

Sept. 11, 1945.

C. H. WARD

2,384,660

APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

Filed March 11, 1940

17 Sheets-Sheet 2

Fig. 3.

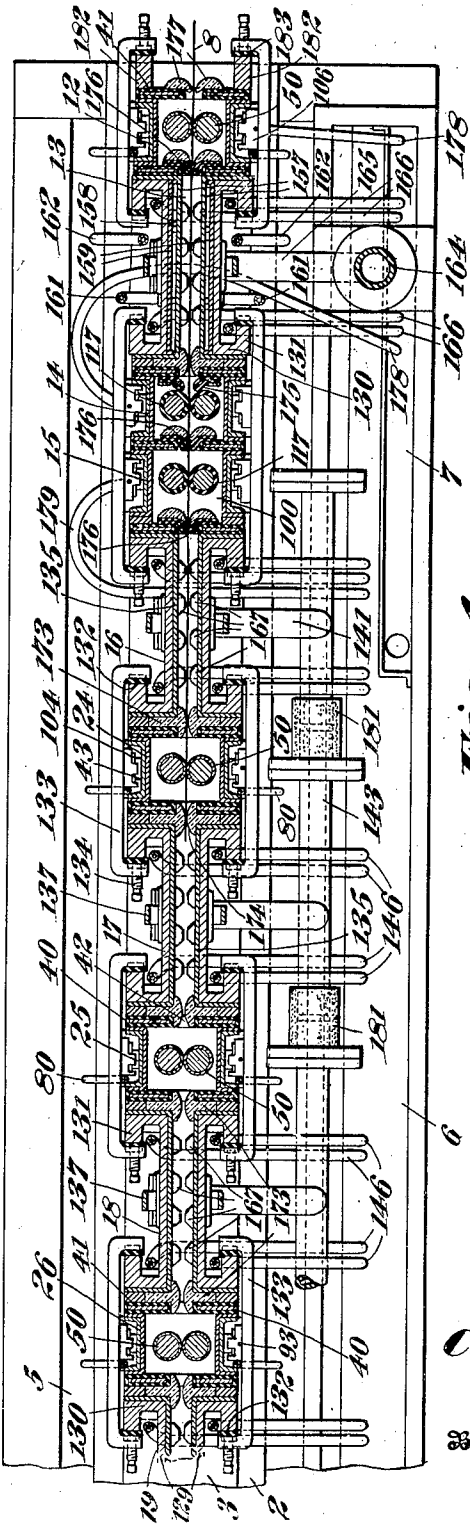
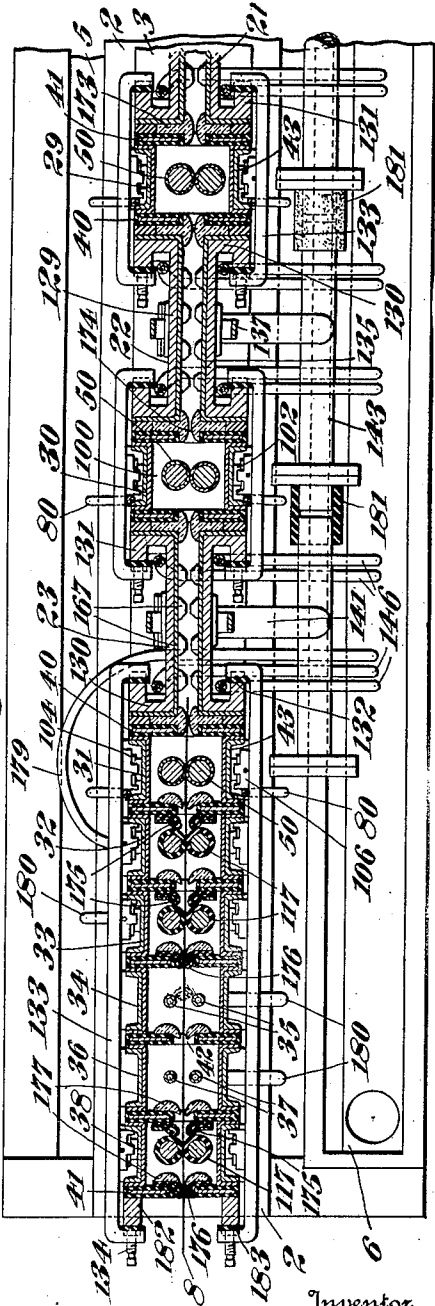


Fig. 4.



