June 23, 1959 W. D. MacLEAN 2,891,898

ELECTROPLATING APPARATUS

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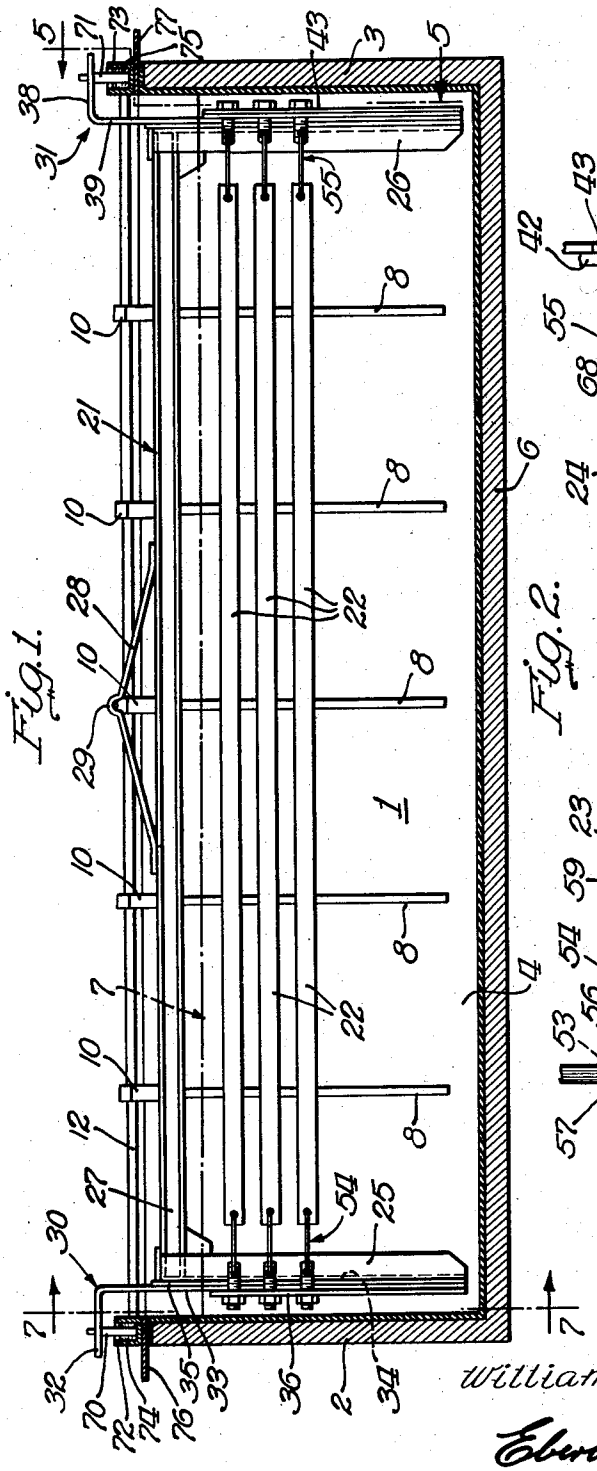


Fig. 1.

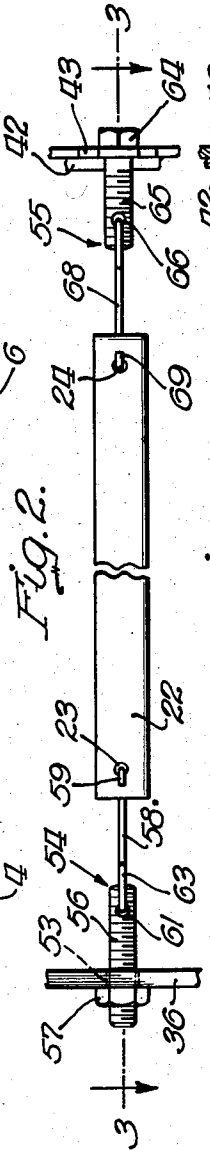


Fig. 2.

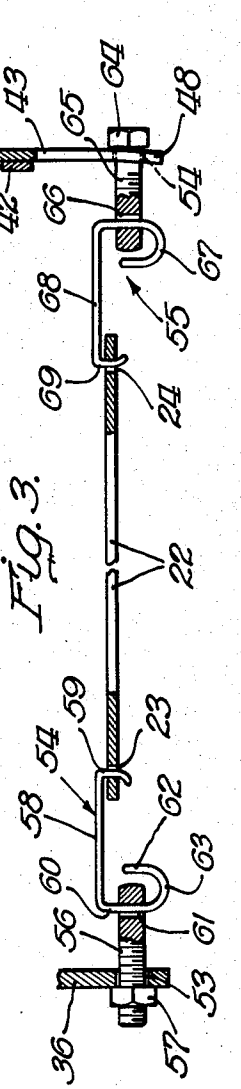


Fig. 3.

