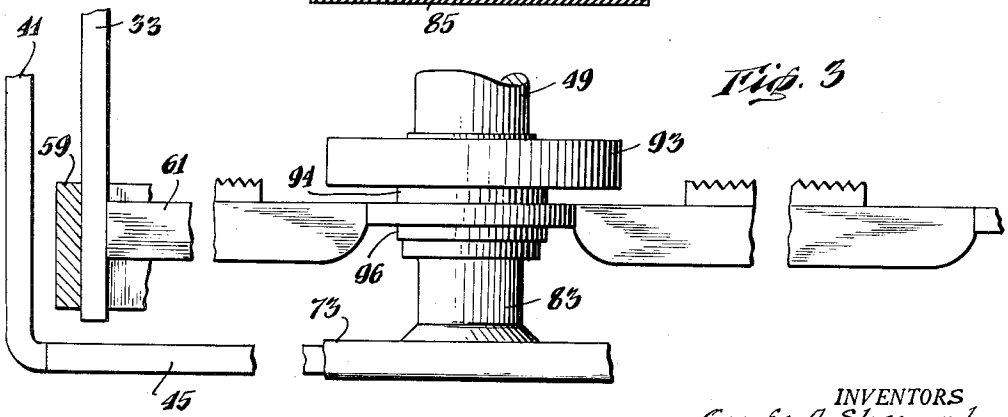


Fig. 3

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ELECTROPLATING APPARATUS

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8 Claims. (Cl. 204—242)

This invention deals with electroplating apparatus. Specifically, the invention is concerned with an improved rack to be used for electroplating hollow articles, e. g. pipe couplings.

The electroplating rack of this invention is superior to prior types in numerous respects among which is the arrangement of the anodes which are readily removable for replacement, and which are simple in construction. A special feature is the adaptability of the apparatus to full utilization of the anodes, in that the metal of each may be essentially completely consumed while maintaining good efficiency of electroplating operation at all times. The rack structure is also characterized by advantageous means for receiving the work, such as tubular or other objects to be plated internally. The articles can merely be set in place without special connection or adjustment of any part, yet they are fully supported in proper relation to their internal anodes, and have effective electrical connection in the plating circuit. In addition, the design of the rack permits free circulation of the electrolyte when the assembly is immersed, and is such as to promote maximum drainage upon its being lifted from the bath. Furthermore, the apparatus is provided with superior brackets or the like upon which the rack is supported, which brackets act to give good electrical contact, and, at the same time, prevent any side sway of the rack which might be caused by vertical or translatory motion of the assembly in the various operations of a mechanically operated plating system, or which might be caused by uneven loading or by the effects of removing or placing upon the rack heavy articles to be plated.

An object of this invention is to provide an electroplating rack having a superior anode arrangement, wherein the anodes are simple and yet make good electrical contact for carrying the plating current. The construction of these anodes for example, as more explicitly described below, allows easy replacement or removal of each one since they merely rest upon or over centrally located pins which have flanges to bear the weight of the anodes and make good electrical contact therewith. By use of this rack and anode supporting structure, the anodes may be very simple in their configuration, i. e. they can be merely cylindrical in shape having an axially located recess or hole in one end. With this construction, and because the anodes fit onto their supporting pins with a slide or even loose fit, no careful machining of the anodes is necessary in making them up, but they may be entirely formed by casting or by other inexpensive methods.

Another object of the arrangement of the anodes and their support is that the anodes may be used until completely consumed or very nearly so since they merely rest upon their own base and obtain electrical contact thereby.

A further object of this invention is the provision of superior brackets for suspending the electroplating rack. This improved structure enables a better electrical contact to be had between the hooks on the arms of the rack and the brackets themselves. Moreover, in addition to such superior electrical contact, the construction of these brackets in cooperation with the hooks on the arms of the rack, provides a mechanical stiffness such that no objectionable swaying horizontally in either direction will be felt during the various movements of the rack in the plating equipment or even when very uneven loads are suddenly applied as when heavy articles to be plated are placed on or removed from the rack, e. g. iron or steel pipe couplings.

Yet another object is the provision of an electroplating rack having improved cathode contacts such that no clips are necessary which would entail more complex handling. The cathode contacts of this invention enable negative electrical contact to be made with the articles to be plated, by merely resting the articles on these contacts.

