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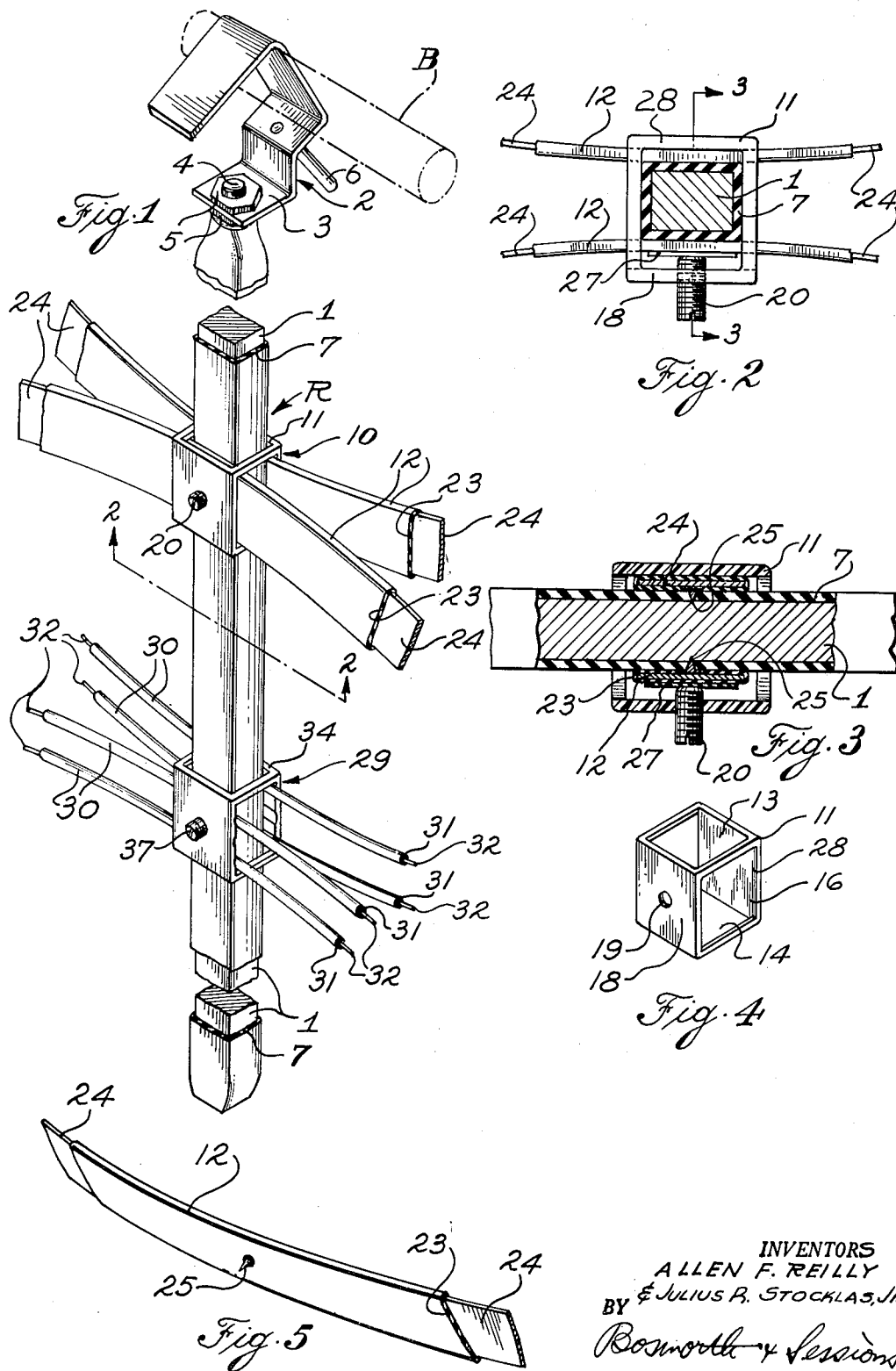
A. F. REILLY ET AL

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PLATING RACK.