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Fig. 4.

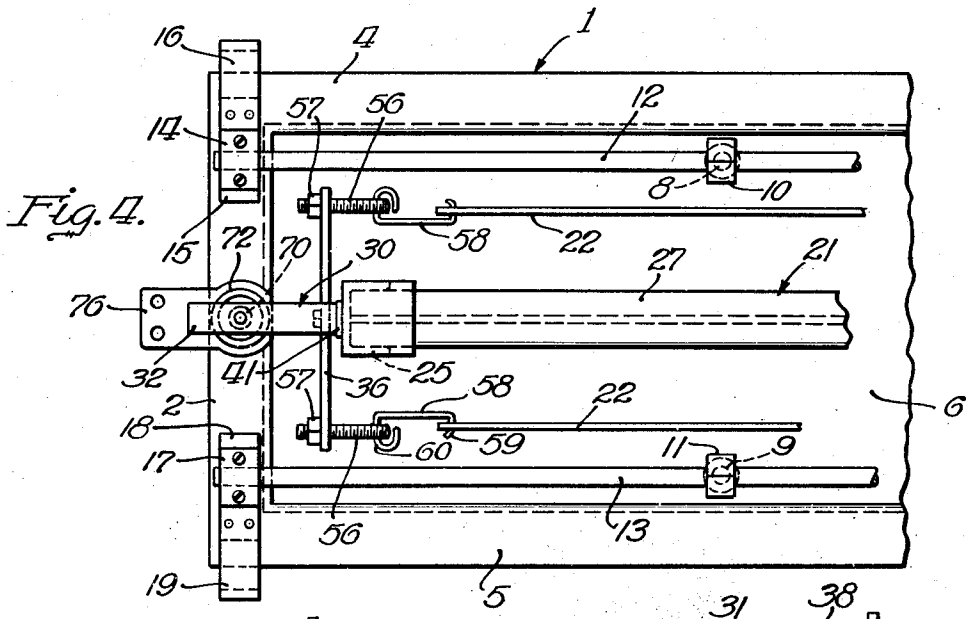


Fig. 5.

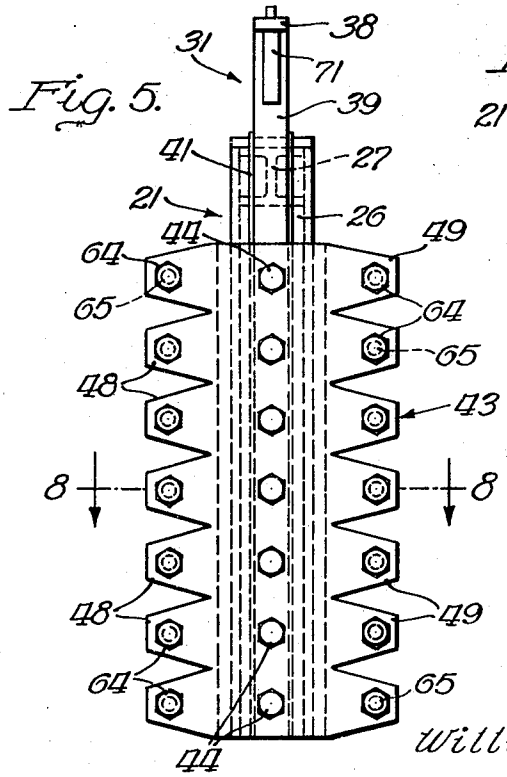
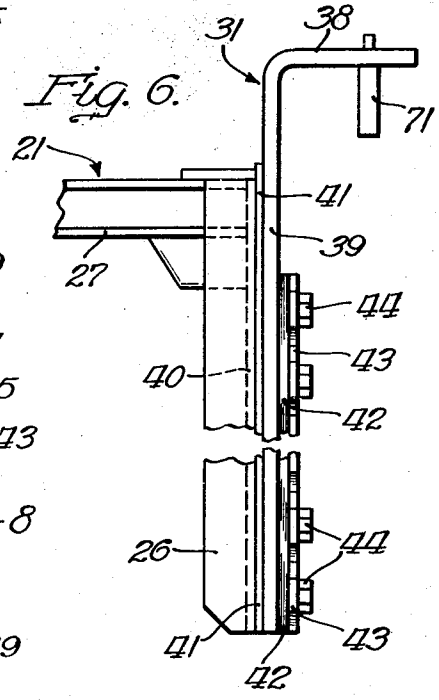


Fig. 6.



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Fig. 7.