Another object of this invention lies in the provision of a superior combination of anode and cathode elements, making it possible to plate articles of various sizes and to consume the complete anode by plating smaller articles at various stages of the operation as the anodes are consumed and become smaller in size, i. e. shorter and smaller in diameter. The construction further provides an insulating collar between the anode and the cathode supports of each unit whereby the articles to be plated are kept from making contact with the anode, should any horizontal sliding of these articles occur. This insulating collar further provides a shielding effect which results in a more uniform corrosion of the base of the anode, and it prevents direct treeing of metal from the negative contact tips to the anode during plating.

To these and other ends, one embodiment of the invention is described below and shown in the drawings by way of example of illustrating the features and principles of improvement. Referring to the drawings:

Fig. 1 is a perspective view showing an electroplating rack being supported in position at one end of an electroplating tank;

Fig. 2 is an enlarged cross-section view of one of the anode-cathode units of an electroplating rack;

Fig. 3 is an elevation partly in cross-section showing the details of the positive electrical connection from the base of an anode unit to the positive bus bar; and

Figs. 4 and 5 illustrate the details of the construction of the brackets as used in this invention.

Fig. 1 illustrates the embodiment of one style of electroplating rack as contemplated by this invention. The electroplating operation in which such a rack may be used may involve the ordinary steps as used in a normal electroplating process. This type of rack would ordinarily be used in a mechanized electroplating process in which some convenient type of conveyor support would be used to carry the rack—with articles to be plated in place thereon—from one tank to the next for the various steps involved in such a process. It is contemplated that the apparatus of this invention may be used on a commercial type of endless conveyor which is laid out in a long oval configuration and which has conveyor arms extending outwardly to reach over a set of tanks. The tanks may be arranged around the conveyor in a horseshoe-shaped configuration. The arms of such a conveyor are movable vertically as well as horizontally in order to lift the racks out of one tank and lower them into the next of the series. Electrical contact to each plating rack from the endless conveyor may be made in any convenient manner, such that current may be caused to flow during those operations of the process where such current is necessary.

In Fig. 1, a rack **11** is shown in place at one end of a tank **13** where it is being supported by means of a

support member 15 which is carried by the conveyor mechanism (not shown) by means of a rod 17. Rod 17 is movable vertically as indicated by the arrows, in order to raise or lower the rack 11 out of or into the tank 13. Also by means of the conveyor mechanism, this rod 17 is movable horizontally in order to cause the rack 11 to travel along within tank 13 during the electroplating step of the process. When the rod 17 is in its lowest position, rack 11, with the articles to be plated, will be totally immersed in the solution contained in tank 13, and at this time, an electrical circuit will be completed by conventional contact mechanism (not shown) on the conveyor (not shown). Such contact mechanism is joined electrically to a pair of bus bars 19 and 21, which are carried by the conveyor and extend parallel to and underneath the rod 17.

Beginning at the positive bus bar 21, an electrical circuit is carried via an insulated cable 23 to a positive bracket 25 which may be constructed of any satisfactory conductive material. This bracket 25 is securely fastened to one end of support member 15 by means of bolts 27, and is insulated from the support member by means of an insulating material block 29. The electrical circuit is continued from bracket 25 to a hook 31 which is the upper end of arm 33 of the two-layered rack 11. The hook 31 is insulated from the lower portion of arm 33 by means of a T-shaped block of insulating material 35 which joins hook 31 to the arm 33 by being fastened securely to each of the hook 31 and the arm 33, by any convenient means, such as bolts 37 illustrated. The electrical circuit is continued from hook 31 by means of a contacting metallic block 39 which is secured to the hook 31 and which has fastened to it a pair of positive bus bars 41. These bus bars 41 extend down the outside of rack 11 parallel to but spaced from arm 33 thereof; one bar 41 is shown broken away to reveal the block 35 more clearly. At each level of rack 11 the bus bars have horizontal lateral extensions 43 which join longitudinal connecting portions 45. These connecting portions 45 are electrically connected to the base of each anode unit 47 and make good electrical connection therewith, as will be pointed out in greater detail in connection with Fig. 3.