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2 Sheets-Sheet 1



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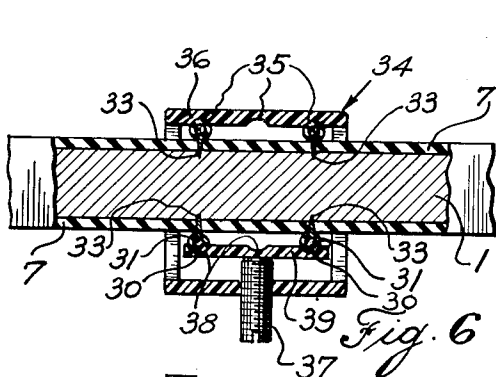
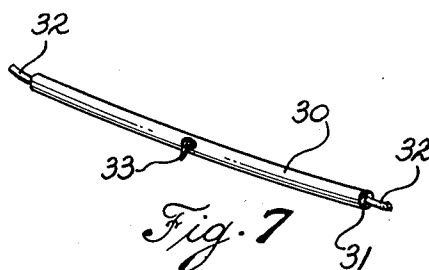
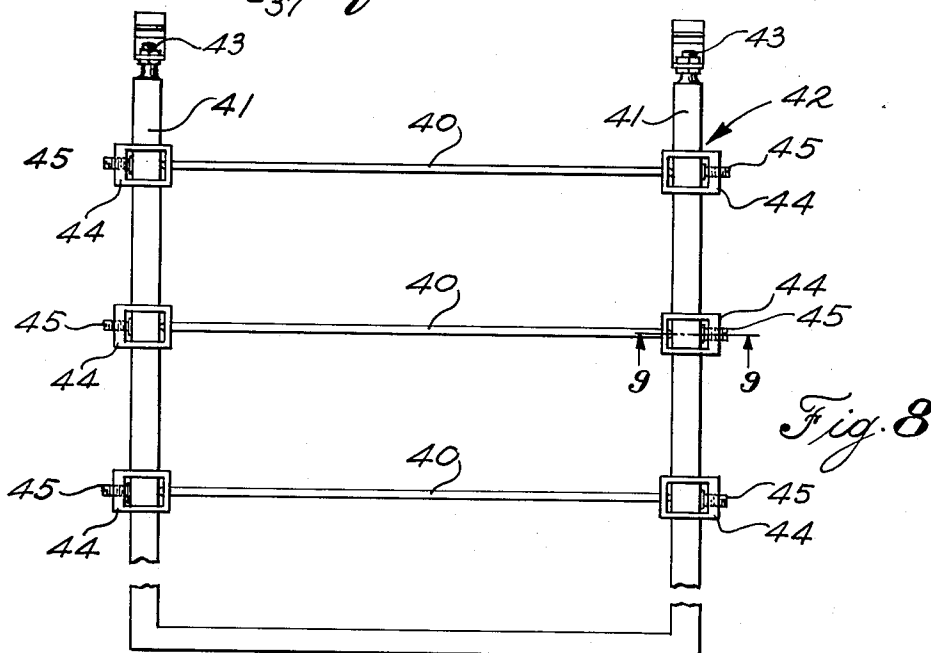
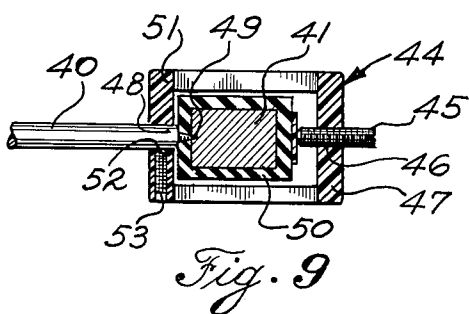
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PLATING RACK

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2 Sheets-Sheet 2



INVENTORS
ALLEN F. REILLY
& JULIUS R. STOCKLAS, JR.
BY

Rosworth & Sessions
ATTORNEYS

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2,734,859

PLATING RACK

Allen F. Reilly, Maple Heights, and Julius R. Stoklas, Jr.,
Cleveland, Ohio, assignors to Keco Plating Co., Cleve-
land, Ohio, a corporation of Ohio

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This invention relates to plating apparatus and in particular to current conducting plating racks on which relatively small articles to be plated are supported in a plating solution.