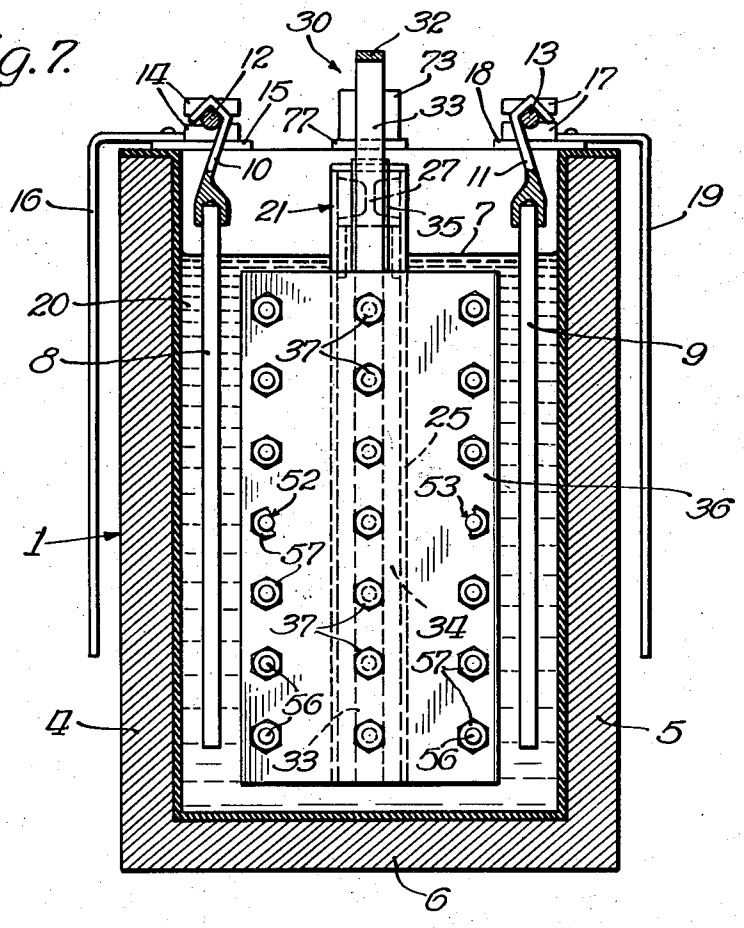
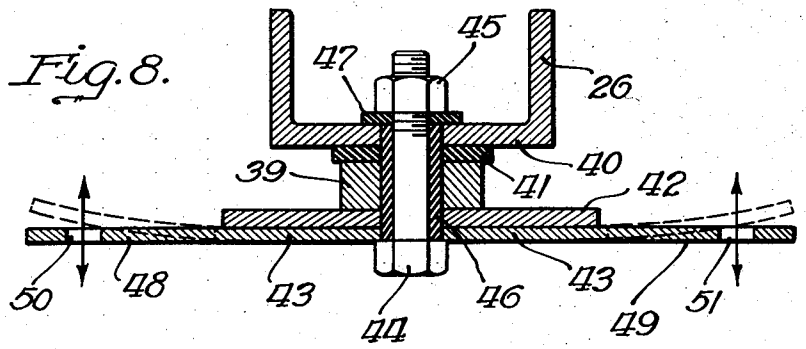


Fig. 8.



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Fig. 9.

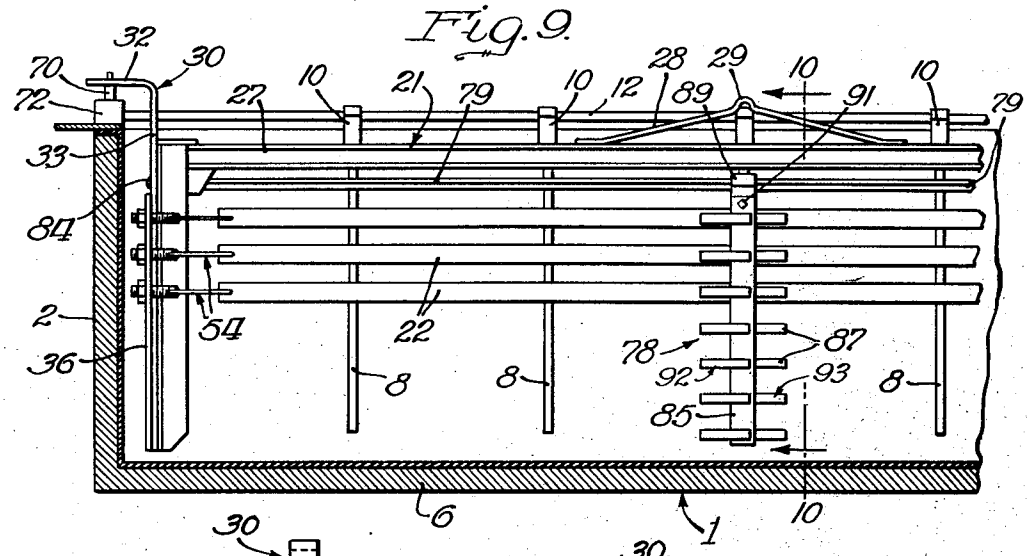


Fig. 10.

