Feb. 11, 1958 E. ROTHSCHILD 2,823,180

METHOD AND MEANS FOR COATING WIRES

Filed Nov. 25, 1953 3 Sheets-Sheet 1

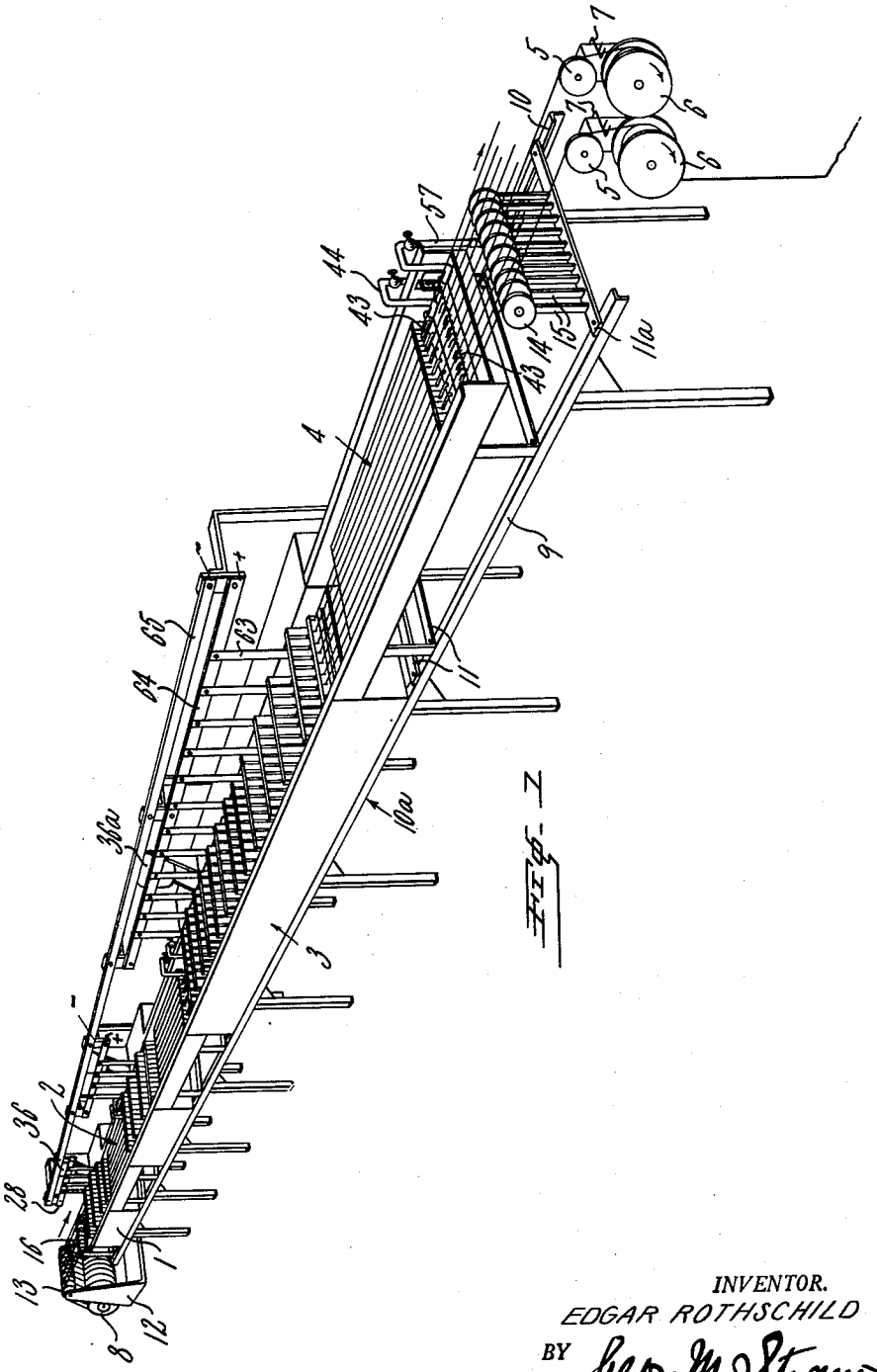


FIG. 1

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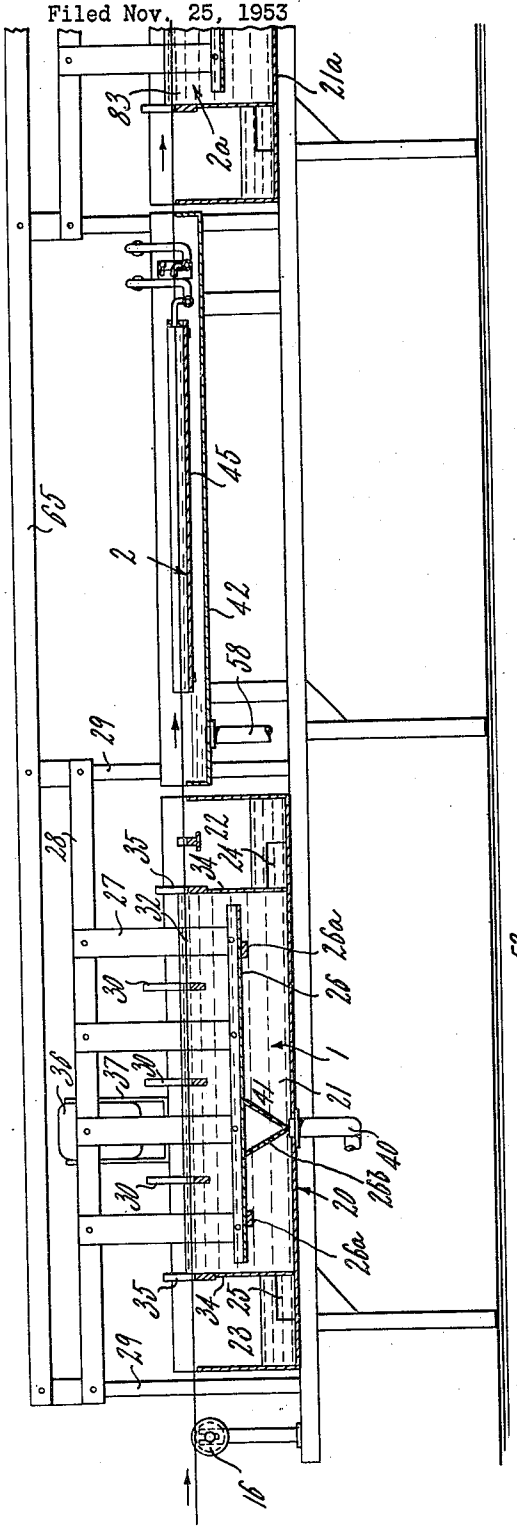


