March 6, 1956 V. A. RAYBURN 2,737,487

ELECTROLYTIC APPARATUS

Filed Nov. 6, 1951 2 Sheets-Sheet 1

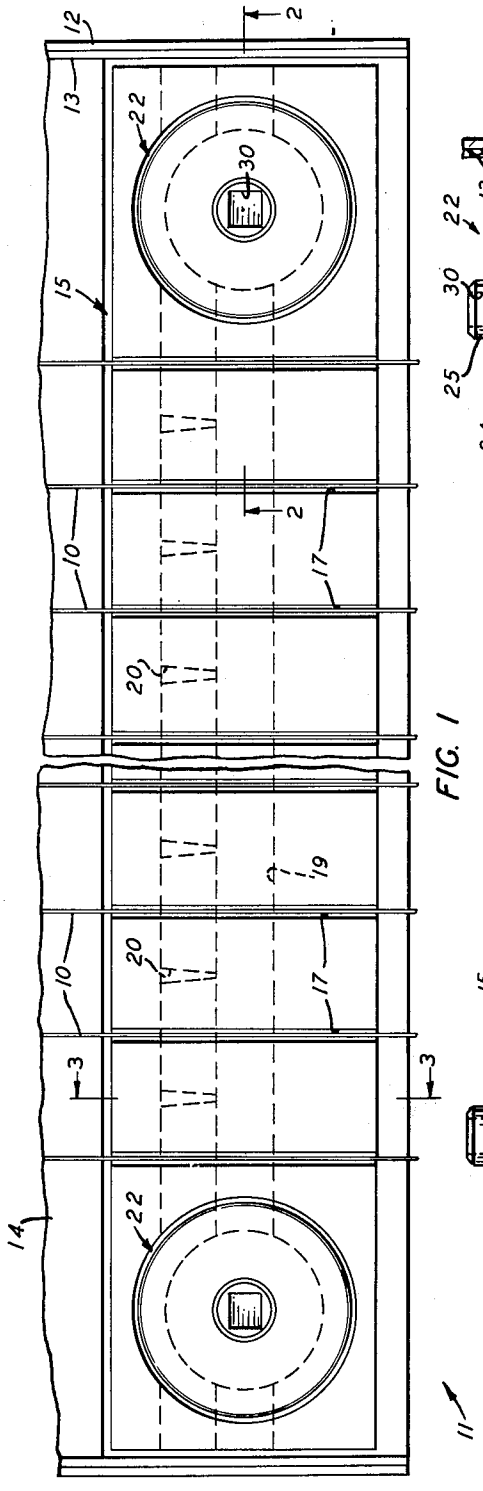


FIG. 1

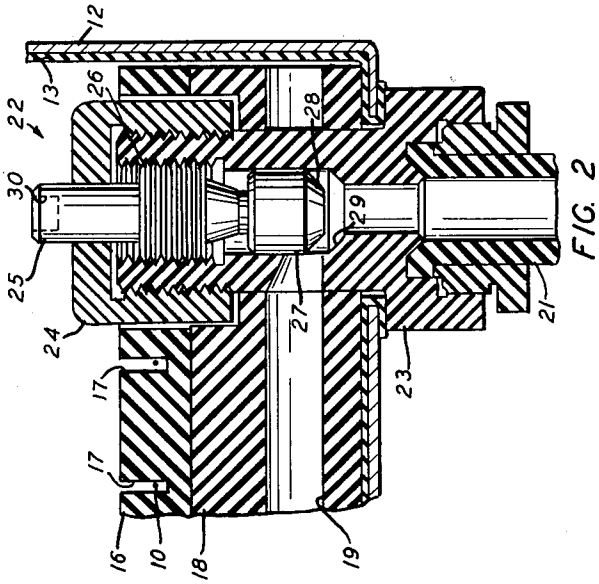


FIG. 2

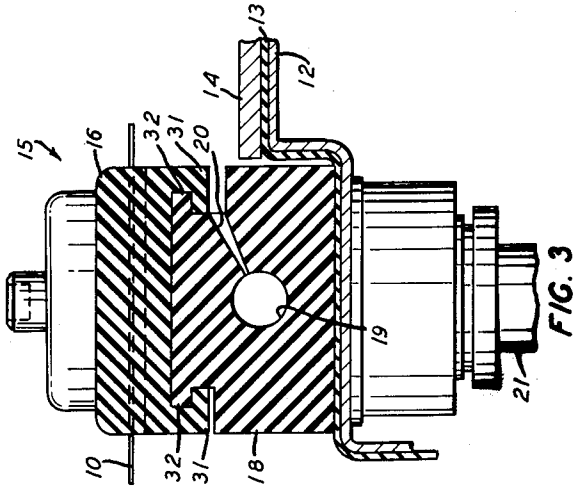


FIG. 3

INVENTOR
V. A. RAYBURN
BY
ATTORNEY

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ELECTROLYTIC APPARATUS

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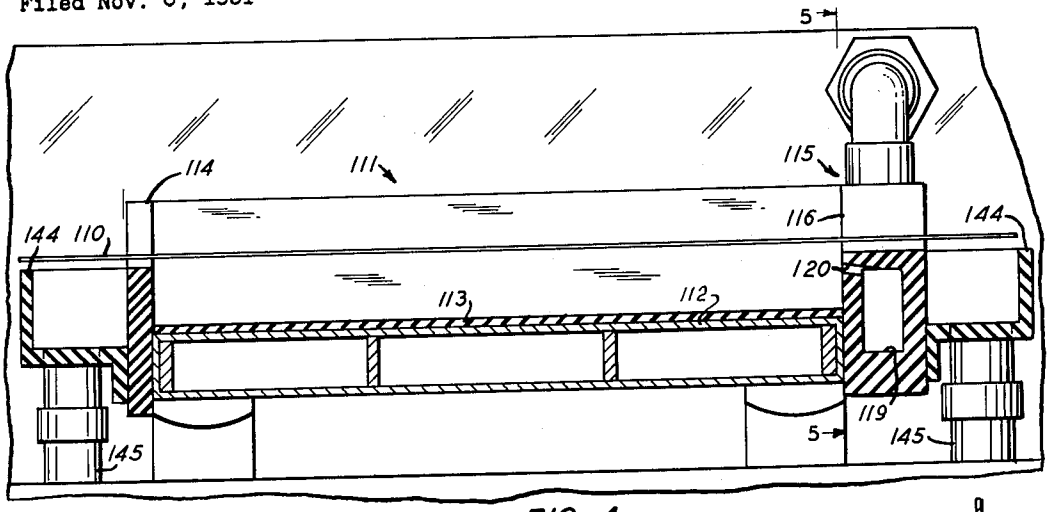


FIG. 4

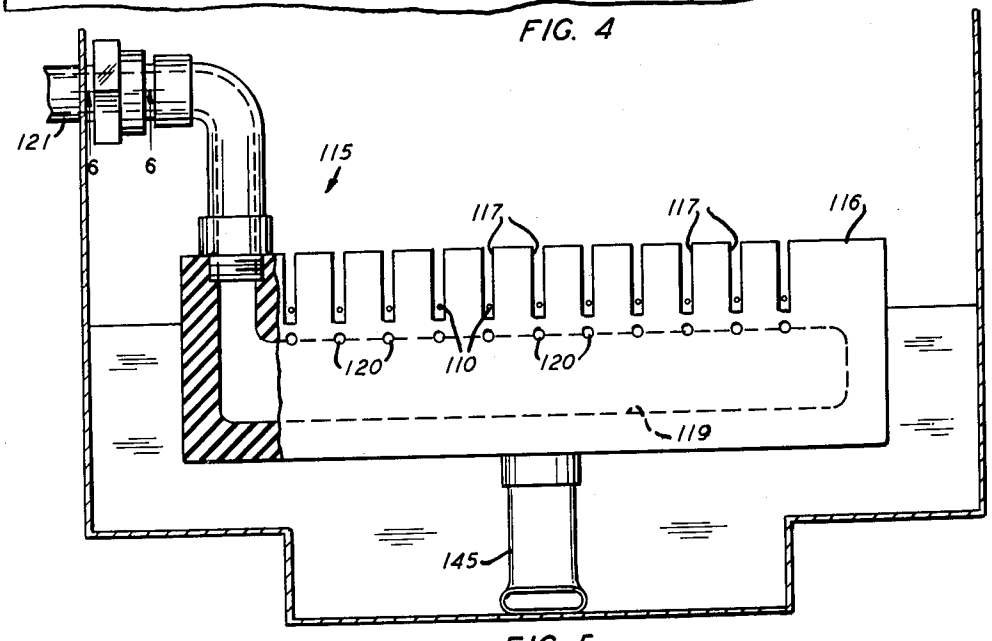


FIG. 5

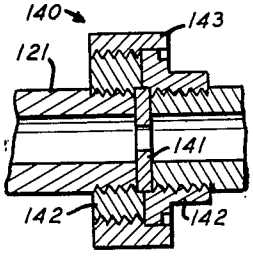


FIG. 6

INVENTOR
V. A. RAYBURN
BY
ATTORNEY

United States Patent Office

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ELECTROLYTIC APPARATUS

Vincent A. Rayburn, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application November 6, 1951, Serial No. 254,989

5 Claims. (Cl. 204—206)

This invention relates to electrolytic apparatus, and more particularly to a combined weir and electrolyte distributor for electroplating cells.

