Jan. 21, 1941. J. L. SCHUELER ET AL 2,229,423

ELECTROPLATING APPARATUS FOR WIRE OR THE LIKE

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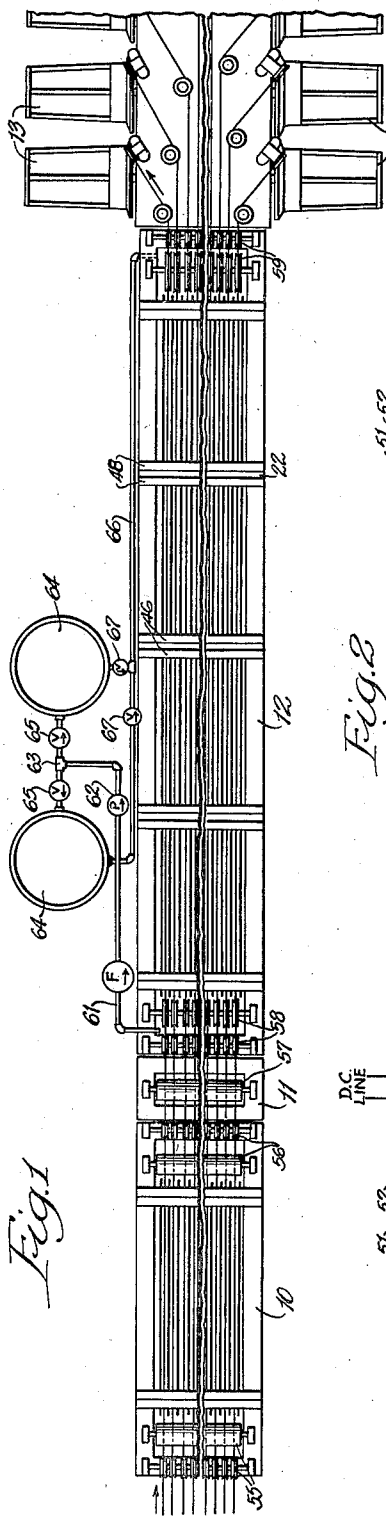