The rack 11 may be constructed with any desired number of anode-cathode units depending upon the size of the articles to be plated and the size of the plating rack to be used. A rack may, of course, be made with any desired number of layers of trays; for instance, for very large articles the rack may have only one tray or frame and only a small number of large anodes (e. g. two) carried on it, or alternatively the rack may have a plurality of layers with many small anodes on each. In the rack illustrated, which has two layers, there is a plurality of these units 47 on each layer of the rack. The electrical circuit continues from the base of each anode unit 47 to the anodes 49 by means of the construction which will be explained in detail in connection with Fig. 2. From anodes 49, the circuit continues through the electroplating solution to the articles 51 and 53 being plated, which articles may be various sizes depending upon the size of anodes 49. The anodes 49 will be eaten away in use, and so become gradually shorter in height as well as somewhat smaller in diameter; and by using smaller size articles to be plated, such as articles 53 shown on the lower level of rack 11, use may be made of the anodes without loss in efficiency in plating until the anodes are entirely consumed or very nearly so. In this way, use may be made of the entire anode material without appreciable waste.

The electrical circuit then continues from articles 51 and 53 to cathode contact bars 55 which are supported on the top of a grid-like arrangement of cross members 57 which, in turn, support the anode units 47 at the intersections of the cross members. The cathode bars 55 are shown in Fig. 1 spaced considerably from the anode units 47 for the sake of clarity. Actually the amount of spacing may be varied, depending upon the size of articles to be plated which are being handled by the rack. This article size is largely determined by the size of the anode units 47. It will be observed that the spacing used in the illustrated size of anode units is quite small (see Fig. 2). The remaining electrical circuit consists of the whole framework of rack 11 which may be made of any suitable conductive material, e. g. steel, and is made up of outer frames 59 and a central cross member 61. These frameworks 59 and 61 are securely fastened to a pair of spaced, upright arms 33 and 63 in any appropriate manner as by welding. Arm 63 completes the negative side of the electrical circuit by means of a hook 65 at the top which rests for support in a bracket 67 which, in turn, is securely fastened to the other end of support member 15. In this instance, bracket 67 need not be insulated from support member 15 since the negative side of the electrical system is grounded. However, to insure proper low resistance for the electrical path, a cable 69 is connected to bracket 67 and carried to negative bus bar 19 in any convenient manner such as that shown in Fig. 1, i. e. through a hole 71 in support member 15. From bus bar 19, the electrical circuit is completed by conventional contact means (not shown) as previously described.

It will be noted that the bracket 67 is located down from the top edge of the support member 15 an appreciable distance, while the bracket 25 is located up flush with the top of the support member 15. The reason for this is to polarize the rack, so to speak, or in other words to avoid the possibility of hanging a rack on the support with its hooks reversed giving the reverse electrical connection from the proper one. In order to carry out this polarization of the rack 11, hook 31 is made correspondingly longer in its vertical extension above the rack than is hook 65, so that, when the rack is in place on the support member 15, it will hang level with the arms 33 and 63 vertical. If an attempt should be made to hang the rack 11 on reversed, one of the hooks 31 or 65 would not mate properly with the corresponding bracket 67 or 25.

In Fig. 2, the details of an anode unit 47 are shown, as well as the details of cathode contact bars 55 and the mechanical joinder of cross members 57 and their relationship to anode unit 47. There is illustrated both a large article 51 to be plated and a small article 53, which in this instance are shown as being internally threaded pipe couplings. The articles 51 and 53 are shown in dashed lines since only one of them would be in place on the plating rack 11 at a time. The illustration of both sizes shows the practical extremes for which the plating rack 11, illustrated in the drawings, is designed.

All exposed metallic elements of the rack 11 except anodes 49 and cathode bars 55 (and a very small part of the anode-supporting structure) are coated with a protective material 73, which may be rubber or any similar inert, non-conducting material. At the intersection of cross members 57, they are joined securely to a circular washer-shaped element 75. This leaves a hole at the center in which is mounted a pin 77 which has a flanged section 79 near the middle thereof and which also has a threaded lower section 81. There is a conductive material cap 83 which has an internally threaded recess 85 adapted to receive the threaded lower section 81 of pin 77 and into which lower section 81 is screwed, in order to secure pin 77 and the other elements of anode unit 47 in place. Pin 77 may be constructed of steel or a similarly rugged material, and carries on its external surface a coating 87 of lead which facilitates the effecting of good electrical contact with anode 49 and is relatively inert to the electrolytic and other chemical operations involved in use of the rack.