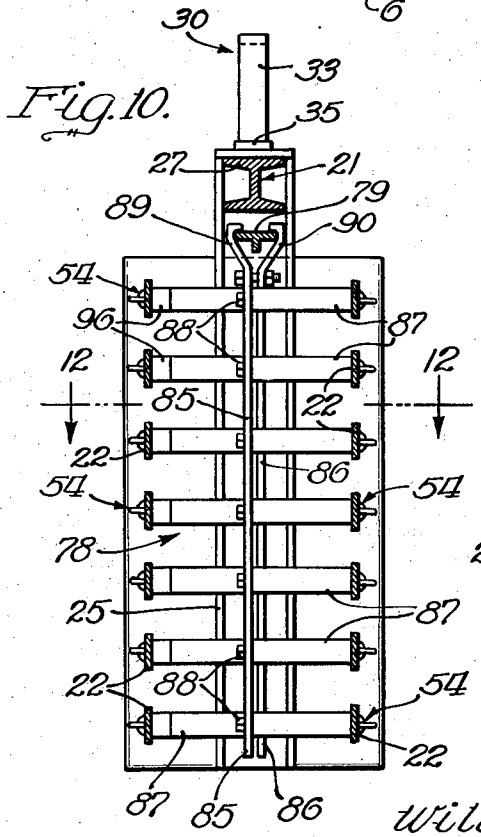


Fig. 11.

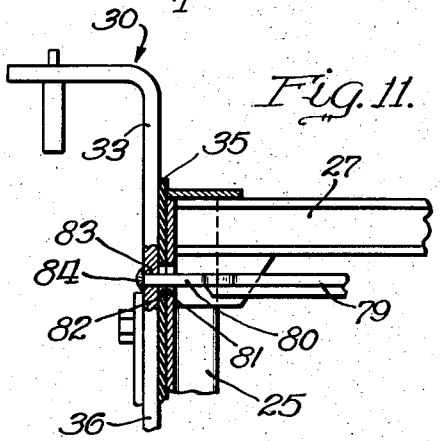
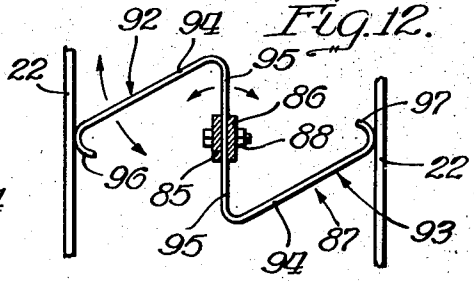


Fig. 12.



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United States Patent Office 2,891,898 Patented June 23, 1959

2,891,898

ELECTROPLATING APPARATUS

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Application October 24, 1955, Serial No. 542,408

7 Claims. (Cl. 204—297)

This invention relates generally to an improvement in electroplating apparatus.

More specifically the invention is directed to a work supporting apparatus consisting of a unitary rack providing a rigid framework that is adapted for the multiple support of a plurality of elongated work pieces to dispose such pieces in a given relation within the electrolyte carried within the confines of a plating tank. This application is a continuation-in-part of my copending application Serial No. 454,411, filed on September 7, 1954, now abandoned, and relating to Electroplating Apparatus.

One of the objects of the invention is to provide a rack having bracket structures for the support of a plurality of elongated work pieces such as bars, rods, molding strips, weather strips and the like, which work pieces together with the rack are designed for quick and convenient entry into the electrolyte in a plating tank and for the equal convenience of rapid bodily removal from the electrolyte carried by such tank.

Another object of the present invention is to provide a rack for handling elongated work pieces, the rack being constructed and arranged to carry current conducting contacts at spaced points thereon that are adapted for direct coaction and electrical union with complementary contacts carried at similarly spaced points upon the plating tank. With this arrangement the rack charged with work pieces may readily be handled as a unit with suitable overhead conveying equipment to bring the rack into registry with the access opening of the tank for entry into or removal from the tank with the coacting contacts forming efficient quick make or quick break means to either establish the current flow or to interrupt the current flow through the work pieces as the case may be for carrying out the plating process.

Another object of the invention is to provide spaced electrical contact mechanisms to carry current to or from the end portions of the elongated work pieces and to further provide at least one intermediate means for contact with central portions of the work pieces to also provide further current carrying stations at such central locations on the work pieces.

Another object of this invention is to provide a rack that includes efficient quick change cooperative work securing units for connecting with and for holding the opposite ends of each work piece, respectively, and for simultaneously providing, by such securing units, good electrical contact for efficient current flow through the work pieces and through the current conducting portions or areas of the rack.