Fig. 1

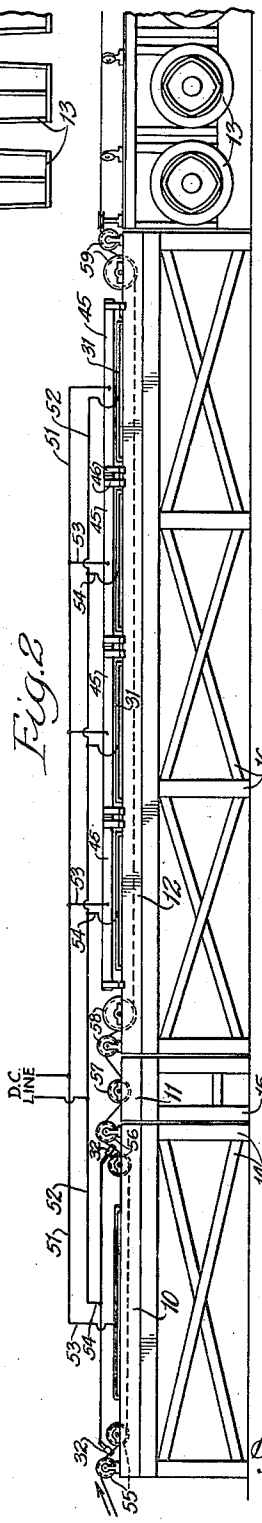


Fig. 2

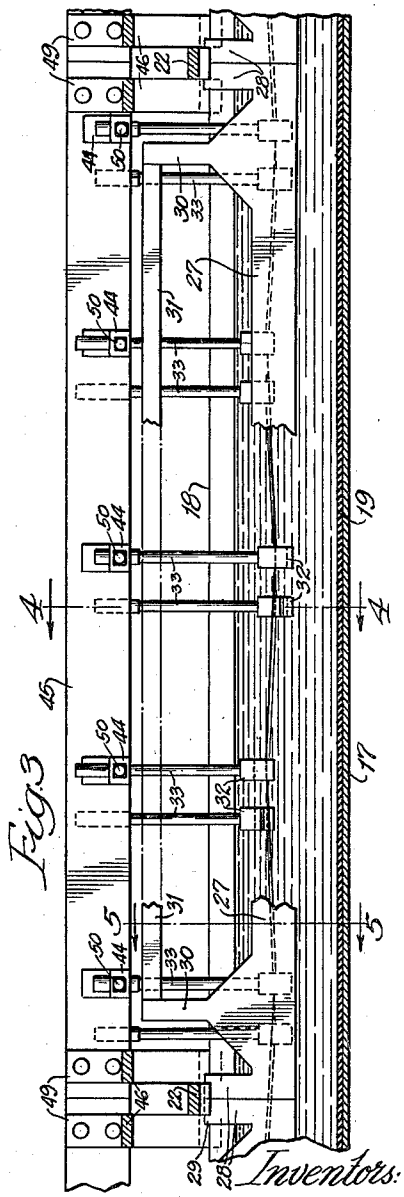


Fig. 3

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Fig. 4

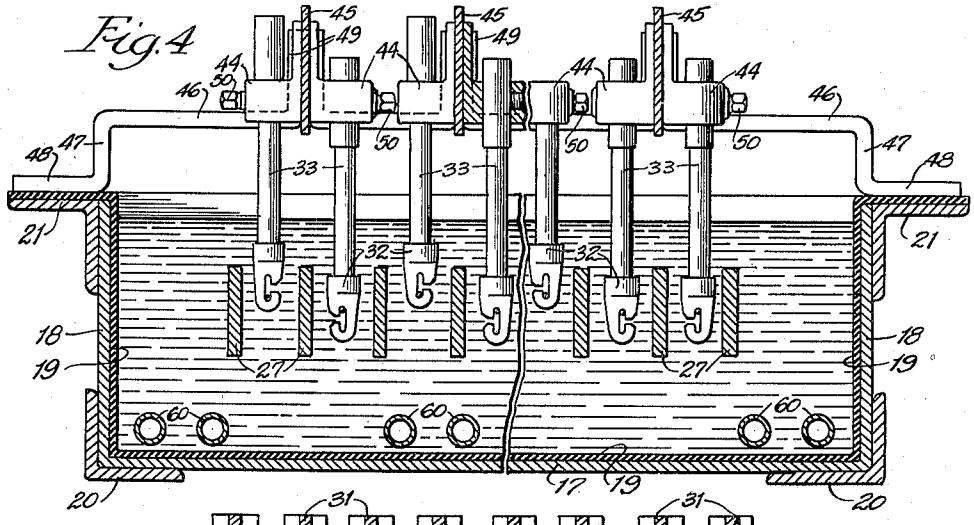


Fig. 5

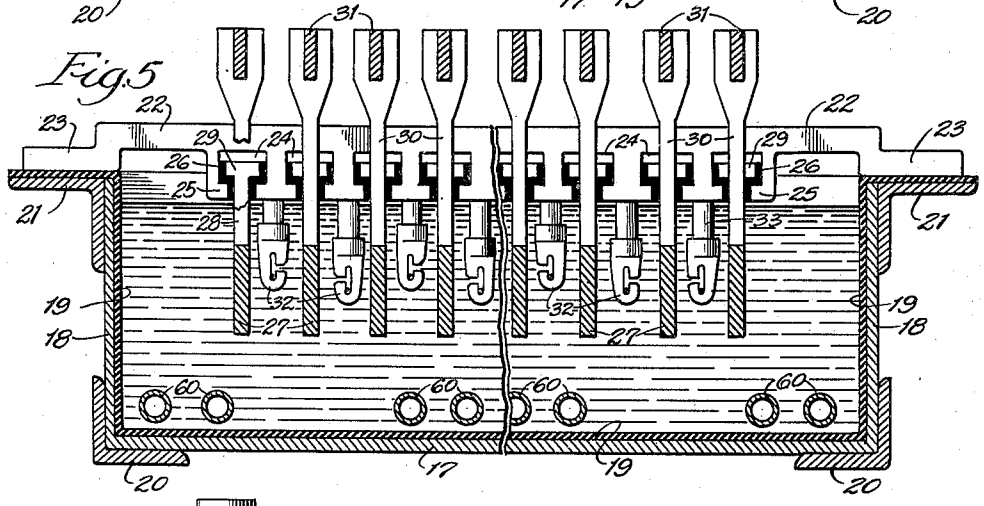
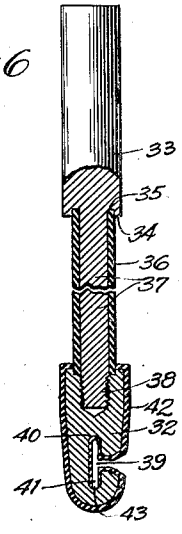


Fig. 6



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2,229,423

ELECTROPLATING APPARATUS FOR WIRE OR THE LIKE

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9 Claims. (Cl. 204—206)

The present invention is directed to apparatus which in the form shown includes means for cleaning and rinsing and thereafter electroplating wire or thin strips of metal (which for convenience throughout the description will be included under the term "wire") by a continuous operation and under proper control to guide the wires through the baths and impose the desired amount of tension on each of the wires individually.

In particular the invention is directed to the means for suspending and energizing the wires within the plating bath so that the immersed sections of the wires constitute the cathodes during the plating operation.

The mechanism is one which provides cathodes that are formed in sections which may be readily renewed or replaced as occasion may require, and relates to the means provided for regulating the hangers which suspend and guide the wires through the bath to impart the desired tension and direction of travel to the wires as well as to energize the same. The construction of the hangers is one which permits the wires to be threaded laterally and to secure the necessary electrical contact thereupon under sufficient tension to insure an effective contact.

Further objects and details will appear from a description of the invention in conjunction with the accompanying drawings, wherein—

Figure 1 is a plan view of the apparatus embodying the features of the present invention;

Fig. 2 is a side elevation thereof;