The anodes 49 will be composed of whatever metal is being used in the plating process, e. g. zinc, and these anodes are constructed in a conveniently simple shape, i. e. a plain cylindrical form with a hole 89 axially located in the bottom of each. A special benefit of the rack con-

struction shown is that these anodes need no machining but may be cast to shape since hole **89** slides over pin **77** in an easy sliding fit, or even a loose fit. The electrical contact surface which is necessary is largely that on the bottom of each anode where it rests on flange **79** of the anode pin **77**. The pin **77** in each case is secured in place in a manner which keeps it insulated from cathode contact bars **55** and from the framework of the rack **11**. There is a washer **91** of insulating material which fits under the lower side of flange **79**, and a cup-shaped insulating device or collar **93** upon which washer **91** rests, and which, in turn, rests on the top of another washer **94** to provide space between the bottom of the cup-shaped insulating device **93** and the top surface of the circular washer-shaped element **75** which is covered by protective layer **73**. The space thus provided allows the free operation of a number of drain holes **95** so that the cup may be drained of the fluids of each bath when the rack is lifted out. There is an additional insulating material washer **96** located below the circular element **75**, which serves to insulate the cap **83** from the frame of the rack **11** as well as to maintain the lower section **81** of pin **77** centrally located in the hole in circular element **75**. These elements are all securely held and maintained in their relative position by the action of the flange **79** and the lower threaded section 81 of the pin 77 which is screwed into threaded recess 85 of cap **83**. The electrical circuit for the negative side is carried from cross members **57** to cathode contact bars **55** by means of machine screws **97**. The positive electrical circuit is carried via the cap **83** of each unit 47 to the bus bar **45**. The caps **83** are preferably made of brass and may be secured to the bus bar **45** in any convenient manner which will give a secure fastening with good low electrical resistance, e. g. by being brazed as at **99**. The bus bars **45** may be constructed of any good electrical conductor, such as copper.

The cathode contact bars **55** are preferably shaped as illustrated in Fig. 2, having the top surface **100** upon which the pipe couplings or other articles being plated are to rest, sloped downward somewhat toward the anode for a self-centering effect on the article being plated. This same upper surface **100** is knurled to provide better electrical contact to the article as well as to prevent sliding. These contact bars **55** are preferably made of Monel metal or nickel plated brass but may be other satisfactory conductive materials.

Fig. 3 illustrates the anode electrical circuit connection from each bus bar **45** to the cap **83** from one of the vertical bus bars **41**. As mentioned in connection with the framework of rack **11**, exposed metallic portions of the anode electrical circuit also will be coated with some protective material 73 which may be rubber or a similar protective coating. This protective coating **73** will be built around the base of each anode unit **47**, e. g. by covering the cap **83** and the brazing fillet **99** in order to seal the anode connection to the pin **77** as well as its connection with positive bus bar **45**. Such protective coating will preferably in every case be made to be continuous for all metallic parts which are to be immersed in the electroplating solution, with the exception, of course, of the anodes **49** and the cathode bars **55**.

Figs. 4 and 5 illustrate the details of the advantageous construction of brackets **25** and **67**. Since these two brackets are alike, only one will be described. In each case, the body of the bracket has a flange section **101** which has holes **103** drilled therethrough for attaching each bracket to support member **15**. The body section **104** is rectangular in shape and contains a recess **105** extending all the way through from top to bottom which receives the straight extremity (i. e. the downwardly turned end portion) of either hook **31** or **65** of the rack **11**. Recess **105** is shaped so as to correspond to the cross-sectional configuration of the straight vertical extremity of each hook **31** and **65** which in this case is rectangular. By these means, no appreciable horizontal motion of the rack **11** laterally or longitudinally will be possible. There is a wide angle knife edge portion **107** on each bracket which supports the hook **31** or **65** as the case may be and which serves to provide improved electrical contact with each hook since only a relatively small area comes in contact with the hook in each case. It is the mechanical pressure that is increased by this small area contact which, in turn, provides good electrical contact. As shown, the knife edge portion extends along the top of one of the long walls of the recess **105**, so that the hook seats essentially immovably on the knife edge, which thus bears the entire weight supported by the hook.