A still further object of the invention is to provide the quick change working securing units with adjustable mechanism to be able to accommodate, within certain limits, different lengths of work pieces for plating purposes.

And still another object of the invention is to provide a work piece supporting rack incorporating yieldable securing mechanisms to permit fast and efficient attachment of the work pieces to the rack and equally efficient

removal of the work pieces per se from the rack after proper adjustments have been made to handle a given assignment of work pieces all of equal lengths all to be plated.

Other objects and advantages relating to the electroplating apparatus of the present invention shall hereinafter appear in the following detailed description having reference to the accompanying drawings forming a part of this specification.

In the drawings:

Figure 1 is a vertical cross sectional view taken longitudinally along a median plane of a plating tank equipped with the electroplating apparatus of the present design and invention;

Figure 2 is a fragmentary side elevational view of one complete adjustable work piece holding arrangement carried by the rack and illustrating the quick change elements employed for supporting a work piece;

Figure 3 is a horizontal sectional view of the structure illustrated in Figure 2 and substantially as seen along the plane of the line 3—3 in Figure 2, certain parts being shown in elevation for clarification of constructional details.

Figure 4 is a fragmentary plan view of one end portion of the plating tank;

Figure 5 is a broadside face view of one of the work holding units of the plating rack as such unit appears when viewed along the line 5—5 in Figure 1;

Figure 6 is a side elevational view of a portion of the rack shown in Figure 5, but omitting the work holding units and work pieces;

Figure 7 is a vertical cross sectional view taken transversely of the plating tank and substantially along the plane of the line 7—7 shown in Figure 1;

Figure 8 is an enlarged horizontal cross sectional view of the rack unit illustrated in Figure 5 and as viewed substantially along the plane of the line 8—8 illustrated in Figure 5.

Figure 9 is a vertical cross sectional view through a fragmentary portion of a plating tank illustrating a modified rack construction providing a center contact mechanism for work piece engagement;

Figure 10 is a vertical cross sectional view of the center contact mechanism of the work piece rack as seen along the line 10—10 in Figure 9 to illustrate certain details of construction thereof;

Figure 11 is a side elevational view of a portion of the plating rack of Figure 9 shown on an enlarged scale and with parts thereof broken away and in section; and

Figure 12 is a plan sectional view of a portion of the plating rack center contact mechanism as viewed along the plane of the line 12—12 in Figure 10.

The structure in Figures 1, 4 and 7 generally illustrates an appropriately lined plating tank 1 having end walls 2 and 3 and side walls 4 and 5 all disposed in upright relation to the bottom 6. The tank carries an appropriate electrolyte to a selected depth such as generally indicated by the dot and dash line 7 in Figure 1 and by the fluid level of the electrolyte in Figure 7.

Suitable anodes 8 and 9 are carried on individual hook hangers 10 and 11, respectively, with hangers releasably engaged over and hanging from a rod 12, while the other hangers 11 are releasably engaged over and hanging from a rod 13. The ends of rod 12 are electrically and physically secured between clamp blocks 14 mounted upon bed plates 15 secured to the rim portions of the walls 2 and 3 of the tank 1; and a bus bar 16 is connected with each plate 15. Similarly, rod 13 is clamped by blocks 17 on plates 18 and a bus bar such as 19 is connected with each plate 18.

Thus current suitably supplied to the bus bars 16 and 19 is conducted to energize the anodes 8 and 9 for induc-

tion into the electrolyte 20 in tank 1 and through the bath onto the work pieces submerged in such electrolytic bath or solution.

The rack 21 of the invention is constructed and arranged to provide a rigid framework for the support of a plurality of work pieces 22 several of which are shown in Figure 1 consisting of elongated strips or bars, each being provided with apertures 23 and 24 located near their ends. It has been a problem to handle strip, bar or molding stocks of this character efficiently and under commercial plating production standards that bring the cost of plating such items down to acceptable ranges. The rack 21 and its associated and assembled parts furnishes a practical and efficient solution and a means to plate long bar, rod or strip stock commercially at relatively low cost.

The rack 21 comprises a main framework having bracket structures in the form of vertical channels 25 and 26 secured and suitably braced to the opposite ends of an I-beam 27 that is provided with a centrally fastened lifting bracket 28 that has a hook clevis 29 adapted for receiving a hook or other connectible unit from an overhead crane or conveying apparatus to transport and handle the rack 21. A pair of rack hangers 30 and 31 are arranged for connection with each bracket or channel end of the rack 21 and together these hangers provide spaced carriers or supports for the entire rack structure.