FIG. 2

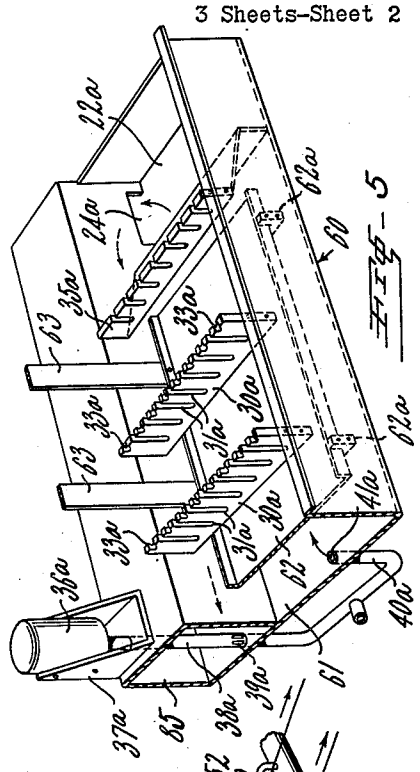


FIG. 5

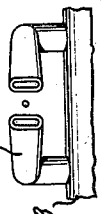


FIG. 4

FIG. 3

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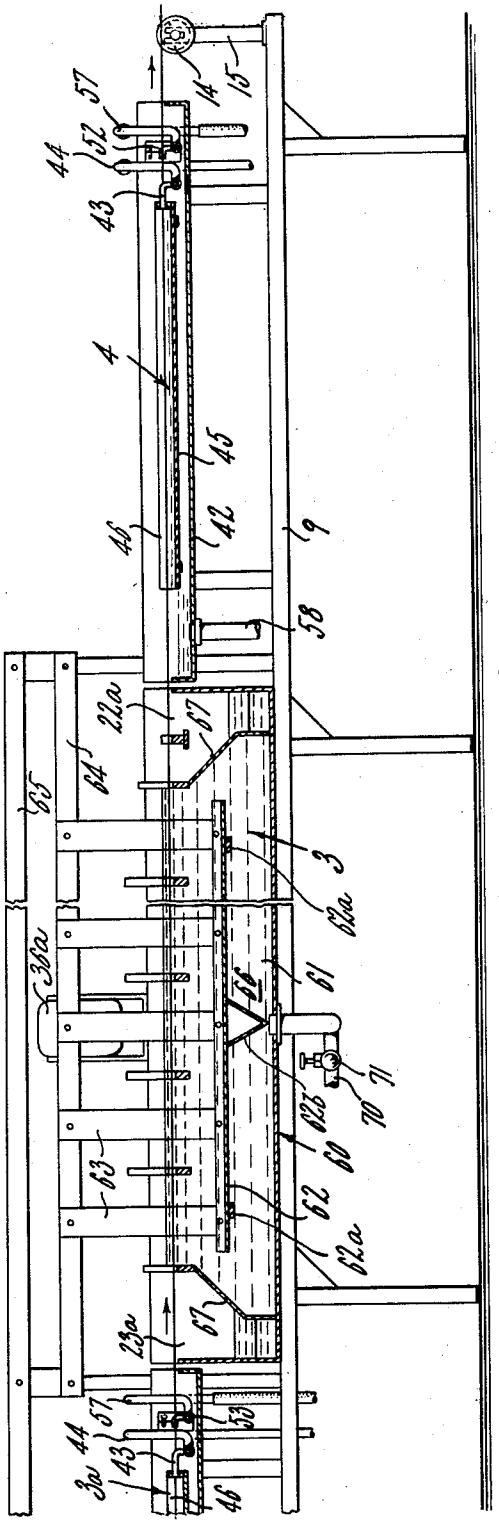


FIG. 6

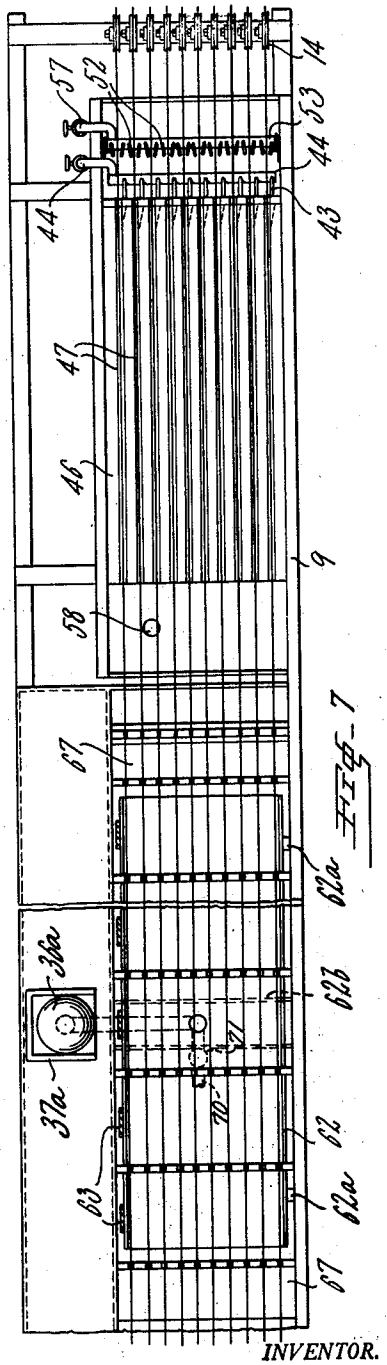


FIG. 7

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METHOD AND MEANS FOR COATING WIRES

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Application November 25, 1953, Serial No. 394,251

3 Claims. (Cl. 204—207)

This invention relates to an apparatus for treating, in particular metalizing or coating wire and similar lengthy metal strip material.

It is one of the objects of the present invention to provide means facilitating the treatment of a plurality of wires, which are led in substantially parallel and straight paths during sequential operational steps by which said wires are simultaneously cleansed, washed, electro-plated, as well as rinsed and dried in continuous operation.

It is another object of the invention to provide an apparatus of the aforesaid character in which wire material is drawn from a plurality of reels and successively passed through a caustic cleaning bath, then rinsed and dried; then subjected to an acid cleaning, rinsed and dried; then electroplated, and thereafter subjected to final rinsing and drying, before the wire material is again wound on reels.