While we have described one specific embodiment in detail in accordance with applicable statutes, our invention should not be limited by such disclosure which is merely illustrative of the invention.

We claim:

1. Electroplating apparatus, comprising a rack to be immersed in an electroplating solution for carrying hollow cathodic articles to be plated during such immersion and cooperating consumable anodes, a plurality of anode supports on said rack, each anode support comprising a vertically upwardly projecting pin having a laterally projecting flange, a plurality of replaceable anodes, one on each said support, each said anode having an annular bottom surface adapted to rest on said flange in electrical contact therewith and a recess in its bottom surface dimensioned to receive said pin with an easily slidable fit, so that each anode projects freely upwardly from its associated flange and each anode remains on its support and in electrical contact therewith only by the cooperation of said pin and recess and by gravity and as long as the rack is horizontal and is replaceable by lifting it off the support and lowering another in its place, a plurality of supports for hollow articles on said rack, each concentric with one of said anode supports and electrically insulated therefrom, each said hollow article support comprising a plurality of contact bars extending radially with respect to the associated anode support and having upper surfaces cooperating to support in a vertically extending position a hollow cathodic article resting on said upper surfaces by gravity and encircling the anode on the associated anode support, so that the article is laterally unrestrained and is held on its support and in electrical contact therewith solely by gravity and as long as the rack is horizontal, and is replaceable by lifting it off the article support and lowering another in its place, means to connect the contact bars electrically with the negative terminal of a source of direct electrical energy, means to connect the anode supports electrically with the positive terminal of said source, and means to mount said rack on a carrier including means to insure that said rack is horizontal when so mounted.

2. Electroplating apparatus, comprising a rack to be immersed in an electroplating solution for carrying hollow cathodic articles to be plated during such immersion and cooperating consumable anodes, said rack comprising a horizontally extending framework including a grid of cross members extending along lines traversing said framework and intersecting at a plurality of locations, and a plurality of annular members, one encircling each of said locations and attached to the cross members extending along the lines intersecting there, each said annular member providing an aperture at its intersection, said cross members and annular members being in electrical contact, a plurality of cathode contact bars, one on top of and in electrical contact with each said cross member adjacent each said intersection, the contact bars at each intersection cooperating to support in a vertically extending position a hollow cathodic article placed on its end thereon, a plurality of anode supports, one extending vertically through the aperture at each intersection, means electrically insulating each anode support from the grid, each anode support comprising a vertically upwardly projecting pin having a laterally projecting

flange, a plurality of replaceable anodes, one on each said support, each said anode having an annular bottom surface adapted to rest on said flange and a recess in said bottom surface adapted to receive said pin slidably, so that said anode remains on said anode support and in electrical contact therewith solely by gravity and as long as said rack is horizontal, and may be replaced by lifting it off the support and lowering another in its place, and means for supporting said rack and conveying electrical current thereto comprising a pair of upwardly extending posts, one mechanically and electrically attached to one end of said framework, means mechanically connecting the other post to and electrically insulating it from the other end of the framework, means electrically connecting the other post to the lower ends of the anode supports, a support member, means to mount said rack on said support member including means to insure that said rack is horizontal when so mounted, and means to connect said posts electrically to the opposite terminals of a source of direct electrical energy.

3. Electroplating apparatus as defined in claim 2, in which said rack mounting means includes a pair of brackets on said support member at different elevations, means electrically insulating at least one of said brackets from said support member, means to connect said brackets electrically to the opposite terminals of a source of electrical energy, and a pair of hooks on the upper ends of said posts and adapted to engage said brackets, one of said posts being longer than the other by an amount equal to the difference in elevation of said hooks so that said rack is supported horizontally only when the longer of said posts is hooked to the higher bracket, and said rack is thereby connectable to said source with only one predetermined polarity.