Hanger 30 has horizontal and vertical legs 32 and 33, with one side of the latter leg 33 flanking the web portion 34 of channel 25, but spaced from the channel by an interposed separator or spacer 35 of insulating material. A rigid work holding plate 36 is positioned to flank the opposite face or side of the hanger leg 33 as best shown in Figures 1 and 7. A plurality of bolt and nut fastenings 37 are used to secure together the plate 36, channel 25 with the insulating separator 35 and the leg 33 of the hanger 30. The bolt and nut fastenings 37 are all constructed with insulating sleeves and washers to insulate or isolate the rack framework electrically from plate 36 and from the work pieces 22 connected with the plate as will be more fully described.

Hanger 31 is made to provide a horizontal leg 38 and a depending leg 39 with the latter having one side flanking the web portion 40 of channel 26, but being spaced therefrom by an interposed separator or spacer 41 constructed of insulating material. The other side of the leg 39 is arranged to flank a pair of coacting spring plates 42 and 43 which together form flexible work holding or tensioning means.

A plurality of bolts 44 and nuts 45 are used to fasten the associated parts of the hanger 31 together as best illustrated in Figures 5 and 8, such parts all being provided with appropriate openings to receive the bolts. In addition, each bolt carries an insulating sleeve 46 and an insulating washer 47 which cooperate with the insulating strip spacer 41 to isolate the channel 26 and associated rack framework electrically from the resilient work holding spring plates 42 and 43. This same described construction is used with the bolt and nut fastenings 37 to prevent electric current flow into the rack from plate 36.

The work pieces 22 are all strung between plates 37 and 43 in two vertically arranged groups spaced laterally to either side of the median plane of the rack 21. As described previously, plate 36 is rigid in construction while plate 43 is of spring material, but lighter in weight than the coacting stiffer spring backing plate 42.

As best shown in Figure 5, plate 43 is further constructed with rows of lateral fingers 48 and 49 having openings 50 and 51 as shown in Figure 8. These rows of openings and their individual locations are aligned with similarly arranged rows of openings 52 and 53 in plate 36 as shown in Figure 7.

Work holding mechanisms 54 and 55 shown generally in Figures 1, 2 and 3 are substantially similar in construction except that the mechanisms 54 are endwise adjustable while the mechanisms 55 are not. Obviously, both

mechanisms may be made adjustable, if desired, or they may both be of the construction of the mechanisms 55 if conditions of operation so warrant.

The units 54 in Figures 1, 2 and 3 each comprises a threaded stud 56, a nut 57, and a resilient wire clip or connector 58. The wire clip 58 has a straight shank with a short hook 59 and a larger hook 60 at the terminal ends thereof, hook 59 being used for attachment through aperture 23 of a work piece 22, while hook 60 is connected with and pivotally carried in opening 61 of the stud 56. The wire clip is normally carried by the stud and also provides stop means to prevent the stud from dropping out of opening 53 in plate 36. It should be noted that hook 60 includes a reentrant tip 62 contiguous with the curved portion 63 and that the radius of the curvature of portion 63 is such that the attachment of hook 60 with stud 56 is forcefully accomplished to keep the wire clip 58 on the stud and removal or replacement of the clip is an easy task. As another feature, the clip parts 62 and 63 form convenient finger grip means to help the tank operator in charging the rack with work pieces or removing the pieces. The hook 59 can be readily positioned as needed to engage into an aperture 23 of a work piece by manipulation of the hook portion 63 to pivot the clip in opening 61 in stud 56. The work pieces are usually assembled into the rack or taken therefrom by two attendants, one at each end of the rack, due to the lengths of the work pieces which may range 12 to 14 feet in length by way of example.

The units 54 are each endwise adjustable by manipulation of the nut 57 to various selected positions along the length of the stud 56 to place the opening 61 at different distances longitudinally in relation to the adjacent face of the rack plate 36. At the same time the tension transmitted into the clip 58 can be so adjusted as to obtain good electrical engagement between both hooks 59 and 60 with the attached work piece 22 and stud 56, respectively. Thus the adjustable work holding mechanisms 54 perform the dual functions of accommodating different lengths of work pieces and also of obtaining good physical electrical contact with the respective work pieces for efficient electrodeposition of the electrolyte metal component upon such work pieces.

The work holding units 55 are quite similar to units 54, but are shown, by way of example, as being of fixed length. Each unit 55 comprises a bolt 64 carried in an opening 50 or 51 in plate 43 with the bolt head abutting plate 43 and with the threaded shank 65 extending toward one of the work pieces. Shank 65 has an opening 66 to receive the hook 67 of the resilient clip 68, and the clip provides a short hook 69 for entry into aperture 24 in a work piece. Although the bolt of unit 55 is not adjustable, spacing washers may be inserted, if desired, between the base of the bolt head and the adjacent surface of resilient plate 43 to obtain endwise adjustment of this type of work holding unit. Clips 58 and 68 are of interchangeable design and both assemblies of the units 54 and 55 furnish efficient easily handled mechanisms for attachment or removal of the individual work pieces 22. The complete assemblies 54 and 55 are also interchangeable and adapted for use at either end of the rack if so desired.