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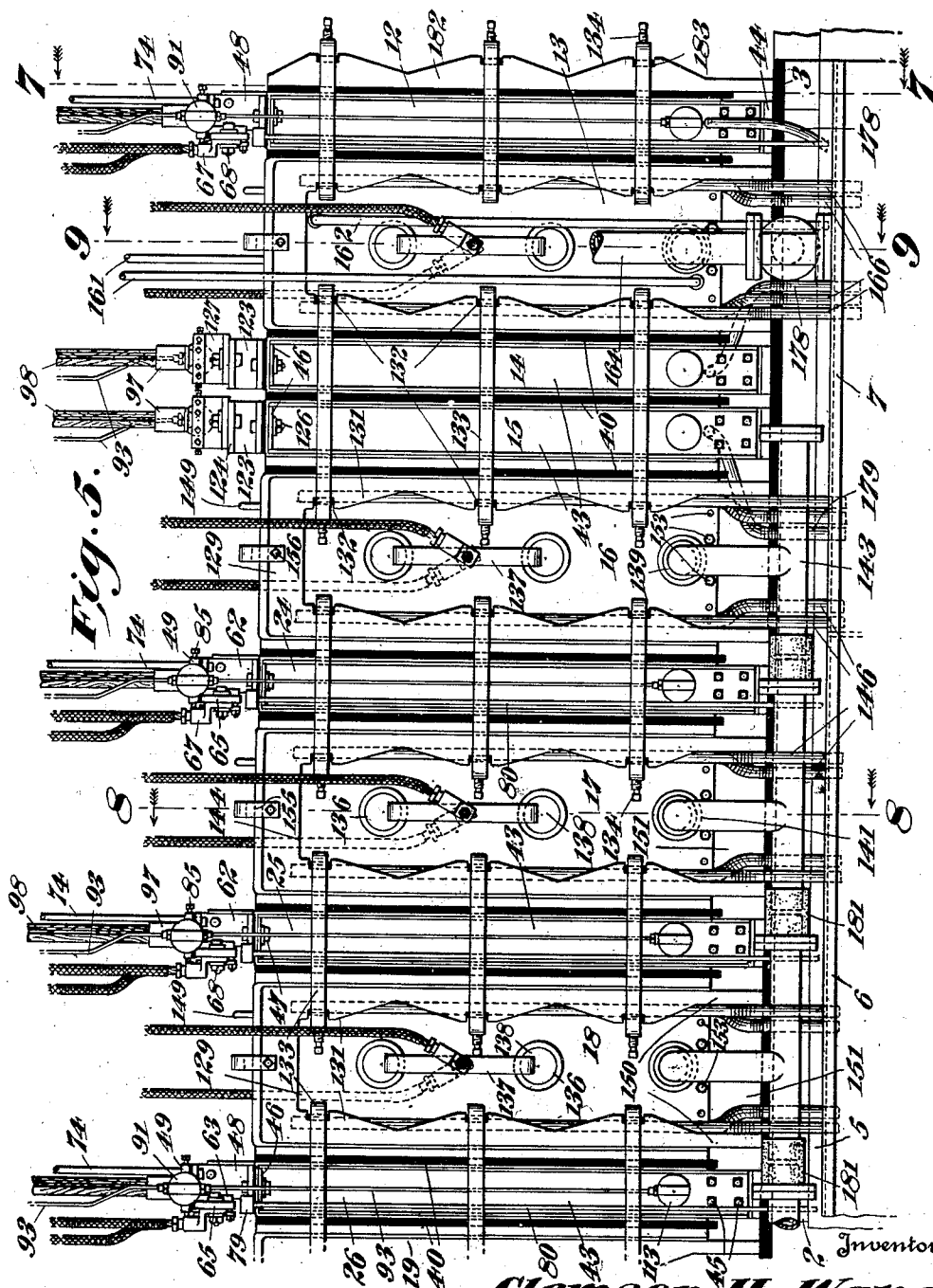
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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

