March 7, 1933. R. A. WILKINS 1,900,534

ELECTROLYTIC APPARATUS

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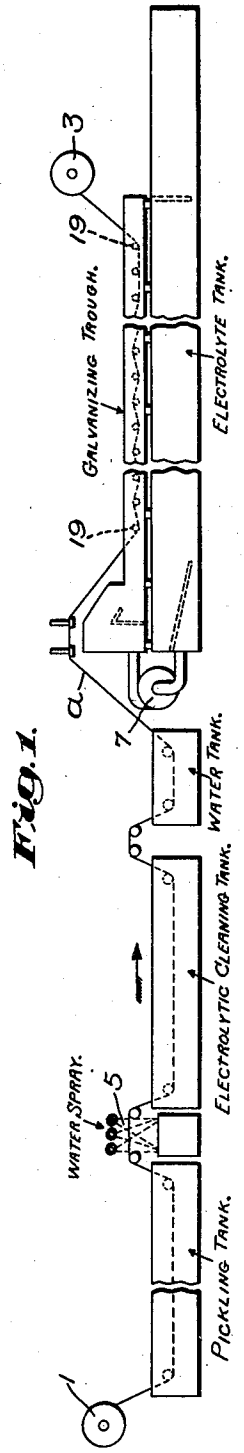

Fig. 1.

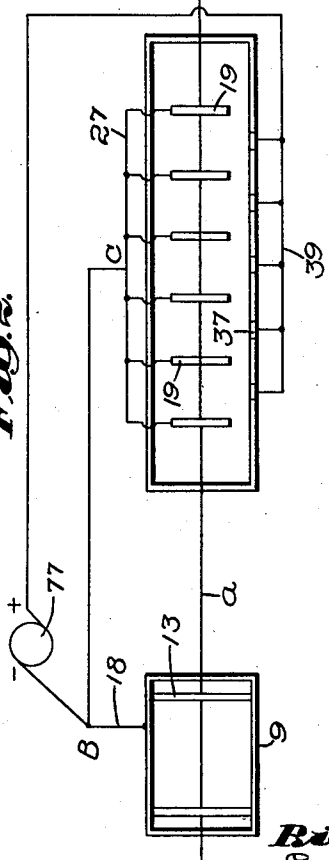

Fig. 2.

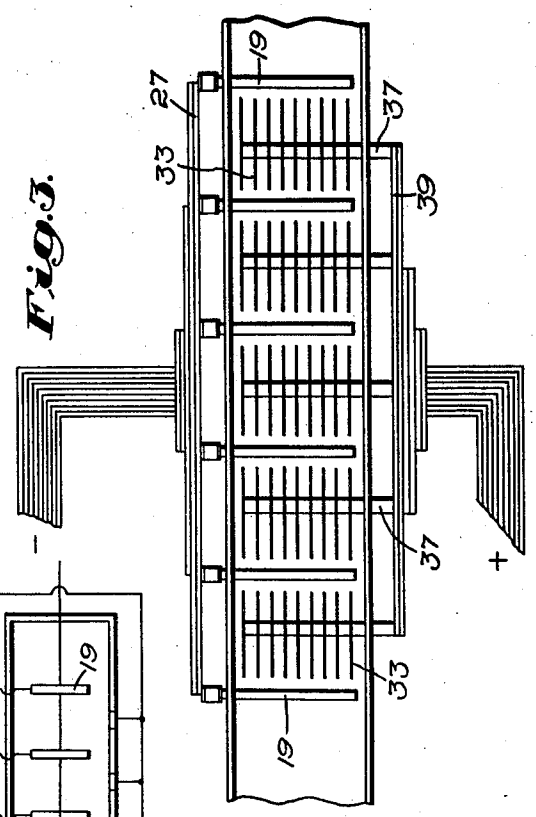

Fig. 3.