In the manufacture of composite copper-clad steel electrical conductors by continuously electrodepositing a copper layer upon an advancing steel core, a great many steel wires may be simultaneously advanced in parallel side-by-side relationship through an electrolytic cell in which the copper layer is deposited. In order to achieve a high rate of production, the wires may be subjected to a high current density and they may be advanced at a high speed through a cell having a length and width which are relatively great in comparison with the size of the wires being treated. As many as twenty-five or more wires may be simultaneously treated in this fashion. Under such circumstances, the problem of obtaining uniform distribution and circulation of the electrolyte in the cell becomes magnified. Various means have been proposed in the past for effecting uniform forced circulation of the electrolyte and for recirculating the electrolyte into the cell, but none of these prior art means have been entirely satisfactory from a practical standpoint.

An object of the invention is to provide new and improved electrolytic apparatus.

Another object of the invention is to provide a new and improved weir combined with an electrolyte distributor for an electroplating cell.

An apparatus illustrating certain features of the invention may include a cell for electrolytically treating a wire advancing through electrolyte contained therein, a weir positioned at one end of the cell in alignment with the advancing wire and means for introducing electrolyte into the cell through a portion of the weir.

A complete understanding of the invention may be had from the following detailed description of electrolytic apparatus forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary plan view of a portion of an electrolytic cell embodying one form of the invention;

Fig. 2 is a section taken along line 2—2 of Fig. 1;

Fig. 3 is a section taken along line 3—3 of Fig. 1;

Fig. 4 is a longitudinal, vertical section of an electrolytic cell embodying an alternative form of electrolytic cell;

Fig. 5 is a section taken along line 5—5 of Fig. 4 with a part broken away, and

Fig. 6 is an enlarged section taken along line 6—6 of Fig. 5.

In the embodiment of the invention illustrated in Figs. 1 to 3, inclusive, a plurality of steel wires 10—10 may be simultaneously advanced in parallel side-by-side relationship in a horizontal plane through an electrolytic cell 11 in which a layer of copper may be deposited upon the wires. The cell 11 has an outer shell 12 provided with a corrosion-resistant lining 13 made of rubber, a polyvinyl compound, or the like. An anodically charged plate 14 extends over the bottom of the cell 11 and is covered by finely divided copper particles (not shown) which gradually go into solution to replenish the supply of metal in the electrolyte as the plating process progresses. The horizontal plane in which the wires 10—10 travel through the cell 11 lies between the anode plate 14 and the surface of the electrolyte in the cell, so that the wires are completely submerged.

In emerging from the electrolytic cell 11, the wires 10—10 pass through a combined weir and distributor assembly 15 positioned at the exit end of the cell. An upper portion 16 of the assembly 15 functions as a weir having a plurality of slots 17—17 in proper alignment with the moving wires. The width of the slots 17—17 is sufficient to provide adequate clearance for the wires moving therethrough, and a small quantity of electrolyte will overflow the cell through these slots. This overflow of the electrolyte is caught in a trough (not shown) positioned at this end of the cell, and is recirculated back into the cell.

The combined weir and distributor assembly 15 is so constructed that it can serve in a dual capacity, acting as a weired dam past which a limited amount of the electrolyte may overflow as the submerged wires 10—10 emerge from the cell 11 through the weir 16, and at the same time functioning as a supply manifold and distributor for electrolyte being pumped into the cell. The weir and distributor assembly 15 includes a base 18 made of hard rubber, or other suitable corrosion resistant material, having a cavity 19 therein which extends transversely of the cell 11. Branching off from the cavity 19 are a plurality of equally spaced orifices 20—20 through which the electrolyte flows into the cell. One of these orifices may be positioned between each of the slots 17—17 through which the wires 10—10 travel, in the manner illustrated in Fig. 1. The orifices 20—20 are tapered outwardly, increasing gradually in size as they lead from the cavity 19, to minimize the jet effect of electrolyte solution being forced therethrough, so that the evenness of the surface of the metal particles resting on the bottom of the cell will not be disturbed.