Plating racks with which our invention is concerned constitute the cathode element of the electroplating system and generally are provided with a plurality of support assemblies or holders spaced at various intervals throughout the length of the body of the rack, each support assembly being designated to support one or more articles to be plated. These assemblies generally have current conducting arms or fingers which project outwardly from the body of the rack, the articles to be plated being supported on and making electrical contact with the outer ends of these arms. These projecting arms are vulnerable to damage and breakage since the racks are frequently removed from and placed in position in the plating tanks and the chance of deleterious contact of these parts with the sides of the tank or other object is thus frequently present.

The problem of providing a holder or support assembly which may be quickly, effectively and economically repaired in event of such damage is one of the problems which our invention solves. In addition the practice of our invention permits a single plating rack to be readily adapted for use in supporting a large variety of numbers and sizes of articles to be plated by effectively facilitating adjustment of the longitudinal position of the individual article supporting assemblies.

It is among the objects of our invention to provide an improved article supporting assembly which is mechanically and electrically detachably connectable to the conducting body of a plating rack. A more specific object of our invention is to provide an individual article supporting assembly for a plating rack which may be electrically connected to and disconnected from the current conducting body of a plating rack without damaging or otherwise deleteriously affecting the protective insulation of the various parts of the plating rack.

Another object of our invention is to provide an improved article supporting assembly which may be successively moved longitudinally to several selected positions on and in electrical contact with the current conducting insulated body of the plating rack. A further and more specific object is to provide a holder member which will accommodate different types of work holding arms thereby permitting many different sizes and shapes of objects to be supported thereby. Another object is to provide a plating rack whose parts may be quickly, conveniently and effectively assembled and disassembled for repair or replacement thereby making more efficient and economical use of the equipment by reducing to a minimum the time it is idle and out of service. Another object is to provide plating apparatus that is sturdy in construction and economical to manufacture.

These and other objects of my invention will become apparent from the following description of preferred embodiments thereof, reference being had to the accompanying ing drawings.

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Figure 1 is a perspective view of a plating rack which embodies our invention.

Figure 2 is a horizontal section through the plating rack, the section being taken on the line 2—2 of Figure 1.

Figure 3 is a longitudinal section taken on the line 3—3 of Figure 2.

Figure 4 is a perspective view of the holder member which forms a part of our invention.

Figure 5 is a perspective view of one of the article supporting arms which forms a part of our invention.

Figure 6 is a longitudinal section similar to Figure 3 and showing the details of construction of a modified form of our invention.

Figure 7 is a perspective view of one of the article support arms which constitutes a part of the modified form of our invention shown in Figure 6.

Figure 8 is a side elevation of another modified form of our invention.

Figure 9 is a transverse section taken on the line 9—9 of Figure 8.

Our invention generally is concerned with improvements in the construction of a plating rack R, see Figure 1, which comprises an elongated rack body member or bar 1 to one end of which is connected a hook indicated generally at 2 to provide a means for suspending the rack in a plating solution. The rack bar 1 preferably is substantially rectangular in cross-section and preferably is made of copper and is adapted to be hung by the hook 2 over and in electrical contact with a main bus bar B shown in dotted lines in Figure 1 which extends around the top of the plating tank in which the rack R is adapted to be immersed. The hook 2 preferably is removably connected to the end of the bar 1 to facilitate assembly and removal of the holder members 10, described below, over the top end of the bar. The bottom leg 3 of the hook has an aperture which fits over the upper threaded end 4 of the bar and is secured thereto by nuts 5. A handle 6 is secured to the hook to facilitate handling of the rack bar. The angular position of the hook around the longitudinal axis of the rack bar also may be adjusted as desired in order to orientate the position of the rack in the plating tank. The major portion of the rack bar 1 is adapted to be immersed in the electroplating bath and accordingly is covered with a protective film or layer of a suitable acid-resistant insulating material 7 such as a rubber-like composition or a synthetic resin, to protect the rack bar from corrosion by the plating solution as well as to prevent wasteful deposit of plating metal on the bar.