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ELECTROLYTIC APPARATUS

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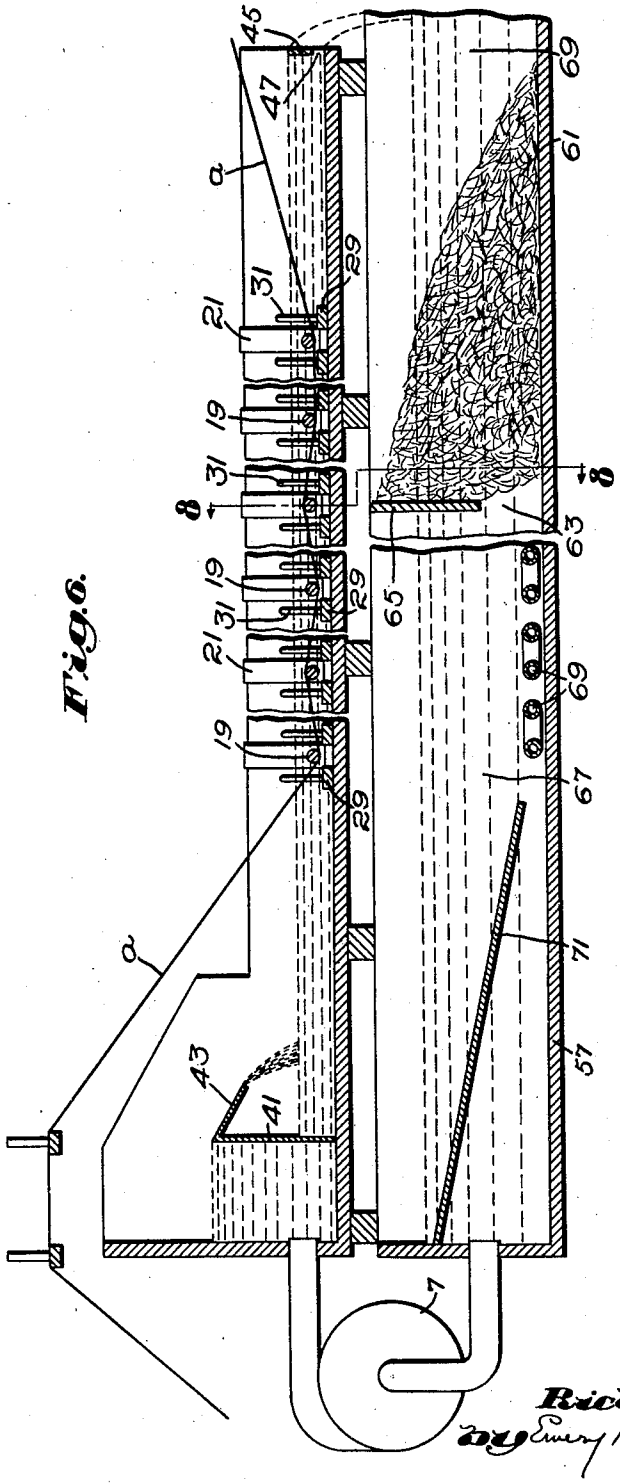

Fig. 6.

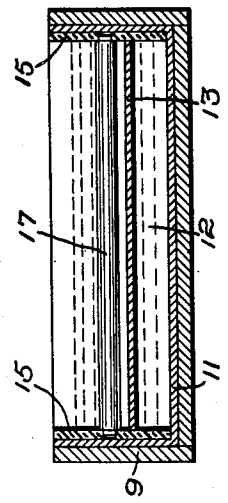

Fig. 5.

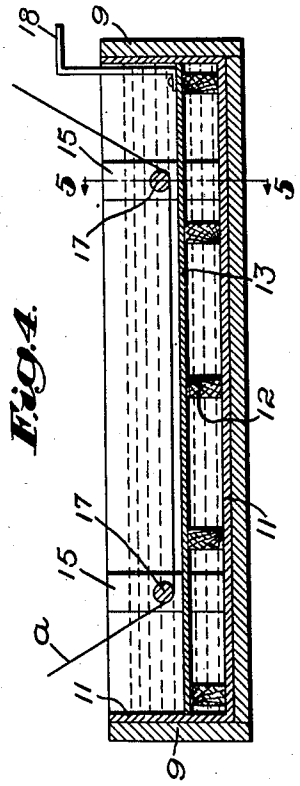

Fig. 4.