It is a further object of the invention to provide means affording the aforesaid operations to be successively carried out on the wires while a plurality of the latter taken from a number of feed reels is simultaneously traveling co-extensively toward take-up reels.

It is still another object of the invention to provide means ensuring controlled performance of operations during the travel of the wires from station to station of the apparatus without interruption of the continuity of movemen of the wires.

It is still a further object of the invention to provide means making it possible that the operational steps are carried out speedily and uniformly on the wires, resulting in maximum output and high-quality products.

Still another object of the present invention is to provide means conducive to a considerable simplified construction of an apparatus for treating or coating wire material, whereby a plurality of tank units and rinsing stations are used which are substantially made up of identical parts but used for different purposes during sequential operational steps.

Yet another object of the present invention is to provide means affording adjustability of the various parts relative to the path of the wire or wires and/or to the level of the liquid or liquids employed for treating the wire or wires and also for drying the latter.

Still a further object of the present invention is the provision of means rendering the possibility of interrupting or eliminating treatment for at least one or some of the wires while the remainder of the wires whose treatment is still in progress passes without disturbance and interruption through the various treatment tanks or baths and without regard to the eliminated wire or wires.

The other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings, it being distinctly understood that the same is by way of illustration and example only and is not to be taken as in any way limiting the spirit or scope of this invention.

In the drawings:

Fig. 1 is a perspective view of an apparatus constructed according to the invention;

Fig. 2 is a vertical sectional view of one of the tanks of the apparatus depicting the caustic cleaning bath and the first rinsing station, as well as part of the acid-cleaning tank;

Fig. 3 is a perspective and exploded view, with some parts in section, of a portion of the rinsing and drying station;

Fig. 4 is a perspective front view of two of the air nozzles used in the drying station of Fig. 3;

Fig. 5 is a perspective view, parts in section, of the electro-plating tank and co-operating parts thereof.

Fig. 6 is a vertical sectional view of the tank for plating as well as for performing final rinsing and drying operations;

Fig. 7 is a top plan view of a part of the structure disclosed in Fig. 6.

Referring now more particularly to the drawings, the apparatus herein disclosed is primarily adapted for the treatment of copper and similar wire and it contemplates the subjection of the wire to tin-plating or coating, whereby first a cleaning treatment takes place by passing the wires through a caustic bath, indicated at **1**; then subjecting the wires to a rinsing and drying operation at the stage generally indicated at **2**; then subjecting the wires to acid cleaning at the stage indicated at **2***a*; then rinsing and drying the wires at the stage **3***a*; then electro-plating the wires at the location or station generally designated at **3**; then causing the wires to be rinsed and dried a the station indicated at **4**. The wire or wires then pass over the guide rollers **5** to the reels **6** upon which the wires are evenly wound in layers by known distributors **7**. The operations upon the wire take place while the wire is in continuous movement from its supply reels **8** to the take-up reels **6** in the direction indicated by the arrows, and the travel of the wire or wires from the feed reels **8** to the take-up reels **6** is substantially a straight line.

The various stations at which the wire or wires are treated, are arranged on a suitable table or frame **10***a*, with the longitudinal supporting bars **9** and **10**, connected by a plurality of cross members **11** as required, to lend strength and rigidity to the frame.

At the entrance end of the apparatus is provided a supporting bracket **12** which supports a plurality of feed or supply reels **8** from which the wires to be treated are drawn, so that the wires simultaneously pass along through the plant or apparatus and are treated successively at the various stations or stages thereof. The wires drawn from the reels **8** pass over idlers or guide rolls **13**, which may be rotatively supported on the bracket **12**, and also over the idlers **16**, the several wires passing along through the apparatus in parallel relation until they reach guide rolls **14** rotatively supported on the upright frames **15** located on the cross member **11***a*, and thence pass over the guide rolls **5** to be wound on the take-up reels **6**. It will be understood that the take-up reels **6** are rotated by any suitable mechanism (not shown), in order to cause the wires to be drawn through the apparatus at the required rate of travel.