In order to support one or a plurality of articles in plating position on the rack R, a plurality of article supporting assemblies 10 preferably are detachably connected to and spaced at desired intervals along the insulated portion of the rack bar 1. Each supporting assembly 10 comprises a holder member 11, see Figure 4, and elongated article supporting elements or arms 12, see Figure 5, which extend transversely of the longitudinal axis of rack bar 1 and which are supported by holder member 11 in juxtaposition with opposite sides of the rack bar as shown in the drawings.

The holder member 11 preferably is a hollow substantially cubical piece which extends completely around the periphery of the bar 1 and has opposed openings 13, 14 through which the rack bar extends and side openings 15, 16 through which the work supporting arms 12 are disposed to extend. The openings 13 and 14 are substantially larger than the cross-sectional area of the insulated rack bar 1, see Figure 2, and hence the holder member 11 initially fits loosely on the rack bar so that the arms 12 may be easily inserted in the holder during assembly of these parts. In order to secure the arms 12 in a selected position the body of the rack bar, one of the sides 18 of the holder member 11 preferably is

formed with a tapped hole 19 into which a set screw 20 is threaded which when tightened down or threaded inwardly toward the rack bar acts to apply a constraining inwardly directed pressure between the holder member and the article supporting arms so as to force these arms tightly against the periphery of the rack bar.

It will be noted that the holder member 11 is essentially an adjustable pressure band or clamp which is adapted to tightly hold or press the article support arms 12 in position against the protective layer of insulation on the rack bar. As will appear more fully below, the holder member is electrically independent of the electroplating circuit, that is, no current passes through the holder member during the plating operation. Hence, the holder member may be made of any electrically non-conducting corrosion resistant material, such as, hard rubber or rubber-like compositions, synthetic resins, ceramics or ceramic based substances and glass. The set screw 20 also may be made of similar non-corrosive material and hence the entire holder member is substantially free of the corrosive effects of the plating solution and is capable of being used continuously practically indefinitely without deterioration.

The arms 12 preferably are substantially identical in shape and size and comprise elongated preferably flat strips of conducting metal such as copper to which a protective coating 23 of rubber or rubber-like insulating material has been applied to prevent corrosion thereof and limit the deposit of plating metal thereon. However, the ends of 24 of each supporting arm are exposed, that is, uncoated, so that the particular articles to be plated and supported on these ends 24 will also make electrical contact with the arms. The width of each arm 12 is substantially the same as or slightly less than the width of openings 15, 16 in holder member 11 and thus there is substantial area of contact between each arm and adjacent parts of rack bar 1 and holder member 11. With such a construction high unit stresses in the parts subjected to the clamping pressure are avoided. We prefer that each supporting arm 12 be bent or bowed slightly in the direction of its length as shown in Figure 2 so that the arms when assembled in pairs with the holder member 11 for supporting small band-like articles between them will diverge slightly from each other remote from the body of the rack. This provides a mutual spring action in the arms when their ends are pressed toward each other so that when the band-like article or articles to be plated are placed around adjacent ends of arms 12, the arms tend to spring outwardly into tight engagement and thus into good electrical contact with the article or articles.

Electrical contact between each of the article supporting arms 12 and the metallic body of the rack bar 1 preferably is made by a small needle-like contact part or pin 25, see Figures 3 and 5, which projects from the central part of each arm 12 and is adapted to penetrate the insulating covering 7 on the bar and make a metal to metal contact with the bar 1. Each contact pin 25 preferably is secured as by soldering as shown, or riveting to the metallic body of the arm 12 before the insulation 23 is applied to the arm and projects a sufficient distance outwardly from the arm surface to extend through the combined thicknesses of the insulating coatings 23 and 7 on the arm 12 and the bar 1, respectively when assembled in the working position on the rack.