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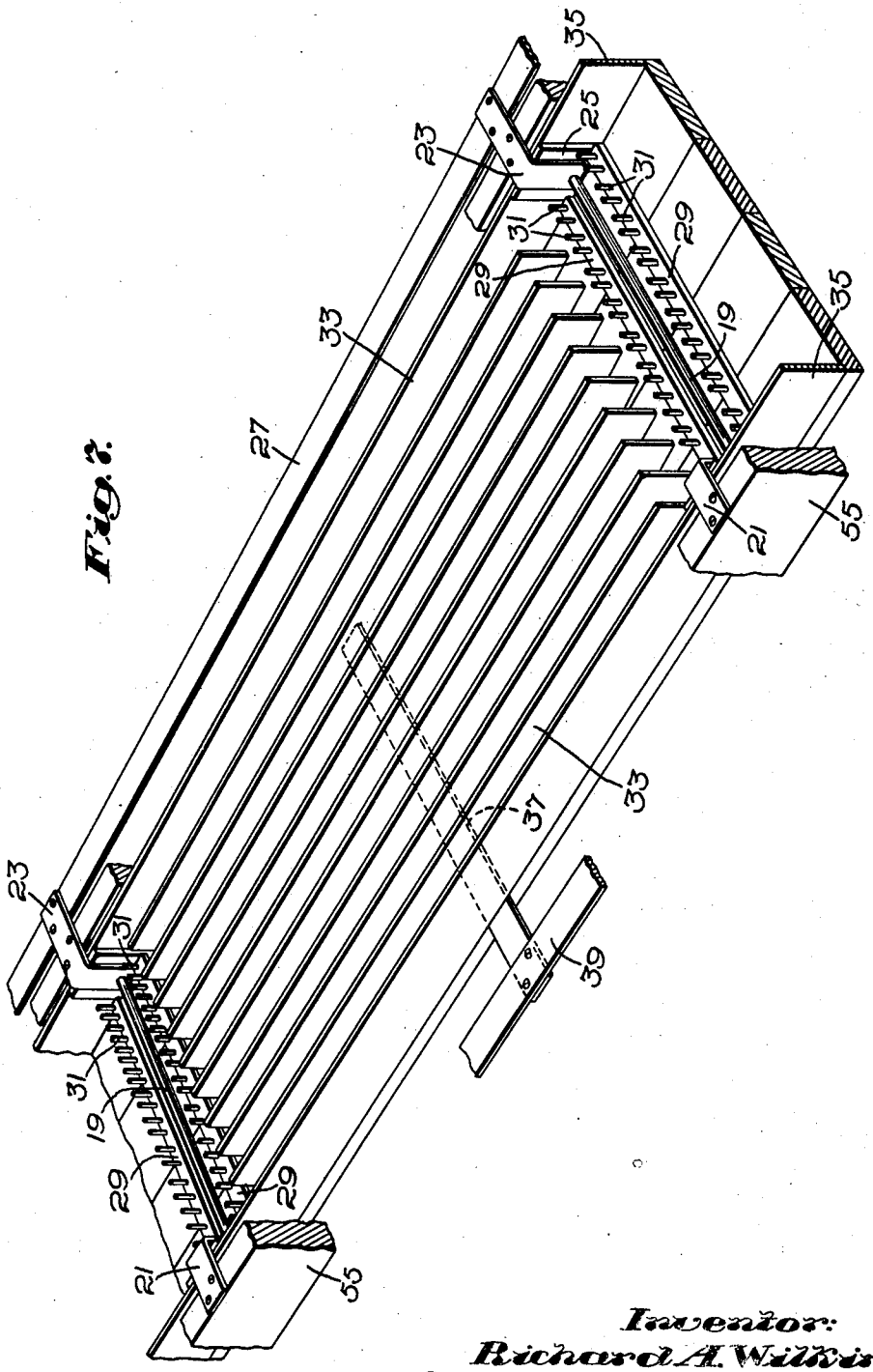
Fig. 2.



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ELECTROLYTIC APPARATUS

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Fig. 10.