Filed March 11, 1940

17 Sheets-Sheet 3



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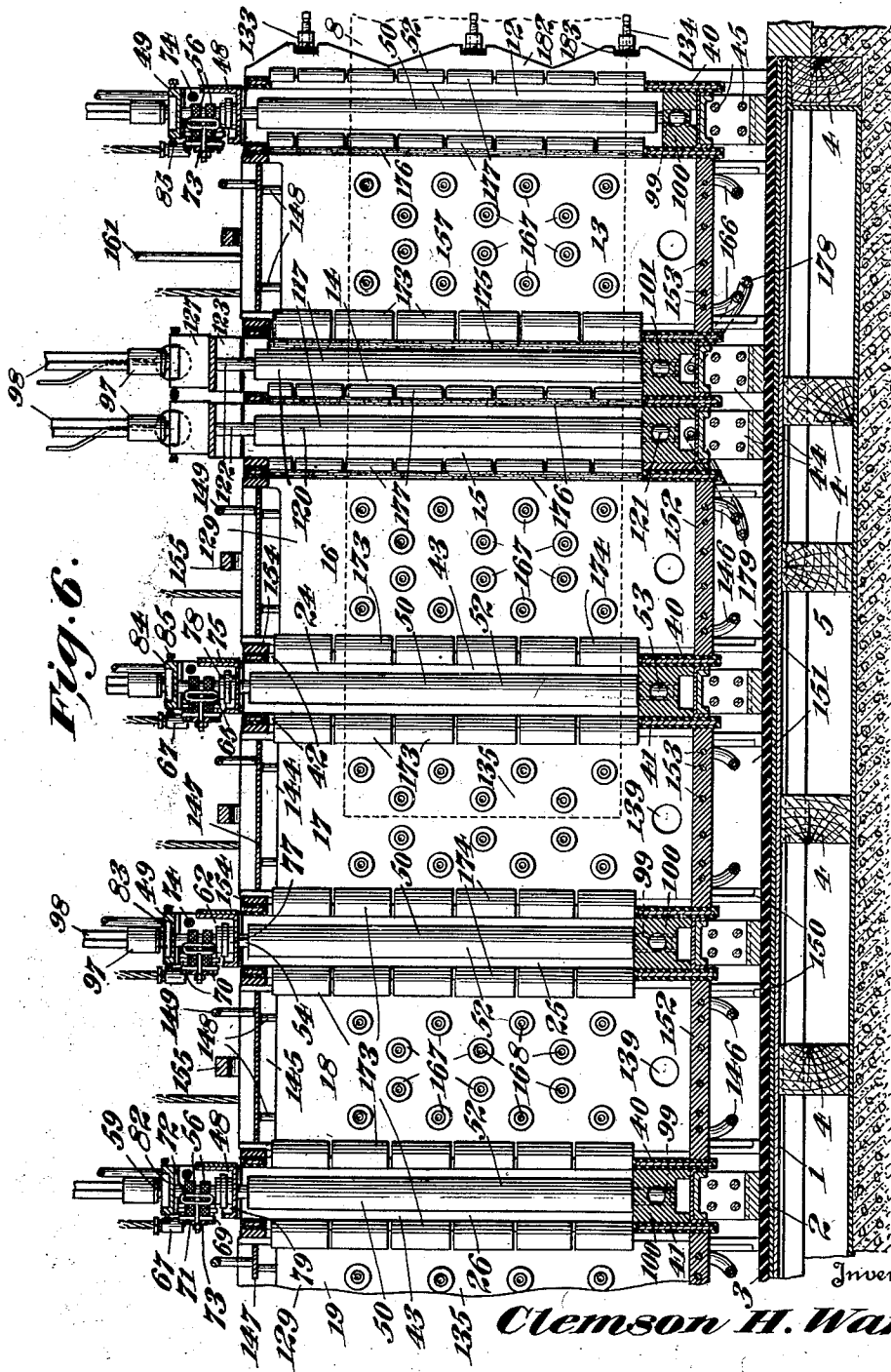
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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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Fig. 9.