After leaving the guide rolls **13** and **16**, the wires pass first through a stainless steel tank containing caustic cleaning bath **1** (Fig. 2). Said tank is identical or somewhat similar in construction to that for the electro-plating bath shown in Figs. 5 and 6, and consists of a container **20** having a main chamber **21**, end chambers **22** and **23** by way of the openings **24** and **25** in the wall of the side passage or by-pass **85**. Located within the main chamber **21** is a tray **26** of stainless steel which is positioned above the bottom of the container **20** and

supported by several insulated cross bars 26*a*. Electric connector straps 27 are secured at the top to a longitudinally extending bar 28 supported by the uprights or posts 29 rising from the frame of the apparatus.

Secured between the side walls of the container or tank 20 is a plurality of spaced comb-like wire guides 30 (similar to those shown at 30*a* in Fig. 5) provided with spaced slots 31*a* through which wires pass in contact with a caustic cleaning liquid contained in the tank. While the wires are traveling in the slots 31*a* they are submerged in the bath contained in the tank, as indicated at 32 in Fig. 2. If for any reason it should be found desirable or necessary to avoid the subjection of the wires to the action of the bath, the wires may be caused to clear the bath by elevating them and causing them to ride through the notches 33*a* provided in the tops of the wire guides 30. Each of the end walls 34 of the main chamber 21 of the tank is provided at the top with a slotted wire separator and guide 35 through which the several wires are guided.

The caustic cleaning fluid in the tank 20 suitably heated (not shown) to about 150° to 200° F. is circulated by means of a pump 36 held on bracket 37 which is positioned on the casing for the by-pass or side passage 85. Leading from the pump 36 is a pipe 38*a* which passes down through by-pass 24 and is provided adjacent to the bottom of the same with inlet openings 39*a*. The pipe 38*a* continues down below the bottom of the tank and is upturned as indicated at 40, permitting the liquid to emerge at 41 against deflector cone means 26*b* for evenly distributing the fluid in main chamber 21 of the tank. There is a constant circulation of the liquid in the tank, the same following the course similar to that indicated by the arrows in Fig. 5 without passing through pump 36, the liquid being thus maintained at the level required in the main chamber 21 of the tank.

The overflow from the main chamber descends into the end compartments 22 and 23 to flow into the by-pass 85 and be suctionally drawn through the openings 39*a* in pipe 38*a* by the action of the pump 36, and recirculated.

After leaving the caustic cleaning bath just described, the wires continue to the first rinsing and drying stage generally indicated at 2. This stage includes a tank 42 serving as a collector for the water or other rinsing fluid that is ejected against the moving wires by means of spray nozzles 43 extending from a water supply pipe 44. Fitted in the tank 42 above the bottom thereof is a tray 45 which supports a plurality of spaced guide strips 46, providing slots 47 between them in which the wires travel. A crosspiece 48 is secured across one end of these strips 46 and the water nozzles 43 extend through the crosspiece 48 to thereby inject streams of water against the wires traveling through the slots 47 between the strips 46. At the outlet ends of the strips 46, adjacent to the crosspiece 48, the strips 46 are undercut as indicated at 49 to thereby provide inclined baffle surfaces 50 against which the water flow from the nozzles 43 is directed to thereby cause the same to impinge against the wires traveling in the slots 47. It will be observed that the water is ejected from these nozzles in a direction opposite to the direction of travel of the wires, thus insuring thorough cleansing of the wires.

The crosspiece 48 is slotted as indicated at 51, the slots 51 guiding the rinsed wires as they leave the tray 45. After leaving the tray 45, the wires pass between pairs of air nozzles 52 so arranged that each wire passes between two inwardly-directed nozzles as shown in Fig. 4.

The nozzles are flattened at their ends as shown in Fig. 4 and are attached to a manifold pipe 53 secured at its ends to angle bars 54 adjustable by the screws 56 in the fixed brackets 55 located at the opposite side walls of the tank 42. This arrangement provides for raising and lowering of the manifold pipe 53 to insure direct impingement of warm air ejected from the nozzles 52, against the wires traveling between each pair of nozzles. Heated or cold air under pressure is delivered through the manifold 53 from any suitable source by way of the supply pipe 57 shown in Fig. 1. The rinsing water ejected from the water nozzles 43 descends from the tray 45 into the collection tank 42 and drains out of the same through the outlet pipe 58 located at the bottom of the tank 42.