The article supporting arms 12 when assembled with the holder member 11 for supporting objects to be plated are disposed within the holder member 11 exteriorly of the opposite sides of the insulated bar 1 so that the central portion of each arm is adapted to lie flush against the insulated side of the bar 1. Each arm 12 when so assembled in the holder member 11 is arranged so that its contact pin 25 faces or extends inwardly toward and preferably initially slightly into the insulation 3 on the bar prior to tightening of the set screw 20. When the

set screw 20 is tightened down in the holder member, the inner end of the set screw bears against the outer surface of the adjacent arm 12 preferably at a point in alignment with the contact pin 25 thereon. Continued tightening of screw 20 causes an inward pressure on the arm so that the arm is forced tightly against the insulation 7 on the bar 1 which in turn causes the contact pin 25 on arm 12 to penetrate the insulation 7 and ultimately make electrical contact with the metallic body of the bar 1. In order to prevent possible damage to the insulation 23 on the arm 12 adjacent the inner end of set screw 20 as a result of the turning action of the screw, a suitable non-corrosive pressure plate 27 preferably is placed between the end of the screw 20 and the rack bar 1.

When the set screw 20 is tightened down in the tapped hole 19 in side 18 of holder member 11, the opposite side 28 of the member 11 also presses the adjacent arm 12 with equal force into tight engagement with the opposite side of the insulated bar 1 similarly causing its contact pin 25 to pierce the insulation 7 on the adjacent side of the rack bar and make electrical contact with the metallic body of the bar. When the article supporting arms 12 have been thus tightly pressed against the insulated body of the bar 1, an electrical path through the rack is established so that current may successively pass through the plating solution, the article being plated, the arms 12 and through the contact pins 25 on the arms 12 to the rack bar 1 and finally to the main bus bar B on which the rack is suspended.

Although we have chosen to illustrate and describe each article supporting assembly as including two arms 12 disposed on opposite sides of the bar 1, it will be understood that the apparatus will operate effectively with but one arm 12 disposed in the holder member if and when such an arrangement is desired. This flexibility of our apparatus to accommodate one or two arms results from the fact that each arm is independent of the other, both electrically and in the manner in which each is supported, and also that each arm is electrically independent of the holder member.

One of the important advantages of our invention is the economical replacement of damaged or broken parts that it affords. The type of damage that occurs most frequently is the breakage of the article supporting arms 12 since these parts project outwardly from the body of the rack bar. In event one or more of these arms are broken, replacement may be quickly and conveniently effected. Set screw 20 is loosened sufficiently to permit withdrawal of the contact pin 25 and ultimate removal of the damaged arm, a new arm is assembled with the holder in the manner described above, and set screw 20 is again tightened to mechanically and electrically secure the arms to the rack bar 1. This replacement operation is quick and convenient and insures that, in event of such damage, the time which the entire rack will be out of service will be reduced to a minimum. The arms 12 are identical in construction and also are relatively inexpensive to fabricate, all of which further contributes to the economy of construction and maintenance of the rack.

The construction of our plating rack has the advantage of convenient and quick adjustability of the position of each article supporting assembly 10 longitudinally on the rack bar 1. In event it is desired to shift or adjust the position of one or more of the article supporting assemblies on the rack bar 1, set screw 20 is loosened sufficiently to permit the tip of the contact pin 25 on each arm 12 to clear the insulation on the rack bar, the assembly is shifted longitudinally, and the set screw again tightened. The contact pins 25, since they are needle-like and relatively small in thickness or diameter, will make correspondingly small openings in the insulation which when the contact pins are withdrawn tend to close by the normal self-sealing action of the insulation. Thus adjustment of these article support assemblies may be effected without

any substantial deleterious impairment of the rack bar insulation. If, however, it is desired, the punctures in the insulation may be dabbed with a suitable sealing compound. Each contact pin 25 projects through and is completely surrounded at its base by the insulation 23 on the arm 12. When each arm 12 is pressed tightly against the insulated body of the rack bar 1, that is, when set screw 20 is tightened down in the holder member against the arm, each contact pin 25 moves inwardly with its arm 12 and penetrates rack bar insulation 7 until the portion of insulation 23 at the base of the pin 25 tightly abuts against insulation 7 on rack bar 1 and completely and effectively seals the pin 25 from the plating solution. The steps of loosening and tightening these parts as an incident to adjusting the longitudinal position of the supporting assemblies on the rack bar may be repeated practically indefinitely without deleteriously affecting the sealing of the contact pins 25 from the plating solution and hence the apparatus is fully protected from the corrosive action of the solution and is capable of giving trouble free service for long periods of time.