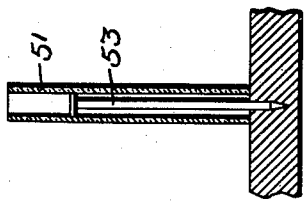


Fig. 8.

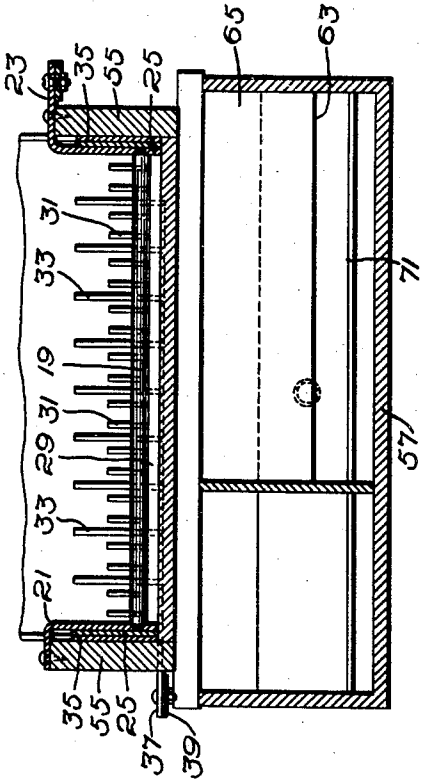
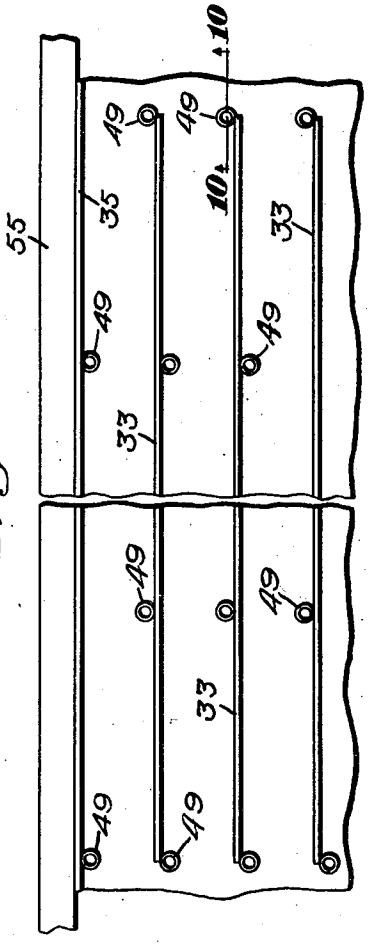


Fig. 9.