After leaving the rinsing and drying station indicated at 2, the wires travel to the acid cleansing bath generally indicated at 2*a*. The construction of this section is substantially similar to that shown at 1 and includes a rubber-lined stainless steel tank 21*a* in which an acid cleaning fluid 83 is circulated at room temperature and in a manner described in connection with the caustic bath at station 1. As a cleaning fluid fluoboric acid solution, containing stannous fluoborate, tin and naphthol is employed.

When the wires have traveled through the acid bath at station 2*a* they are rinsed and then dried by the apparatus forming station 3*a*. This apparatus is similar to that constituting station 2 and disclosed in detail in Fig. 3. After leaving the air nozzles at station 3*a* the wires pass into the electroplating tank at station 3 where the wires are electroplated.

The construction of this stage is somewhat similar to that shown in connection with the caustic and acid bath apparatus, and is disclosed in detail in Fig. 5. In this stage of the apparatus, there is included a stainless steel tank 60 having a main chamber 61 within which is extended a stainless steel tray 62 constituting the anode support. As anode, pure metal slabs (tin or tin-lead) are placed in said tray and are replaced from time to time. The tray 62 is covered with carbon or graphite for conducting current to the anode slabs and is connected to conductor straps 63 which make contact with bar 64 supported by and suitably electrically insulated from the uprights 29 rising from the frame of the apparatus. The anode tray 62 is charged by current communicated to it through said straps 63 which receive the current from the bar 64 charged from a suitable current source.

As the wires pass through the electrolytic bath 66 contained in the tank 60, the wires form the cathodes and will thus acquire the required electroplating in the known manner. The wires, in passing through the electrolytic bath 66 are guided through the separators or guides 30*a*, having the slots 31*a* and notches 33*a* disposed at a higher level than notches 31*a* as described in connection with the caustic cleaning bath construction. These wire-guiding means or separators are composed of electric insulating material, as are the end guide members 35*a* supported at the tops of end walls 67 of the tank 60. It will be noted that these end walls 67 are angular or slanted downwardly and outwardly toward the end portions of the tank to prevent oxidation of the electroplating solution 66 which flows gradually down over these end walls from the main tank, to enter into the tank end portions or compartments 22*a* and 23*a* and pass therefrom through openings 24*a* and 25*a* into the bypass 85 for recirculation through the openings of the pipe 38*a* at 39*a*, then through the upturned pipe portion 40*a* into the main chamber 61 of the tank out of the end 41*a* of said pipe.

The solution 66 may be maintained at lower temperature by suitable cooling coils in the tank (not shown) and said solution can be drained out of the tank when required through pipe 70, which is provided with a valve 71. The circulation of the electroplating solution 66 in the manner described is attained by pump 36*a* mounted on a bracket 37*a* in the manner described with respect to the pump 36 at the caustic cleaning and acid cleaning stations.

After leaving the electroplating stage 3, the wires travel through the final rinsing and drying stage indicated at

4. Since the structure of this stage is similar in all respects to that shown at **2** and **3***a* it is not to be described in detail except to explain that at this stage the wires are rinsed and dried, and when they leave the same they are ready to be rolled upon the several take-up reels **6** in the manner previously explained and by suitable mechanism which will distribute the windings of the wires evenly on the several reels.

It will be noted that the travel of the several wires from the supply spools to the collection or take-up reels occurs in straight course; that the several operations on the wires take place while the wires are in movement so that there is no material interruption or pause in the treatment of the wires from one end of the apparatus to the other. Guide rollers are disposed at the beginning and end of the tanks to adjust the wires to desired level and to maintain same during operation.

While a preferred embodiment of the invention has been described, it is obvious that the drying of the wires at the several drying stages may take place by means of the ejection of heated or cold air against the wires. It is apparent that the drying might be carried out by other means, as, for example, the application of wiping elements against the wires. Also, while it has been suggested herein that the flow of rinsing water applied against the traveling wires shall be supplied in a direction opposite to the direction of travel of the wires, it will be apparent that this is not strictly essential since the water flow might be applied angularly and in other directions to secure satisfactory rinsing action on the wires without interfering with the travel thereof through the apparatus.

According to the invention, copper wires may be plated with extremely fine tin film, after the wires have been subjected to a caustic-cleaning solution, which eliminates grease and slivers of copper particles clinging to the wires, and then to an acid-cleaning bath which takes off oxides on the wire surface and slivers.