Fig. 3 is an enlarged longitudinal sectional elevation through the plating tank and associated parts;

Fig. 4 is a cross sectional elevation taken on line 4—4 of Fig. 3;

Fig. 5 is a cross sectional elevation taken on line 5—5 of Fig. 3; and

Fig. 6 is a detail of one of the hangers showing the hooked end thereof in section.

The plating apparatus includes a cleaning tank 10, a rinsing tank 11, a plating tank 12, and a series of takeup reels 13, the corresponding delivery reels at the feeding end of the apparatus not being shown. The tanks for convenience are mounted respectively upon supports 14, 15 and 16.

The cleaning tank affords a receptacle for the retention of a suitable cleaning fluid which is preferably an acid solution capable of providing a chemically clean surface to the wire. It may even be desired to pre-rust the wire, so that the acid cleaning, in removing the rust, will carry with it all forms of materials upon the surface of the wire. This pre-rusting may be effected in any suitable manner, as by pure water, acidulated water, or any other liquid which tends to promote rust prior to the cleaning operation.

It is preferred in the cleaning bath to employ electrodes similar in all respects to those employed in the plating bath, except that the current flow is reversed in the acid cleaning bath passing from the wire to the electrode, whereas in the plating bath it passes over the electrode to the wire. However, for purposes of description, the terms "anode" and "cathode" will be given their usual signification in respect to the functions performed by these elements in the plating bath, with the understanding, however, that the same mechanical elements are present in the cleaning bath but utilized with reverse polarity. With this understanding, therefore, most of the description will be directed to the plating bath and with the parts operating as anodes and cathodes and with the current flow from the anodes to the wires for plating purposes.