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ELECTROLYTIC APPARATUS

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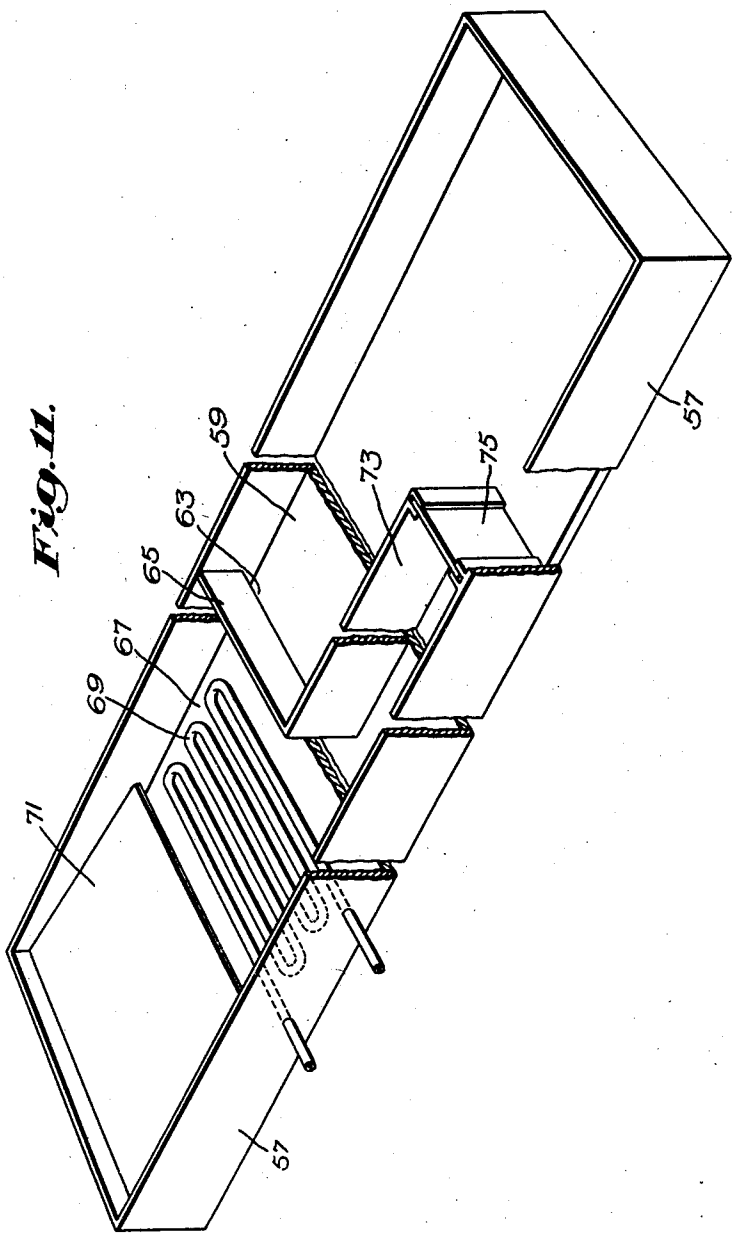
Fig. 11.



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UNITED STATES PATENT OFFICE

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ELECTROLYTIC APPARATUS

Application filed August 21, 1928. Serial No. 301,120.

My invention relates to electrolytic methods and apparatus, and particularly but not exclusively to methods and apparatus for galvanizing articles such as metal wires, ribbons, and the like.

The invention will be best understood from the following description when read in the light of the accompanying drawings of an example of apparatus according to the invention, and description of an example of the practice of the improved method, while the scope of the invention will be more particularly pointed out in the appended claims.

In the drawings:—

Fig. 1 is a diagrammatic representation of an apparatus for practicing the invention;

Figs. 2 and 3 are schematic wiring diagrams;

Fig. 4 is a longitudinal section of the electrolytic cleaning tank;

Fig. 5 is a section on the line 5—5 of Fig. 4;

Fig. 6 is a fragmentary longitudinal section through the galvanizing trough and electrolyte tank;

Fig. 7 is an isometric view of a fragment of the galvanizing trough with parts broken away;

Fig. 8 is a section on the line 8—8 of Fig. 6;

Fig. 9 is a plan view of a fragment of the electrolyte trough illustrating a detail of construction;

Fig. 10 is a section on the line 10—10 of Fig. 9; and

Fig. 11 is an isometric view of the electrolyte tank.

Referring to the drawings I have illustrated diagrammatically in Fig. 1 an arrangement of apparatus comprising a pickling tank, an electrolytic cleaning tank, and a trough in which the articles treated are electrolytically coated, through which tanks and trough one or more wires, ribbons, or other elongated articles of conductive material are moved in the direction of the arrow from one or more supply reels 1 to collecting reels 3. Herein for convenience the trough in which the articles are coated is termed the galvanizing trough, although it will be understood that the invention is not limited to galvanizing.

Between the pickling tank and electrolytic cleaning tank I have indicated a water spray 5 for washing the adhering pickling solution from the articles being treated after they leave the pickling tank, and between the cleaning tank and the galvanizing trough I have indicated a water tank through which the articles pass so as to free them from the electrolyte adhering to them after they leave the cleaning tank.

As will hereinafter be more fully described the electrolyte used for galvanizing the articles is circulated through the galvanizing trough and an electrolyte tank, which herein is positioned below it, a pump 7 raising the electrolyte from the electrolyte tank to the galvanizing trough, through which trough the electrolyte flows and discharges at the right hand end thereof by gravity into the electrolyte tank.