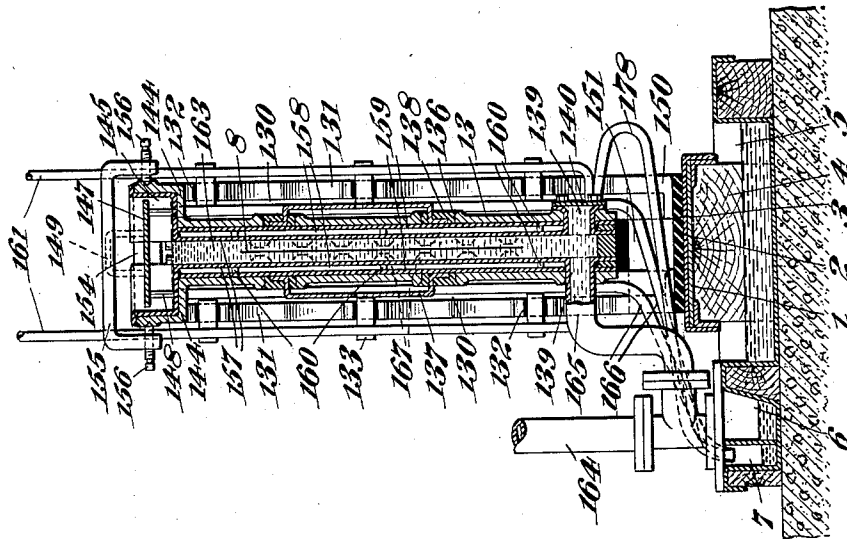


Fig. 8.

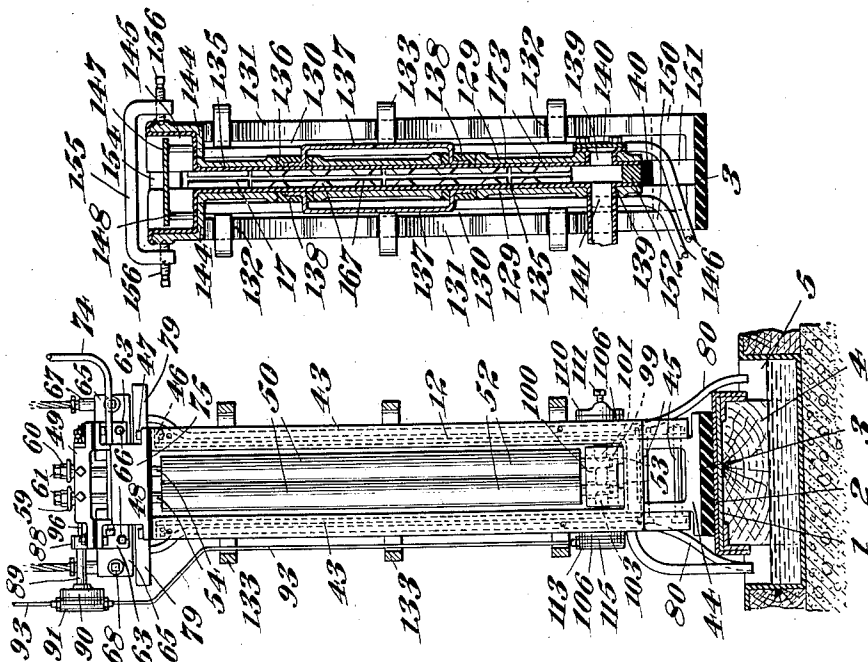
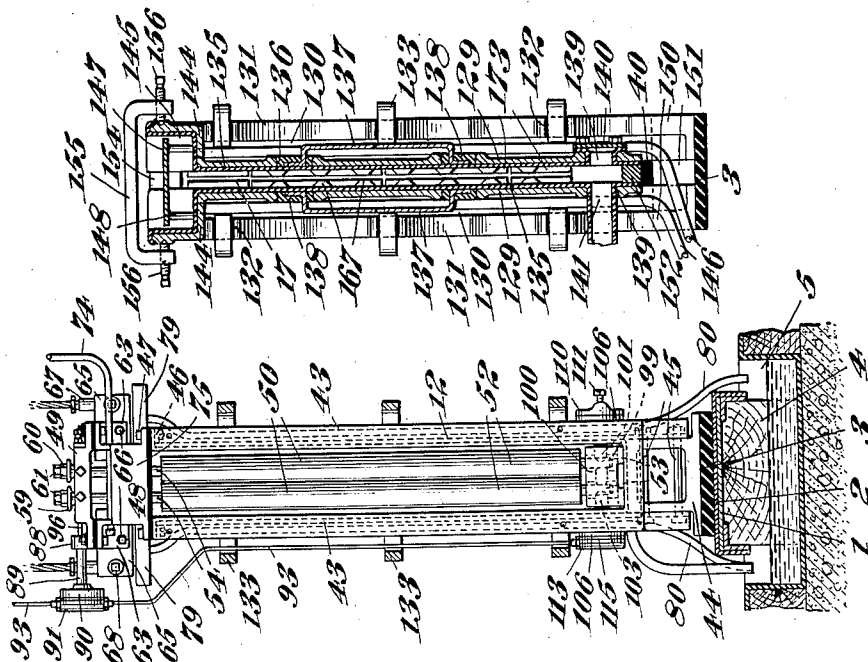