Referring, therefore, particularly to Figs. 4 and 5, which represent sections taken from the plating tank, and with the understanding that the physical construction is the same through the cleaning tank, it will be noted that the tank is relatively long and shallow, the width being variable to accommodate the desired number of wires which may be multiplied indefinitely.

The tank comprises a bottom 17, side walls 18, and suitable end walls (not indicated), the tank being provided with an insulating lining 19 throughout. As shown, the lower corners of the tank are supported within angle iron sills 20 which constitute the top rails for the frame or support 16 which holds the tank in elevated relation. The above description applies equally to the cleaning tank.

The upper margins of the tank are provided with angle bars or rails 21, the horizontal flanges of which extend outwardly, and as shown the insulating lining is extended outwardly along the rails 21 and constitutes the upper facing therefor.

The edges of the tank serve to support a plurality of bridge bars 22, each of which at its ends is offset to afford supporting feet 23 which rest upon the insulation covering the rails 21, and each bridge bar is provided on its under edge with T-shaped recesses 24 in spaced relation to one another, which afford keyhole apertures providing inturned shoulders 25 having an insulating facing 26. The shouldered recesses 24 afford sockets for the suspension of elongated anodes 27 which are in the form of plates or bars stand-

ing edgewise and in closely spaced relation to one another across the width of the tank.

Each of the anode bars 27 at each end is provided with a hanger 28 having a T-shaped head 29 which is socketed within the shouldered recesses 24, the anode bars being formed in sections, the hanger ends of which stand in butt relation to one another, the hangers of contiguous bars being socketed within the same shoulder recess, as shown in Fig. 3. This method of suspension permits the anode sections to be formed of convenient length and coupled together to form in effect a continuous anode, which may be of any desired length depending upon the length of the tank.

Furthermore, the employment of anode sections obviates the necessity for manipulating the entire length of the anode, since if the latter were made integral, its length and weight might make it difficult to properly manipulate and at the same time the arrangement permits individual sections to be substituted or replaced as occasion may require. Each anode section is provided with a pair of upstanding arms 30 which extend above the level of the tank and are connected by a buss bar 31.

The wires are suspended at a proper elevation to run between the anodes 27, and it is preferred to run the adjacent wires in a zigzag or undulatory path of travel rather than in a straight line path, in order to secure the necessary tension to afford electrical contact for the immersed sections of the wires so that the wires may act as the cathodes in the plating operation. For this purpose, each of the wires runs through the hooked head ends 32 of hangers 33, best illustrated in Fig. 6. Each of the hangers is shouldered at its medial point 34 and undercut to afford an annular recess 35 which receives the upper end of an insulating tubular sheath 36 which surrounds the reduced lower end 37 of the hanger, which terminates in a threaded stem 38 upon which the head 32 is threaded.

The head 32 is slotted in one side to afford a T-shaped recess 39 having upper and lower legs 40 and 41. The outer surface of the head 32 is covered throughout with an insulating sheath 42 which is continuous within the T-shaped recess 39 with the exception only of a single spot in the base of either the upper or lower legs 40 and 41 of the recess, depending upon whether the hanger is adjustable to impart an upward lift or a downward thrust upon the wire. If adjusted to afford a lift, the bare spot 43 should be formed at the lower leg of the slot, but if the adjustment is to be one which imparts a thrust upon the wire, the bare spot should be at the base of the upper leg of the slot. In other words, that portion only of the head of the hanger should be bare of insulation which makes direct tensioned contact with the surface of the wire, so that the transfer of energy will be centered at such points of contact only.