4. Electroplating apparatus, comprising a rack to be immersed in an electroplating solution for carrying at least one hollow cathodic article to be plated during such immersion and a cooperating consumable anode, said rack comprising a horizontally extending grid of cross members extending along intersecting lines, but terminating short of the intersection thereof, and an annular member encircling the intersection of said lines and attached to all of the cross members extending along said intersecting lines, said annular member providing an aperture at the intersection, means to connect said cross members electrically to the negative terminal of a source or direct electrical energy, a plurality of cathode contact bars, one on top of and in electrical contact with each said cross member adjacent each said intersection, the contact bars at each intersection cooperating to support in a vertically extending position a hollow cathodic article resting thereon by gravity, so that the article is held on said bars and in electrical contact therewith solely by gravity and is replaceable by lifting it off the contact bars and lowering another in its place, an anode support extending vertically through the aperture at the intersection, means electrically insulating each anode support from the grid and the annular member, said anode support comprising a vertically upwardly projecting pin having a laterally projecting flange, a replaceable anode on said support, said anode having an annular bottom surface adapted to rest on said flange and a recess in said bottom surface adapted to receive said pin slidably, so that said anode remains on said anode support and in electrical contact thereby solely by gravity, and may be replaced by lifting it off the support and lowering another in its place, and means to connect said anode support to the positive terminal of said source.

5. Electroplating apparatus as defined in claim 3, including an electrically insulating collar on said pin below said flange and projecting laterally beyond said flange, said collar being effective to prevent lateral movement of the article into electrical contact with the anode or its support.

6. Electroplating apparatus, comprising a rack to be immersed in an electroplating solution for carrying hollow cathodic articles to be plated during such immersion and cooperating anodes, anode supports mounted on and electrically insulated from said rack, article supports mounted on and electrically connected to said rack, means for supporting said rack comprising a pair of posts extending upwardly from said rack, means mechanically and electrically connecting one of the posts to the rack, means mechanically connecting the other post to and electrically insulating it from the rack, means electrically connecting the other post to the anode supports, a support member, a pair of brackets on said support member at different elevations, means electrically insulating at least one of said brackets from said support member, means to connect said brackets electrically to the opposite terminals of a source of direct electrical energy, and a pair of hooks on the upper ends of said posts and adapted to engage said brackets, one of said posts being longer than the other by an amount equal to the difference in elevation of said brackets so that said rack is supported horizontally only when the longer of said posts is hooked to the higher bracket, and said rack is thereby connectable to said source with only one predetermined polarity.

7. Electroplating apparatus, comprising a rack to be immersed in an electroplating solution for carrying a hollow cathodic article to be plated during such immersion, said rack comprising a horizontally extending grid of intersecting cross members, means defining an aperture in said grid at said intersection, an anode support extending vertically through said aperture, means electrically insulating the anode support from the grid, a replaceable anode mounted on and projecting vertically upward from the anode support, means to connect said cross members electrically to the negative terminal of a source of direct electrical energy, a plurality of cathode contact bars, one on top of and in electrical contact with each said cross member adjacent each said intersection, the contact bars at each intersection cooperating to support in a vertically extending position a hollow cathodic article resting thereon by gravity, so that the article is held on said bars and in electrical contact therewith solely by gravity and is replaceable by lifting it off the contact bars and lowering another in its place, the said contact bars having upper surfaces sloping generally downward toward the intersection and tending to center with respect to the anode a hollow article placed thereon.

8. Electroplating apparatus as defined in claim 7, in which each contact bar extends radially a substantial distance with respect to its associated intersection, so that the contact bars of each intersection may receive for electroplating articles having diameters anywhere within a range of substantial extent.

References Cited in the file of this patent

UNITED STATES PATENTS

349,535	Sohner	Sept. 21, 1886
628,686	Boissier	July 11, 1899
644,029	Cowper-Coles	Feb. 20, 1900
742,131	Pratt	Oct. 20, 1903
825,591	Engelhard	July 10, 1906
1,438,722	Price	Dec. 12, 1922
1,715,411	DiCesare	June 4, 1929
1,872,290	Hitner	Aug. 16, 1932
2,116,929	Harshaw	May 10, 1938
2,323,952	Wick	July 13, 1943
2,363,005	Kalista	Nov. 21, 1944
2,620,296	Wilsdon	Dec. 2, 1952

OTHER REFERENCES

"Belke Plating Rack Manual," June 18, 1947, pages 45, 47, 51, Belke Mfg. Co. 947 N. Cicero Ave., Chicago, Illinois.