The rack 21 as previously explained is for the greater part electrically inert and it is only the end portions consisting of the hangers 30 and 31 with the supported plates 36 and 43 that form part of the cathodic circuit in conjunction with the work pieces and the work holding units 54 and 55.

The cathodic circuit to the exterior of the plating tank 1 is established through readily separable coacting contacts 70 and 71 that provide the electrical connectors coacting with cups 72 and 73 by which bodily removal of the rack from the tank or insertion of the rack into the tank is practically accomplished with a quick make or quick break of the cathode circuit. Each contact 70

and 71 is a copper pole vertically arranged and connected with legs 32 and 38 of hangers 30 and 31 to provide stilt supports for the hangers of rack 21. Each cup 72 and 73 is of copper construction and the cups carry a quantity of concentrated sulphuric acid 74 and 75, the construction of the poles and cups together with the fluid being more specifically shown and described in my copending application Serial No. 542,407, filed of even date herewith and directed to these electrical plating tank connectors.

The poles sit within the cups and each cup is secured to the tank rim of walls 2 and 3 in any suitable fashion and include electrically efficient terminal plates 76 and 77, respectively, to receive external cables or bus bars to complete the cathodic circuit in complementary relation to the tank charging bus bars 16 and 19 that introduce the anodic energizing current into the electrolytic bath of the tank 1.

The effective surface plating area of the rack is held to a minimum by the insulating members, and in addition the greater portions of the exposed surface areas of the live parts such as the plates 36 and 43 are covered with suitable nonconducting material to reduce unnecessary electrodeposition of the metal of the salt out of the solution in the plating tank and onto rack parts. The areas of the plate structures at the fastening or attaching zones of the work holding units are kept clear of insulating shielding materials for good contact. Portions of the hangers 30 and 31 may also be covered for the same purposes noted.

Referring now to Figures 9 to 12, the modified arrangement here illustrated generally comprises the same tank and rack units as indicated by like reference numerals, but a central contact mechanism 78 has been embodied into the construction to cut down the length of the cathodic current flow through the work pieces 22 thus providing better plating efficiency and results.

This construction includes a current carrying or conducting bus bar such as 79 having reduced end portions such as 80 that pass through appropriate openings 81 and 82 in the web of the channel 25 and insulator 35, respectively, to snugly rest or seat in an aperture 83 in the legs of the hangers 30 and 31, only hanger 30 being shown in the drawings. Solder 84 or other fastening means may be used to anchor the ends of the bus bar 79 to the rack.

Contact mechanism 78 is constructed from two coacting metal straps 85 and 86 carrying a plurality of double ended spring contacts 87 through bolt means 88. The upper terminal ends of the straps are formed as coacting hook clamps 89 and 90 that may be drawn together by a bolt unit 91 to secure the mechanism in any appropriate position along the length of the bus bar 79 in the length of the tank and in relation to the elongated work pieces 22.

Spring contacts 87 are provided with two spring blades 92 and 93 each having dual connected flexing sections 94 and 95 that are supplemented by the resilient curved fingers 96 and 97 that engage the work pieces as best shown in Figure 12.

Since the work pieces 22 are normally tensioned by the pairs of work holding mechanisms 54 and 55, the spring blades 92 and 93 establish good electrical contact with the work pieces at the intermediate portions thereof. Conceivably, the work pieces can bow outwardly slightly at the contact mechanism 78 location to arrive at a balance of pressure between the work pieces and contact fingers. This will also depend upon and be controlled by the relative resiliency between the parts, but in all cases, the contact is efficient and well made under all normal conditions of operation and use. At the same time the work pieces can be assembled on the holding mechanisms 54 and 55 as in the first construction described and the central contacts are automatically established with the fingers of the contact mechanism 78.

The shapes of the contact fingers can be varied to accommodate different kinds of work pieces and to keep contact areas at a minimum when necessary or desired. However, with the addition of the center contact mechanism 78 the overall cathodic current efficiency of the tank work is enhanced considerably. This is especially true for exceedingly long work pieces.

The foregoing description and disclosure has been directed to a preferred construction of plating tank apparatus comprising the mechanisms of the present invention. Changes are contemplated in the individual associated elements and in the combinations of the elements as set forth. Such modifications shall, however, be governed by the breadth and scope of the language of the following claimed subject matter as directed to the fundamental concept of this invention.