All of the hangers for a single wire stand in longitudinally aligned relation and have their upper ends adjustably entered through lugs 44 which are secured to and extend laterally from an intermediate longitudinally extending suspension bar 45, the ends of which are supported upon elevated bridge bars 46 carried by standards 47, the ends 48 of which rest upon the side walls of the tank. The bridge bars 46 are formed of sections, the ends 49 being struck upwardly to bear against opposite sides of the series of suspension buss bars 45 to which they are secured in any suitable manner.

The suspension bars 45 constitute buss bars for energizing the hangers 33 which through the heads 32 make contact with the wires, and in order to facilitate adjustment the suspension bars (buss bars) 45 are formed in aligned sections which are supported at each end in the manner just described and so that in effect a series of parallel closely spaced suspension bars extend from end to end of the tank, each bar supporting and energizing the hangers for a particular wire.

The hangers are held in adjusted position by means of set screws 50, which permits the hangers to be individually adjusted to the desired degree to impart a zigzag path of travel to each of the wires, which will run through the tank under tension and in such a way as to alternately contact the upper and lower bare spots 43 of the hanger heads to afford electrical contact at these points only. The arrangement is clearly indicated in Fig. 4, from which it will be observed that the hangers for the alternate wires stand in staggered relation, so that the wires which are elevated will make contact within the lower legs of the recesses while the wires which are depressed will make contact within the upper legs of the recesses.

The arrangement just described is duplicated within the cleaning tank, where, however, a pair of electrode heads 32, one at the entering end and the other at the exit end of the tank, engages the wire at points above the level of the cleaning solution. These electrodes function as anodes and because they remain out of the solution are protected from corrosion. Within the tank, in closely adjacent relation to the wires, are elongated bars which serve as cathodes, their arrangement being the same as in the plating tank. Direct current wires 51 and 52 are employed with lead wires 53 and 54 leading to the respective buss bars, and it will be noted that the leads for the connections in the cleaning tank are reversed as compared with the leads of the plating tank.

The wires are led over and under guide rollers 55 at the entering end of the cleaning tank and pass out over guide rollers 56 at the opposite end, and thence under a roller 57 and down into the washing solution in the tank 11, after which they are led over and under rollers 58 and into the plating tank, and after their travel therethrough are led out and under and over rollers 59 at the delivery end of the plating tank, after which the wires are led individually to the takeup reels 13.

In order to maintain a circulation of the electrolyte within the plating tank, and preferably in a direction opposite to the travel of the wire therethrough, a plurality of discharge pipe coils 60 are laid in the base of the plating tank, which coils are provided with apertures for the discharge of the fluid into the tank, which fluid is withdrawn through a pipe 61 and the action of a pump 62, which delivers the fluid to a header 63 discharging into either of two storage tanks 64, depending upon the adjustment of valves 65.

The fluid from either or both of the storage tanks flows through a delivery pipe 66 connecting with the coils 60, and thus completes the circuit, valves 67 being provided to afford the necessary regulation of the flow from one or both of the tanks 64.

The plating tank is preferably of very much elongated construction in order to afford the

necessary length of travel for the wires to secure the required deposition of the plating material thereon, and in order to accommodate this condition, the suspension bars for the hangers and the anodes are made in unit sections which may be multiplied to the desired degree to accommodate a tank of any desired length.

The means provided for suspending, guiding and tensioning the wires during their period of immersion within the plating tank is one which enables the direction of movement of the wires throughout their travel from end to end of the tank to be repeatedly varied back and forth in a zigzag direction to secure repeated points of electrical contact throughout the line of travel and irrespective of the length of the tank as a whole. These details of construction make it possible to guide and adjust the wire at all points, or to renew a section or sections of the anode bars without difficulty or dismantlement of the apparatus as a whole, so that the number of wires running through the apparatus can be varied and the length of the immersion period can be varied within wide limits, since the arrangement shown permits the entire length of the tank, or any fractional portion thereof, to be utilized, depending upon the weight of the plating desired or the period of immersion required, so that different wires may be variously plated while running through the same tank and without change in the feeding speed, which may be uniform for all wires of the series. These factors make the arrangement one which is highly desirable for use in materials where it is frequently necessary to change or regulate the plating conditions, and in which economy requires that a uniform feeding speed for all of the wires be maintained.