As illustrated, (Figs. 4 and 5) the electrolytic cleaning tank comprises a wooden or other suitable container 9 having a lining 11 of sheet lead or other material insoluble in the electrolyte contained in that tank. Supported above the bottom of the tank by blocks 12 is shown a plate 13 of conductive material insoluble in the electrolyte, as for example iron. At opposite sides of the tank are illustrated strips of insulating material 15 which support bars 17 of suitable acid-resisting material, as for example the iron-silicon alloy hereinafter referred to in connection with the galvanizing trough. The bars 17 as clearly indicated in Fig. 4 serve to cause the article being treated to move in closely spaced relation to the conductive plate 13, and as hereinafter explained where a plurality of wires or ribbons are passed through a tank said wires or ribbons may be held in spaced relation by the rake-like guides hereinafter described. As shown the plate 13 has in electrical communication therewith a conductor 18 for connecting it to a source of electromotive force.

As will hereinafter be more fully ex-

plained, the portion of the article being treated in the electrolytic cleaning tank constitutes an anode, while the conductive plate 13 is connected to a source of electromotive force which is negative relative to the article and consequently constitutes a cathode. With this arrangement, a small depositing current is effective to clean the surface of the portion of the article in the electrolytic cleaning tank. Preferably the article before being moved into the cleaning tank is passed through a pickling tank which will remove the grease, oxides etc. from the surface of the article. With this arrangement the hydrogen bubbles resulting from pickling which adhere to the article after leaving the pickling solution are "plated-off" in the cleaning tank. However if desired the pickling tank may be dispensed with and all the cleaning of the wire be effected by "plating-off" with a relatively higher current density in the cleaning tank. For example, with high carbon steel wire pickling in a sulphuric acid bath hardens the wire and makes it brittle. Therefore, with such wire, the pickling, according to my invention, may be dispensed with and the entire cleaning effected in the cleaning tank using a relatively high current density for the plating-off operation.

With the present arrangement for treating iron wires or ribbons I have found as suitable for a cleaning solution in the electrolytic cleaning tank a saturated solution of ferrous sulphate precipitated to a heavy slime with ammonium hydroxide, but it will be understood that I am not limited to this composition.

As illustrated, the galvanizing trough contains a series of spaced bars 19 (Figs. 1, 6, 7 and 8) opposite ends of which are supported in brackets 21 and 23 carried on the blocks 25 of insulating material, the brackets 23 and the bars 19 being of conductive material insoluble in the electrolyte. As illustrated, the brackets 23 are placed in electrical communication by a buss bar 27 which when connected to the negative terminal of a source of electromotive force for the depositing current will cause those portions of the articles being treated and moving through the galvanizing trough to constitute cathodes. At opposite sides of the bars 19 are shown rake-like guides comprising wooden strips 29 into which are driven rows of pins 31 formed of suitable acid-resisting material. These pins serve to hold the wires or ribbons being treated in spaced relation.

Extending from adjacent one bar 19 to adjacent the next bar 19 are shown parallel partitions 33, preferably of zinc to constitute soluble anodes, but which may be formed of suitable conductive material insoluble in the electrolyte, the sides of the galvanizing trough being of wood or other material not attacked by the electrolyte. As illustrated, the partitions 33 are placed in electrical communication with each other by means of bars 37 of conductive material, as for example copper bars which are in contact with the bottom edges of the sides and partitions. The bars 37 when connected by means of a conductor, as for example a buss bar 39, to the positive terminal of the source of electromotive force, the negative terminal of which is connected to bars 19, cause the partitions 33 to act as anodes.

As best illustrated in Fig. 6 the end of the galvanizing trough adjacent the pump is provided with a dam 41 having an apron 43 over which the electrolyte flows and moves in a swift-flowing stream through the trough in the spaces between the partitions 33. At the right hand end of the trough, as viewed in the drawings, the electrolyte discharges by gravity into the electrolyte tank, the right hand end of the galvanizing trough for this purpose herein being provided with a dam 45, the lower edge of which dam is spaced from the bottom of the trough to permit the bulk of the electrolyte to discharge beneath it, only a portion of the electrolyte passing over the top of the dam. This construction provides that the top of the electrolyte will be approximately level so that there will be approximately the same depth of electrolyte throughout the portion of the trough in which the wires or ribbons are submerged.