What I claim is:

1. In an electroplating apparatus, a tank, a rack to carry a plurality of work pieces in said tank comprising a rigid structure having an overhead carrier frame, depending frame ends to suspend work pieces therebetween, hangers for said frame ends having opposite outward overhanging ends supported upon opposite rim portions of said tank, parallel plates on said frame ends, and securing mechanisms carried by said plates for attachment to fixed points on opposite ends of the work pieces respectively, said securing mechanisms being of predetermined lengths, one of said plates being rigid and the other of said plates being resilient and adapted to flex in a direction to accommodate attachment of said securing mechanisms to said work pieces and to provide a given intimate contact between the connected members for efficient electrical current conduction through said members.

2. In an electroplating apparatus of the character defined in claim 1, and wherein said resilient plate is provided with individual flexing fingers for connection with each of said securing mechanisms, respectively, to increase the flexing range of the plate toward and away from each adjacent work piece end location.

3. In an electroplating apparatus, a tank, a rack to carry a plurality of work pieces in said tank comprising a rigid structure having an overhead carrier frame, depending frame ends to suspend work pieces therebetween, hangers for said frame ends having opposite outward overhanging ends supported upon opposite rim portions of said tank, parallel plates on said frame ends, and securing mechanisms carried by said plates for attachment to fixed points on opposite ends of the work pieces respectively, said securing mechanisms being of predetermined lengths, one of said plates being rigid and the other of said plates being resilient and adapted to flex in a direction to accommodate attachment of said securing mechanisms to said work pieces and to provide a given intimate contact between the connected members for efficient electrical current conduction through said members, said resilient plate having individual flexing fingers for connection with each of said securing mechanisms, respectively, to increase the flexing range of the plate toward and away from each adjacent work piece end location, and a flex control spring plate providing a backing unit for cooperation with said resilient plate to centralize the resilient action in line with the work pieces and to supplement the tension imparted to the work pieces by said flexible plate.

4. In an electroplating apparatus, a tank, a rack to carry a plurality of work pieces in said tank comprising a rigid structure having an overhead carrier frame, depending frame ends to suspend work pieces therebetween, hangers for said frame ends having opposite outward overhanging ends supported upon opposite rim portions of said tank, parallel plates on said frame ends, and securing mechanisms carried by said plates for attachment to fixed points on opposite ends of the work pieces respectively, said securing mechanisms being of

predetermined lengths, one of said plates being rigid and the other of said plates being resilient and adapted to flex in a direction to accommodate attachment of said securing mechanisms to said work pieces and to provide a given intimate contact between the connected members for efficient electrical current conduction through said members, some of said securing mechanisms having adjustable means to vary the position of attachment of said mechanisms in respect to a connected work piece having a different length.

5. In an electroplating apparatus, a tank, a rack to carry a plurality of work pieces in said tank comprising a rigid structure having an overhead carrier frame, depending frame ends to suspend work pieces therebetween, hangers for said frame ends having opposite outward overhanging ends supported upon opposite rim portions of said tank, parallel plates on said frame ends, and securing mechanisms carried by said plates for attachment to fixed points on opposite ends of the work pieces respectively, said securing mechanisms being of predetermined lengths, one of said plates being rigid and the other of said plates being resilient and adapted to flex in a direction to accommodate attachment of said securing mechanisms to said work pieces and to provide a given intimate contact between the connected members for efficient electrical current conduction through said members, some of said securing mechanisms having adjustable means to vary the position of attachment of said mechanisms in respect to a connected work piece having a different length, said securing mechanisms each being provided with resilient clips adapted for connection with the work pieces.

6. A plating rack to carry a plurality of elongated work pieces in a plating tank solution, said rack comprising a frame having spaced current conducting supports thereon, securing means carried by said supports respectively and adapted for releasable connection with opposite end portions of said work pieces, said securing means being provided with adjustable tensioning means to suspend the work pieces in predetermined unflexed positions between said frame supports, and an auxiliary current conducting unit releasably secured to said frame to depend in fixed relation from said frame in a position to flank said work pieces, and resilient members on said unit arranged in laterally outwardly disposed relation with respect to said unit to surface abut said work pieces at points intermediate the lengths of the tensioned work pieces respectively.

7. In an electroplating apparatus, an electrolyte solution tank, and a rack to support a plurality of work pieces in operative submerged condition within said tank solution comprising a frame supported upon said tank, spaced work piece carrying brackets depending from said frame to provide current conducting means for said work pieces, and work piece holding mechanisms on said brackets to releasably secure said work pieces in given relations within said tank and between said brackets, and an independent current conducting unit carried in suspended relation by said frame partially in the path of said work pieces to provide abutting surface contact with intermediate portions of the work pieces supported between said orientation brackets, said current conducting unit including fastening means to rigidly suspend said unit from said frame adjacent said work pieces in the tank solution, and said unit being provided with resilient fingers to bodily engage said intermediate portions of said individual work pieces.

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