Although the invention has been described with full particularity as to detail, it will be understood that the various feaures of construction here described may be used in varying combinations, and that it is not the intention, unless otherwise indicated in the claims, to limit the invention to the mechanism in the form shown.

We claim:

1. In apparatus for electroplating wire, the combination of a tank, a longitudinally extending electrode bar having a hanger at each end, a bridge bar at each end of the electrode bar spanning the tank and adapted to engage with and suspend the hangers on the electrode bar, a pair of elevated bridge bars, a suspending bar carried by the bridge bars, a plurality of hangers adjustably secured to the suspension bar and depending therefrom into the tank, each of the hangers at its lower end being provided with a wire engaging portion having a laterally opening recess terminating in oppositely extending legs, either of which is adapted to have the wire brought into engagement with its base, the intended points of contact for the wire being unprotected to afford electrical contact with the wire and the remaining surface of the recessed portions being protected by an insulating covering, means for energizing the electrode bar, and means for energizing the suspension bar and the hangers carried thereby.

2. In apparatus for electroplating wire, the combination of a tank, an electrode extending longitudinally of the tank and consisting of sections, each section being of bar formation standing edgewise and the sections having their ends in abutting relation to one another, the ends of each section being upturned to provide hangers, a bridge bar for each pair of contiguous hangers, each bridge bar having a member for engaging a pair of contiguous hangers, suspension bar sections extending longitudinally of and above the tank, bridge members for supporting the suspension bar sections in elevated relation, hangers adjustably supported by the suspension bar sections and having their lower ends depending into the tank, each hanger having at its lower end a member provided with a laterally opening recess merging into oppositely extending legs, either of which is adapted to have the wire brought into contact with its base, the point of contact for the wire being unprotected to afford an electrical contact and the remainder of the recessed portion being protected by the insulating covering, means for energizing the electrode bar, and means for energizing the suspension bar sections with the hangers carried thereby.

3. In apparatus for electroplating wire, the combination of an elongated tank, a horizontally elongated electrode in the form of a plate extending longitudinally of the tank and above and in edgewise relation to the bottom of the tank, a bridge bar at each end of the electrode spanning the tank and supported in fixed relation thereto, a hanger at each end of the electrode extending therefrom and engaging the proximate bridge bar for suspending the electrode between the bridge bars, a row of wire supporting hangers having their lower ends in laterally adjacent relation to one of the side faces of the electrode, said lower ends having laterally opening recesses vertically enlarged above and below the opening to retain a wire against withdrawal when held under tension against either end of the recess, a suspension bar rigidly supported above the tank and in position to support the upper ends of the row of wire hangers, and supporting means for each hanger secured to said bar and adapted to permit individual adjustment of the respective wire hangers to vary the height of the wire engaging recessed ends of the row of hangers and thereby impart tension to the wire to hold the same against displacement from the recesses and stagger the travel of the wire.

4. In apparatus for electroplating wire, the combination of an elongated tank, a horizontally elongated electrode in the form of a plate extending longitudinally of the tank and above and in edgewise relation to the bottom of the tank, a bridge bar at each end of the electrode spanning the tank and supported in fixed relation thereto, a hanger at each end of the electrode extending upwardly therefrom and engaging the proximate bridge bar for suspending the electrode between the bridge bars, a row of wire supporting hangers having their lower ends in laterally adjacent relation to one of the side faces of the electrode, said lower ends having laterally opening recesses vertically enlarged above and below the opening to retain a wire against withdrawal when held under tension against either of the recesses, the walls of the recess being insulated save for the wire contact points at each end of the recess, a suspension bar rigidly supported above the tank and in position to support the upper ends of the row of wire hangers, supporting means for each hanger secured to said bar and adapted to permit individual adjustment of the respective wire hangers to vary the height of the wire engaging recessed ends of the row of hangers and thereby impart tension to the wire to

hold the same against displacement from the recesses and stagger the travel of the wire.