Fig. 7.



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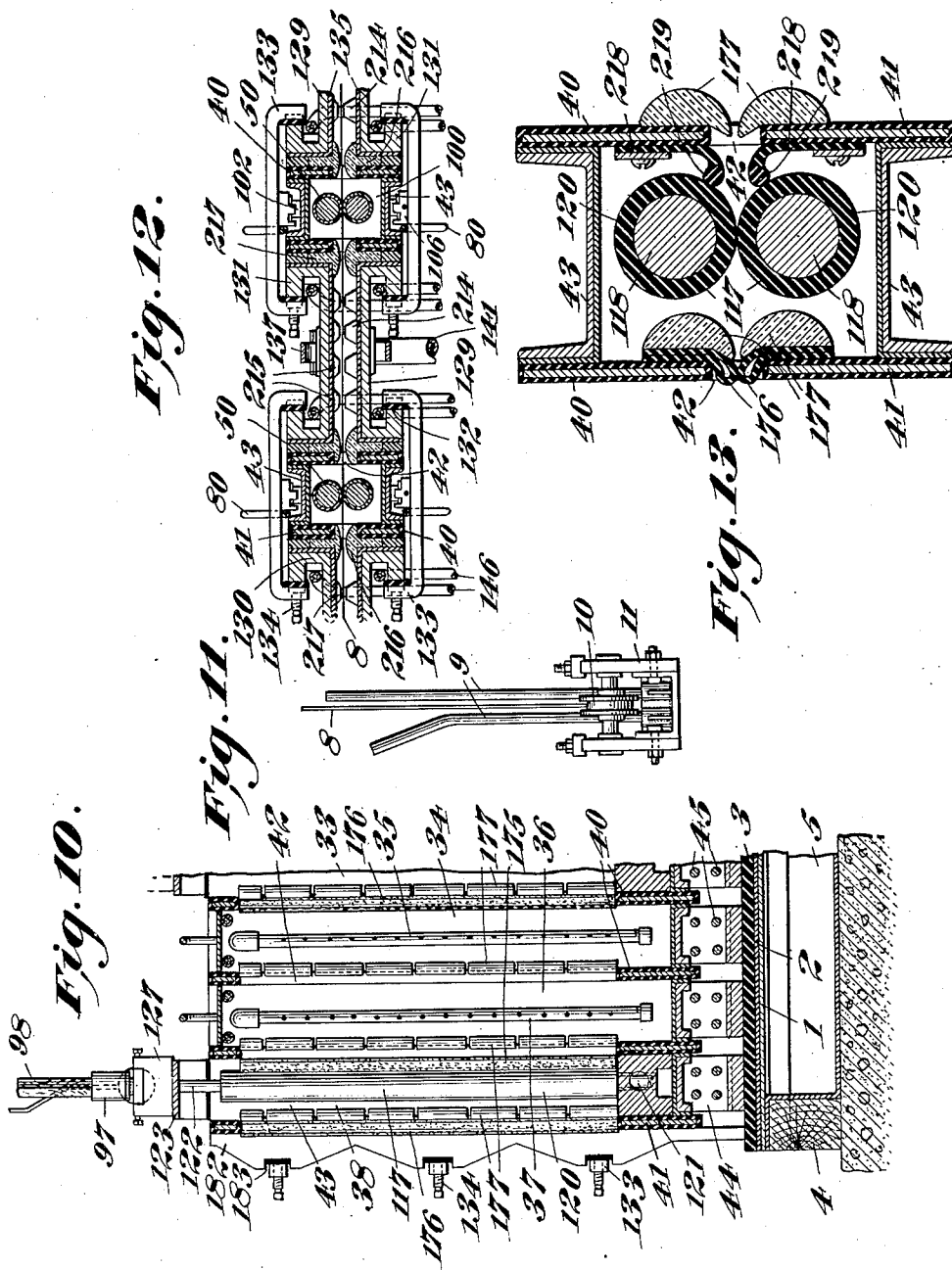
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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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17 Sheets-Sheet 6