Electrolyte may be fed under pressure into the cavity 19 from a pair of supply pipes 21—21 through a pair of regulating valves 22—22 positioned at opposite ends of the combined weir and distributor assembly 15. While a single supply pipe and valve may operate satisfactorily, it will be found more desirable to utilize a pair of supply pipes and valves. If the electrolyte were introduced under a high pressure into a distributor for a wide plating cell, most of the solution would enter the cell near the distant end of the distributor if only one supply pipe and valve were used. Also, in using an electrolyte having a high specific gravity, more uniform distribution of the solution may be had by utilizing a supply pipe and valve at each end of the distributor.

Since the valves 22—22 are identical in construction and in operation, only one need be described. The valve 22 includes a hard rubber body 23 held in position on the assembly 15 by a threaded, hard rubber cap 24. A hard rubber stem 25 having a portion 26 in threaded engagement with the body 23 of the valve, extends through the cap 24 and carries a soft rubber seat 27 on the lower end thereof. The seat 27 has a frustoconical tip 28 designed to engage a matching seat 29 formed in the body 23, when the valve is closed. The valve stem 25 is provided with a socket 30 formed in the top end thereof, into which a suitable wrench may be inserted to raise and lower the soft rubber seat 27. In this manner, the flow of electrolyte solution may be regulated, or shut off when desired.

The weir 16 may be composed of a vulcanized rubber compound having a stiffness and a resiliency approximating those of tire tread. The weir 16 is provided with a pair of flanges 31—31, which enable it to be snapped onto the top of the base 18 and held in place by engagement

of the flanges 31—31 with a matching pair of flanges 32—32 formed on the top of the base 16. This arrangement permits the weir and distributor assembly 15 to be readily dismantled. The resiliency feature of the weir offers further advantages, for should particles of copper metal or of a foreign material become stuck to the weir, they may be readily dislodged by a mere flexing action performed by an operator. Also the weir is adjustable laterally to a limited degree in order to align it with the wires passing through the slots 17—17 therein.

Alternate construction

In the second embodiment of the invention, illustrated in Figs. 4 to 6, inclusive, a plurality of wires 110—110 may be advanced in a horizontal plane through an electroplating cell 111 having a shell 112 provided with a rubber lining 113. The exit end of the cell 111 is provided with a weir 114 through which the wires may emerge from the cell. At the entrance end of the cell the moving wires pass through a combined weir and distributor assembly 115 provided with an upper portion 116 constituting a weir having a plurality of slots 117—117 for receiving the moving wires. This assembly is a unitary structure composed of hard rubber, or like corrosion resistant material, and having a cavity 119 formed therein transversely of the cell. A plurality of equally spaced orifices 120—120 lead from the cavity 119, and electrolyte may be introduced under pressure into the cell through these orifices.

In this embodiment of the invention, the orifices 120—120 are not tapered, and they correspond with and are in alignment with the slots 117—117. Below each slot is one orifice directed substantially parallel to the horizontal plane in which the moving wires travel. Also, in this embodiment of the apparatus the weir 116 is integral with the electrolyte distributor, and this entire assembly may be removed as a unit from the apparatus.

Electrolyte is introduced into the cavity 119 from a supply pipe 121 having a flow regulator 140 therein. A centrally apertured orifice plate 141 is removably positioned within the supply pipe 121 at a union joint, which includes a pair of threaded collars 142—142. These collars are positioned on opposite sides of the orifice plate 141, and a third threaded collar 143 is designed to hold the other two collars together. This union joint may be readily uncoupled, so that an orifice plate having an aperture of a different size may be inserted to change the rate of flow of the electrolyte. Under ordinary operating conditions, frequent regulation of the rate of flow of the electrolyte is unnecessary. Hence, this type of flow regulator may be satisfactorily substituted for the adjustable valve incorporated in the first embodiment of the invention.

A small quantity of the electrolyte being introduced into the cell 111 overflows through the weir 114 as the wires emerge therefrom, and another small quantity of the electrolyte overflows through the weir 116 of the combined weir and distributor assembly 115 at the entrance end of the cell. Such overflow is caught in a pair of troughs 144—144 positioned at opposite ends of the cell 111, from which it is drained through a pair of discharge pipes 145—145 to an electrolyte supply tank (not shown) and is pumped back into the cell.