5. In apparatus for electroplating wire, the combination of an elongated tank, a plurality of horizontally elongated electrodes standing in edgewise alignment with one another and each being in the form of a plate extending longitudinally of the tank and above and in edgewise relation to the bottom of the tank, a bridge bar at each end of the group of electrodes and an intervening bridge bar adjacent the aligned ends of contiguous electrodes, each of said bridge bars transversely spanning the tank and fixedly supported with relation thereto, a hanger at each end of each electrode extending upwardly therefrom and removably engaging the proximate bridge bar for suspending the electrodes between the bridge bars, a row of wire supporting hangers having their lower ends in laterally adjacent relation to the side faces of the electrodes, said lower ends having laterally opening recesses vertically enlarged in opposite directions behind the opening to retain a wire against withdrawal when held under tension against either end of a recessed enlargement, and means for suspending the wire supporting hangers and permitting individual vertical adjustment thereof to impart tension to the wire and hold the same against displacement from the recesses and stagger the travel of the wire.

6. In apparatus for electroplating wire, in combination with a tank and an electrode therein and means for drawing wire under tension therethrough, a plurality of guide members for the wire having their wire engaging ends offset with relation to the line of tension of the wire and positioned within the tank in laterally adjacent relation to the electrode and each having in its end a lateral opening adapted to permit a wire to be entered therethrough, said opening merging into an elongated slot extended in opposite directions behind the opening to afford opposite contact points for the wire so positioned as to prevent displacement of the wire through the opening when the wire is tensioned to maintain it in engagement with either of said contact points.

7. In apparatus for electroplating wire, in combination with a tank and an electrode therein, and means for drawing wire under tension therethrough a plurality of guide members for the wire having their wire engaging ends offset vertically with relation to the line of tension of the wire and positioned within the tank in laterally adjacent relation to the electrode and each having in its end a lateral opening adapted to permit a wire to be entered therethrough, said opening merging into a vertical slot extended in opposite directions behind the opening to afford opposite contact points for the wire at the opposite ends of the slot and so positioned as to prevent lateral displacement of the wire through the opening when the wire is tensioned to maintain it in engagement with either of said contact points, the recessed portion of said guide member being insulated save for said contact points.

8. In apparatus for electroplating wire, in combination with a tank and an electrode therein and means for drawing wire under tension therethrough, a plurality of vertically disposed guide members for the wire having their wire engaging ends offset vertically with relation to the line of tension of the wire and positioned within the tank and in laterally adjacent relation to the electrode and each having in its end a T-shaped recess with the center leg of said recess opening laterally to permit a wire to be entered therethrough and said leg at its inner end merging into the vertically disposed cross portion of the T-shaped recess to afford contact points for the wire at each end of said cross portion to prevent lateral withdrawal of the wire when held under tension against the base at either end of said cross portion of the recess.

9. In apparatus for electroplating wire, in combination with a tank and an electrode therein and means for drawing wire under tension therethrough, a plurality of vertically suspended guide members for the wire having their wire engaging ends offset vertically with relation to the line of tension of the wire and positioned within the tank and in laterally adjacent relation to the electrode and each having in its end a T-shaped recess with the center leg of said recess opening laterally to permit a wire to be entered therethrough and said leg at its inner end merging into the vertically disposed cross portion of the T-shaped recess to afford contact points for the wire at each end of said cross portion to prevent lateral withdrawal of the wire when held under tension against the base at either end of said cross portion of the recess, the surface of said recess being insulated except at the wire contacting ends of the cross portion of said recess.

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