Another advantage of our invention is that the article supporting arms 12 may be removed from the holder member 11 to render it inoperative. The inoperative or standby holder member may then be locked in any desired position on the rack bar. This is particularly advantageous when the rack, for example, is fitted with six or eight article supporting assemblies 10, as may be the case when small articles are being plated; and it is desired to convert the rack for the plating of larger pieces requiring a correspondingly fewer number of article supporting assemblies, say three or four. Such conversion of our novel plating rack may be accomplished quickly and conveniently by merely removing the article supporting arms from the desired number of holder members 11, thereafter securing the standby, that is, armless holder members to the rack bar by means of set screw 20. When it is desired to reconvert the rack for plating smaller pieces permitting closer spacing of and hence requiring a larger number of article supporting assemblies 10, the arms 12 may be reinserted in the standby holder members.

In the modified form of our invention shown at the lower part of Figure 1 and in Figures 6 and 7, there is provided an article supporting assembly 29 corresponding to assembly 10 described above and comprising a plurality of identical article supporting elements or arms 30. These arms 30 preferably are made in the form of wires consisting of suitable current conducting material such as copper and covered with a layer of corrosion resistant insulation 31, similar to the insulation 7 and 23 described above. The ends 32 of the arms 30 are uninsulated or exposed, as shown, and serve to support and make direct electrical contact with the article or articles to be plated. Each wire supporting arm 30 has a contact pin 33 similar to pins 25 on the flat arms 12 described above, the pin 33 being secured as by soldering to and projecting outwardly from the central part of the arm 30 and which, when the arm 30 is assembled with the holder member 34, is adapted to pierce the insulation 7 on and make electrical contact with the current conducting body of the rack bar in the manner described above in connection with the arms 12.

In order to properly locate and position the wire-type support arms 30 in the holder member 34 which corresponds to and is similar to holder member 11 described above, a plurality of laterally spaced grooves 35 are formed on the interior of one of the sides 36 of the holder member opposite from the set screws 37, and corresponding grooves 38 are likewise provided in a pressure plate 39. The diameter of each arm 30 is substantially less than the width of holder member 34 and consequently each holder member is adapted to accommodate a plurality of such arms on each side of the rack bar. The grooves 35, 38 are adapted to receive the central parts

of the arms 30 and guide the arms to extend transversely of the rack bar 1 as shown in Figures 1 and 6. This holder member 34 can accommodate as many article supporting arms 30 as there are grooves 35 and 38 formed in its parts; and hence the support assembly 29 is quite flexible with regard to the number of articles to be plated it will support. The holder member 34, for example, has three pairs of grooves 35, 38 by which it may support four arms 30 as shown in Figures 1 and 6, or six arms or even one arm, depending upon the size of the article to be plated and the plating requirements. The article supporting arms 30 preferably are bent into a slight longitudinal arc as shown so as to provide a mutual spring action between opposite pairs of arms for maintaining the articles to be plated which are placed over the ends of these arms in good electrical contact with these parts of the rack.

It will be noted that the two holder members 11 and 34 both loosely surround the body of the rack bar with their set screws 20 and 37 adapted to function in substantially the same manner to support and press the article supporting arms 12 and 30 tightly against the outer surfaces of the insulation on the rack bar. In fact, the flat strap-like arms 12 may be used effectively with the grooved holder member 34 since these arms 12 are substantially as wide as the openings in the holder members. Thus it is possible in the practice of our invention to have but one standard internally grooved holder member 34 which is capable of accommodating either type of article supporting arm, that is either the flat arm 12 or the wire-like arm 30. This feature results in increased flexibility in the use of our plating rack and, because of the standardization of holder members, the apparatus is much more economical to manufacture and maintain and is more convenient to use.