For supporting the partitions 33 I have shown the staggered pins 49 each of which may consist of a porcelain tube 51 slipped over the end of a nail 53 driven into the bottom of the tank. In a similar manner the side anodes 35 are held against the sides 55 of the trough by like pins 49.

The electrolyte tank, as illustrated, may consist of a lead lined wooden trough 57 having the compartment 59 in which is placed a body of electrolyte replenishing material 61, as for example scrap zinc. The electrolyte discharging at the right hand end of the galvanizing trough is received by the compartment 59 and from there flows through the electrolyte replenishing material and through the space 63 below the partition 65 into the cooling compartment 67 of the electrolyte tank, which latter compartment contains a coil 69 through which is circulated a cooling medium. As shown, the left hand end of the electrolyte tank is a baffle plate 71 for preventing air from being drawn into the intake of the electrolyte circulating pump 7.

Any suitable means may be provided for regulating the rate of replenishment of the metal content of the electrolyte. Herein for this purpose is provided a bypass passage 73 which may be controlled by a gate 75 to

permit more or less of the electrolyte received by the compartment 59 to pass through said bypass passage instead of through the electrolyte replenishing material. Where the anodes in the galvanizing tank are soluble, the greater portion of the replenishment takes place from the soluble anodes, the bypass gate 75 being opened relatively wide and a relatively small amount of zinc being used as replenishing material 61 in the compartment 59. Where, on the other hand, the anodes 33 are insoluble, the bypass gate is closed to such an extent that the electrolyte flowing past the replenishing material 61 will be sufficient to prevent impoverishment of the bath.

As an example of a suitable electrolyte, but without limitation thereto, I may use about two percent of free sulphuric acid, with nine percent of zinc added in the form of zinc sulphate, and the balance water. I have found as suitable for guide bars 17, for insoluble anodes 33 where such are used, and for other acid-resisting parts, an alloy comprising from 8 to 18% silicon, 5 to 20% copper, and 5 to 20% nickel, with the balance iron. It will be understood however that I am not limited to the use of this alloy.

As an example of the practice of the invention, but without limitation thereto, I have found that satisfactory results may be obtained by simultaneously galvanizing 10 steel ribbons each about 3/8 inch wide, when the anode bars 33—35 are about 10 feet long and spaced about 4 5/8 inches apart, and moving the ribbons at about 20 feet per minute with a 50 foot length submerged in the electrolyte, the latter circulating at about 1000 gallons per minute, and the depositing current being about 8000 amperes with an impressed voltage of about 4½ to 5 volts. In this example of my invention I have found that satisfactory results may be obtained by maintaining the metal content of the electrolyte from about 8½ to 9½ percent zinc.

In practicing the invention the metal content of the electrolyte may be determined from time to time by measuring the specific gravity of the electrolyte. By manipulating the by-pass controlling gate 75 from time to time the metal content of the electrolyte may be maintained between upper and lower limits, as for example the by-pass gate may be controlled to cause a rate of replenishment of the metal content of the electrolyte greater than the rate of depositing metal from the electrolyte until the metal content reaches a maximum limit of about 9½% of zinc, whereupon the by-pass gate may be closed sufficiently to cause a rate of replenishment less than the rate of depositing until the metal content of the electrolyte reaches a lower limit of about 8½% zinc, whereupon the gate may be opened farther and the operation repeated.