The above-described arrangements are effective to insure uniform distribution of electrolyte solution under forced circulation in this type of electroplating cell. A plurality of wire being treated therein may be continuously advanced at a high rate of speed, yet these wires will receive a uniform electrodeposited coating. The apparatus is made impervious to chemical action of the electrolyte solution by having all surfaces except that of the anode and the moving cathode coated with or made of solid rubber, or other material that is not attacked by the electrolyte. The apparatus is simple in construction and in operation, and it may be readily disassembled for cleaning or repairs.

What is claimed is:

1. In a generally rectangular, open-topped electrolytic cell having bottom and side walls through which a plurality of wires are advanced in parallel, side-by-side relationship in the same plane submerged in electrolyte, the improvement which comprises a manifold removably positioned transversely across the cell and cooperating with the bottom and side walls thereof to close one end of the cell, said manifold being composed of hard rubber and having a cavity formed therein extending transversely across the cell and also having a plurality of orifices leading from the cavity to the cell at equal intervals across the cell, a weir composed of tough, flexible rubber removably snapped into liquid-tight engagement with the top of the manifold and having a plurality of spaced slots at the top thereof through which the advancing wires and small quantity of electrolyte pass, an electrolyte supply pipe communicating with said cavity in the manifold, and a valve located in the supply pipe for regulating the rate at which electrolyte is introduced into the manifold.

2. In a generally rectangular, open-topped electrolytic cell having bottom and side walls through which a plurality of wires are advanced in parallel, side-by-side relationship in the same plane submerged in electrolyte, the improvement which comprises a manifold removably positioned transversely across the cell and cooperating with the bottom and side walls thereof to close one end of the cell, said manifold being composed of hard rubber and having a cavity formed therein extending transversely across the cell and also having a plurality of orifices leading from the cavity to the cell at equal intervals across the cell below the top thereof and directed towards the opposite end of the cell, said orifices being tapered to increase gradually in size as they lead away from the cavity, a weir composed of tough, flexible rubber removably snapped into liquid-tight engagement with the top of the manifold and having a plurality of spaced slots at the top thereof through which the advancing wires pass and through which a small quantity of electrolyte overflows from the cell, and a pair of rubber valves communicating with opposite ends of the cavity in the manifold for regulating the rate at which electrolyte is introduced into the cavity.

3. In a generally rectangular, open-topped electrolytic cell having bottom and side walls through which a plurality of wires are advanced in parallel, side-by-side relationship in the same plane submerged in electrolyte, the improvement which comprises a manifold removably positioned across the cell and cooperating with the bottom and side walls thereof to substantially close one end of the cell for introducing and controlling the direction of flow of the electrolyte into the cell, a weir positioned across the cell and removably mounted in liquid-tight engagement with the top of the manifold for maintaining the electrolyte contained within the cell at a predetermined depth, and means for supplying electrolyte to the manifold at a regulated rate.

4. In a generally rectangular, open-topped electrolytic cell having bottom and side walls through which a plurality of wires are advanced in parallel, side-by-side relationship in the same plane submerged in electrolyte, the improvement which comprises a manifold removably positioned across the cell and cooperating with the bottom and side walls thereof to substantially close one end of the cell and having a plurality of diverging orifices formed therein for introducing and controlling the direction of flow of the electrolyte into the cell, a weir positioned across the cell and removably mounted in liquid-tight engagement with the top of the manifold for maintaining the electrolyte contained within the cell at a predetermined depth, and supply means including a valve for regulating the rate at which the electrolyte is introduced into the manifold and thereby into the cell.

5. In a generally rectangular, open-topped electrolytic cell having bottom and side walls through which a plurality of wires are advanced in parallel, side-by-side relationship in the same plane submerged in electrolyte, the improvement which comprises a hard rubber manifold removably positioned transversely across the cell and cooperating with the bottom and side walls thereof to close one end of the cell, said manifold having a plurality of spaced diverging orifices formed therein for introducing and restricting the direction of flow of the electrolyte into the cell, a rubber weir positioned transversely across the cell and removably mounted in liquid-tight engagement with the top of the manifold, said weir having a plurality of spaced slots formed therein through which the advancing wires and limited quantities of electrolyte pass and also being adjustable laterally with respect to the

manifold to an extent sufficient to align the slots therein with the wires, and a valve connected to the manifold for regulating the rate at which the electrolyte is introduced into the manifold.

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