This latter bath may be dispensed with if the wires were previously annealed and freed of any oxides. Furthermore, other cleaning stages may be added to the treatment plant depending upon the state of the wires or the like to be coated.

It is further to be noted that the connector bars **27**, **63** are preferably insulated against contact with the respective bath solutions. Separate rectifiers (not shown) are used to supply current to said bars (small rectifiers for cleaning baths and larger rectifier for plating bath) and that contactors of known construction (not shown) may be employed to maintain the respective circuits through the baths. It is well understood that the return connection from the wires to the negative common bus bar **65**, which in turn is insulated from bus bars **28** and **64**, may be had in any known and appropriate manner.

These and other modifications of the invention are considered as within the scope of the invention as defined by the claims appended hereto.

I claim:

1. In a plant for electro-plating a plurality of wires which are disposed to move in spaced apart and parallel relation to each other along straight paths from respective supply reels to corresponding take-up reels; elongated tank means having opposite ends and adapted to contain an electrolyte forming treatment liquid, a plurality of electrically insulated, upright guide bar means successively arranged to and spaced apart from each other, said guide bar means extending across and within said tank means, each of said guide bar means having first notches for normally locating said wires therein during their movement along their paths within said tank means for contact with said treatment liquid when supplied to said tank means and having second notches on the top of said guide bar means for positioning predetermined wires during their movement to keep the latter out of contact with said treatment liquid, treatment liquid circulating means for said tank means, said guide bar means including end guide bar means provided with respective end walls sloping toward the ends of said tank means gradually orient overflow of said treatment liquid beyond said first notches to end compartments defined by spaces between said end tank means and said opposite ends of said tanks, and by-pass means level with the bottom of and interconnecting said end compartments and operatively connected to said circulating means, said tank means being provided with anode constituting tray means located below said guide bar means, said wires constituting cathodes in said tank means.

2. In a plant for electrolytically treating simultaneously a plurality of wires disposed to move in spaced apart and parallel relation to each other along straight paths from respective supply reels to corresponding take-up reels; elongated tank means having a bottom wall and end walls and adapted to contain a treatment liquid, a plurality of electrically insulated wire guide means arranged in succession to and spaced from each other and extending across and within said tank means, each of said guide means having slots in which said wires are located during their movement along their paths, respectively, treatment liquid circulating means for said tank means, the slots of said guide means having different depths, predetermined slots of said guide means being arranged at a level above said tank means so that wires engaged in said predetermined slots are kept out of contact with said treatment liquid when supplied to said tank means, whereas other wires when disposed in the remaining slots of said guide means extend below said level and in contact with said treatment liquid, said wire guide means including at least one end guide means provided with a downwardly and outwardly slanting end wall extending from said end guide means into said tank means and spaced from the respective end wall of the latter to define at least one end compartment for collection of overflow treatment liquid escaping from said one slotted end guide means, a by-pass level with said bottom wall of said tank means and in communication with said one end compartment and operatively connected to said treatment liquid circulating means, and respective electrode means located within said treatment liquid of said tank means, one of said electrode means being formed by said wires.

3. In a plant for electro-plating simultaneously a plurality of wires disposed to move in spaced apart and parallel relation to each other along straight paths from respective supply reels to corresponding take-up reels; elongated tank means having a bottom wall and end walls and adapted to contain a treatment liquid, a plurality of electrically insulated wire guide means arranged in succession to and spaced from each other and extending across and within said tank means, each of said guide means having slots in which said wires are located during their movement along their paths, respectively, treatment liquid circulating means for said tank means, the slots of said guide means having different depths, predetermined slots of said guide means being arranged at a level above said tank means so that wires engaged in said predetermined slots are kept out of contact with said treatment liquid when supplied to said tank means, whereas other wires when disposed in the remaining slots of said guide means extend below said level and in contact with said treatment liquid, said wire guide means including two spaced end guide means each provided with a downwardly and outwardly slanting end wall extending into said tank means and in spaced relation to the respective end walls of the latter to define respective end compartments for collection of overflow treatment liquid escaping from said slotted end guide means, a by-pass level with said bottom wall of said tank means positioned exteriorly of said tank means and in communication with said end compartments, said by-pass being operatively connected to said treatment liquid circulating means, and

respective electrode means located within said treatment liquid of said tank means, one of said electrode means being formed by said wires, the other electrode means forming a tray extending above said bottom of said tank means.

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