In Figures 8 and 9 we have shown another modified form of our invention in which one or a plurality of preferably bare uninsulated current conducting rods 40 are disposed to extend between the vertical insulated legs 41 of a U-shaped rack 42. The upper ends of legs 41 of the rack are threaded and have hooks 43 similar to hook 2, described above, removably connected to the legs 41 in the same manner as hook 2 is connected to rack bar 1 and by which the rack is suspended from the main bus bar, not shown. The legs 41 are spaced apart a distance slightly greater than the length of rods 40. Such a rack is particularly well adapted to hold a plurality of relatively small objects, such as washers, wire-like articles, etc., the articles being spaced along and hung on each rod 40 throughout its entire length.

In order to permit vertical adjustment of rods 40 in the rack 42 and yet provide a mechanical and electrical connection between the ends of the rods 40 and the respective insulated legs 41 of the rack, holder members 44 which fit over the legs of the rack and are adapted to support each end of the rod 40 are provided. Since the rod 40 is supported at its ends, two holder members 44 for each rod 40 are required. Each of the holder members 44 is similar in structure and function to the holder members 11 and 34 described above, and is provided with a set screw 45 adapted to threadedly engage a tapped hole 46 in one side 47 of the holder member 44 for exerting an inwardly directed pressure between the holder member and the adjacent parts of the rack bar. Assembly of the holder members 44 on legs 41 is accomplished by removal of the rack suspension hooks 43 from the upper ends of the legs and sliding the members down over the legs.

Referring to Figure 9, each end 48 of the rod 40 has an electrical contact pin 49 which preferably is integral with the rod and which projects from each end thereof preferably substantially parallel to the longitudinal axis of the rod 40. This pin 49, like the contact pins 25 and 33 on the article supporting arms described above, is

relatively small in diameter and is pointed so as to be able to pierce the insulation 50 on the adjacent rack leg and make electrical contact with the current conducting body of the leg. The side 51 of the holder member opposite the pressure set screw 45 has an aperture 52 for receiving and supporting the rod 40. The aperture 52 is preferably slightly larger than the external dimension of the rod to permit easy insertion of the rod into the holder. In order to securely tighten the article supporting rod 40 to the holder member 44, the holder member is provided with a lock set screw 53 which when tightened against rod 44 locks and secures the rod firmly in the aperture 50 and to the holder member 44.

In the assembly of the rod 40 with holder member at each end, the ends of the rod 40 are first inserted in the respective apertures 52 of opposite holder members 44 with only the contact pins 49 projecting inwardly of the holder members toward the rack legs 41, as shown. The lock set screw 53 in one of the holder members is then tightened to secure the adjacent end of the rod to that holder member. The corresponding pressure set screw 45 is then tightened against the rack leg, the contact pin 49 on that end of the rod being forced through the insulation on and into electrical contact with the adjacent rack leg. The other end of the rod 40 at this time of the assembly is not yet secured to its holder member 44.

Since the lateral spacing between the legs 41 of the rack 42 is slightly greater than the length of each rod 40 in order to permit each rod to be disposed horizontally between the legs, the unsecured end of the rod 40 will be slightly spaced from the insulation on the adjacent rack leg and will not be fully inserted in the supporting aperture 52 of the holder member. In order to close the gap between the contact pin 49 on this end of the rod and the adjacent rack leg, the latter, that is the rack leg may be deflected toward the opposite leg, decreasing the spacing between the legs until the end of the rod is fully disposed in the holder aperture 52 with the pin 49 projecting inwardly. Then the corresponding lock screw 53 is tightened to secure the rod to the holder and thereafter pressure set screw 45 is tightened as described above to draw the pin 49 through the insulation on and into electrical contact with that leg of the rack.