Referring to Fig. 2, which shows a schematic wiring diagram of the apparatus, the guide bars 19 of the galvanizing trough which contact with the wires or ribbons *a* are connected to the negative side of a generator or other source of electromotive force 77, while the bars 27 in electrical communication with the anodes 35 and 33 of the galvanizing trough are connected to the positive side of the generator. The plate 13 constituting the cathode of the electrolytic cleaning tank is connected to a point B between the negative terminal of the generator and the bars 19 so that the portions of the wires or ribbons *a* in the electrolytic cleaning tank are at a positive potential relative to said plate, due to the drop in potential between the points of contact of the wires or ribbons with the bars 19 and the point B. I have found that satisfactory results may be obtained when treating 10 wires or ribbons and when the depositing current through the electrolyte trough is 8000 amperes, if the resistance between the points of contact of the wires or ribbons with the bars 19 and the point B is about 0.00005 ohms corresponding to a potential drop of about 0.4 volts, and the resistance through the wires or ribbons *a*, electrolytic cleaning tank, and conductor 18 to the point B is about 0.08 ohms, corresponding to a total "depositing" current in the cleaning tank of about 5 amperes.

It will be observed from the foregoing that I utilize the same source of electromotive force for the electrolytic cleaning tank and galvanizing trough, and that the portions of the wires or ribbons in the cleaning tank constitute the anode of an electrolytic cell, while the portions thereof in the galvanizing trough constitute a cathode of another cell. It will also be observed that the drop in potential through a portion of the circuit for the last mentioned cell serves to cause the current through the first mentioned cell.

As illustrated more or less diagrammatically by Fig. 3 the buss bars 27 and 39 may be of non-uniform cross-section so as to determine the rate of deposition on different portions of the wires or ribbons submerged in the electrolyte of the galvanizing trough. As illustrated, the buss bars uniformly decrease in cross-section from the conductors connecting them to the terminals of the generator so that the rate of deposition will be substantially constant throughout the length of the wires or ribbons submerged in the electrolyte.

Although I have described a specific example of apparatus and of the practice of my improved method, it will be understood that within the scope of my invention wide

deviations may be made therefrom without departing from the spirit of my invention.

I claim:

1. Apparatus for electro-depositing zinc comprising, in combination, a cathode, an anode containing soluble zinc in proximity to said cathode; said anode so proportioned and so located as primarily electrolytically to supply zinc to the electrolyte at a rate less than zinc is deposited upon the cathode under the desired electrolyte and current conditions; supplemental zinc bearing material relatively remote from said cathode and having the capacity for supplying to the electrolyte, primarily by chemical reaction, more than sufficient zinc to compensate for the excess of zinc deposited over that supplied by said anode; means for circulating said electrolyte in contact with said cathode and anode and in contact with said supplemental zinc bearing material, and means for varying the extent to which the capacity of said supplemental material is used, thereby to increase or decrease the zinc content of the electrolyte.

2. Apparatus for electro-depositing zinc comprising, in combination, a cathode, an anode containing soluble zinc in proximity to said cathode; said anode so proportioned and so located as primarily electrolytically to supply zinc to the electrolyte at a rate less than zinc is deposited upon the cathode under the desired electrolyte and current conditions; supplemental zinc bearing material relatively remote from said cathode and having the capacity for supplying to the electrolyte, primarily by chemical reaction, more than sufficient zinc to compensate for the excess of zinc deposited over that supplied by said anode; means for circulating said electrolyte in contact with said cathode and anode and in contact with said supplemental zinc bearing material, and means for varying the extent to which the capacity of said anode and supplemental material are used, thereby to increase or decrease the metal content of the electrolyte.

3. Apparatus for electro-depositing zinc comprising, in combination, a cathode, means for guiding an electrolyte in contact with said cathode comprising guiding means of soluble zinc bearing material constituting an anode in proximity to said cathode, a body of electrolyte replenishing zinc bearing material, and means for circulating said electrolyte in a swift flowing stream in contact with said guiding means and cathode and in contact with said replenishing material.

4. Apparatus for electro-depositing zinc comprising, in combination, a cathode, means for guiding an electrolyte in contact with said cathode comprising guiding means of soluble zinc bearing material constituting an anode in proximity to said cathode, a body of electrolyte replenishing zinc bearing material, means for circulating said electrolyte in a swift flowing stream in contact with said guiding means and cathode and in contact with said replenishing material, and means for controlling the rate of solution of said zinc of said body.

In testimony whereof, I have signed my name to this specification.

RICHARD A. WILKINS.