This form of our invention, like the others, has the same advantage of adjustability of the longitudinal position of each article supporting bar 40. When it is desired to adjust the position of these bars or rods 40 vertically on the rack 42, the pressure set screws 45 are loosened until the tip of each contact pin 49 on the rod clears the insulation on the corresponding rack leg. The rod with its respective holders 44 is then moved to the new selected position and the set screws 45 again tightened as described above to complete the electrical connection between the rack body and the rods 40. The contact pins 49 being relatively small in diameter make only negligibly small pin holes in the insulation and so do not deleteriously affect it.

The illustrated and described forms of our invention are not restrictive, and the invention may be practiced in many ways within the scope of the appended claims.

We claim:

1. A rack for suspending articles to be electroplated in an electroplating bath comprising a current conducting rack bar adapted to be immersed in said bath and to make contact with an electric circuit external of the bath, the portion of said bar immersed in said bath being covered with a layer of corrosion resistant insulation, and means for supporting the articles to be plated at selected positions longitudinally on said bar, said means comprising a holder member surrounding said bar, a pair of independent detachable article supporting current conducting insulated arms disposed adjacent to and on opposite sides of said bar and within said holder member and each extending divergently outwardly from and trans-

versely of said bar, the outer extremities of said arms being uninsulated for supporting and making electrical contact with the articles to be plated, each arm having a pointed contact pin connected thereto and projecting inwardly toward said bar from the part of each arm that lies adjacent said bar, screw means threaded into said holder and bearing against one of said arms opposite said pins, said screw means being adjustably threadable in said holder whereby to apply pressure against said arms to cause each contact pin to penetrate insulation on said bar and make electrical contact with said bar.

2. A rack for suspending articles to be electroplated in an electroplating bath comprising an insulated current conducting rack bar, and means for adjustably supporting the articles to be plated in selected longitudinal positions on said bar, said means comprising a holder member loosely encircling said bar, independent substantially identical article supporting current conducting insulated arms disposed on opposite sides of said bar and within said holder member and each extending transversely of said bar, the outer extremities of said arms being uninsulated for supporting and making electrical contact with the articles to be plated, the portion of each arm within the holder being juxtaposed with the outer surface of said insulated bar, each arm having a contact pin mechanically and electrically connected to and projecting from said portion of said arm a distance greater than the thickness of the insulation on said bar, screw means independent of said arms operatively engaging said holder and one of said arms and adjustable to move in a direction substantially corresponding to the direction of projection of said pins from said arms whereby to cause said contact pins to penetrate the insulation on said bar and make electrical contact therewith.

3. A plating rack comprising an elongated current conducting insulated rack bar, article supporting means detachably and longitudinally adjustably secured to said bar, said supporting means comprising at least one holder member disposed to encircle said bar, said holder member having inner dimensions larger than the corresponding external dimensions of said bar whereby to fit loosely on said bar, an article supporting arm disposed to extend transversely of said bar with end parts projecting on each side of the bar and with a central part disposed between the exterior of said insulated bar and the interior of adjacent parts of said holder member, said central part of said arm having a contact pin electrically connected thereto and projecting therefrom toward the said bar, and screw means operatively engaging said holder and said arm and adjustable to apply pressure between said holder and said arm to force said pin through the insulation on said bar into electrical contact with said bar.

4. In an electroplating rack having an insulated current conducting rack bar adapted to be suspended in an electroplating solution for supporting articles to be plated, an article supporting assembly adjustably positionable longitudinally along said bar comprising a hollow holder member having a first set of openings in one pair of opposite sides through which said bar extends, a second set of openings in another pair of opposite sides of said member, an article supporting current conducting arm disposed to extend transversely of the axis of said bar through said second set of openings in said member and having a contact pin electrically connected thereto and projecting therefrom into the insulation on said bar, independent pressure means operative between said holder and said arm to force said pin into electrical contact with said bar.

5. The rack according to claim 4 in which said arm has a substantially rectangular cross-section and a width substantially equal to the width of the second set of openings.

6. The rack according to claim 5 in which said arm has a substantially circular cross-section and a diameter

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substantially less than the width of said second set of openings, said holder member having a plurality of transverse grooves on the inner surface thereof for receiving one or more of said arms.

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