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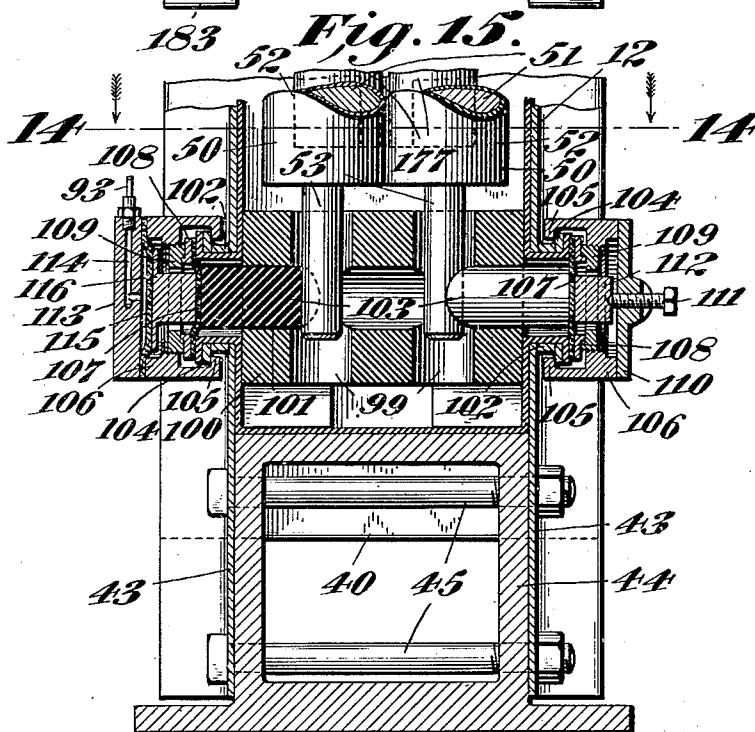
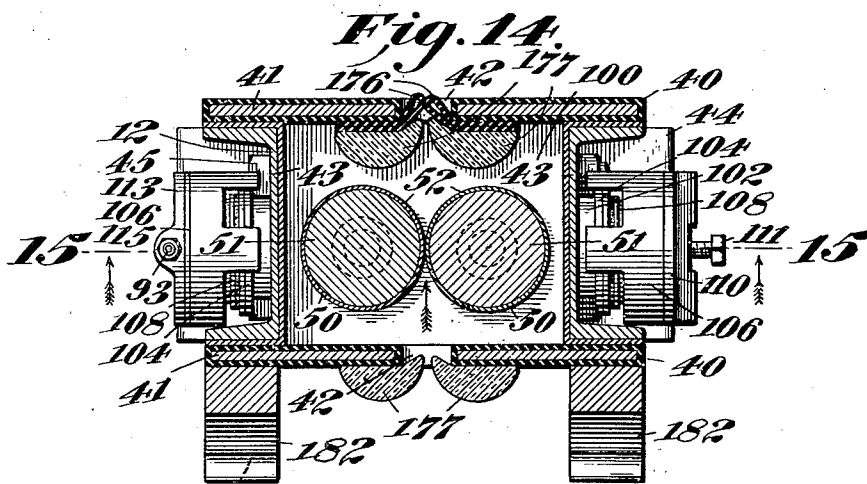
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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

Filed March 11, 1940

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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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Fig. 16.

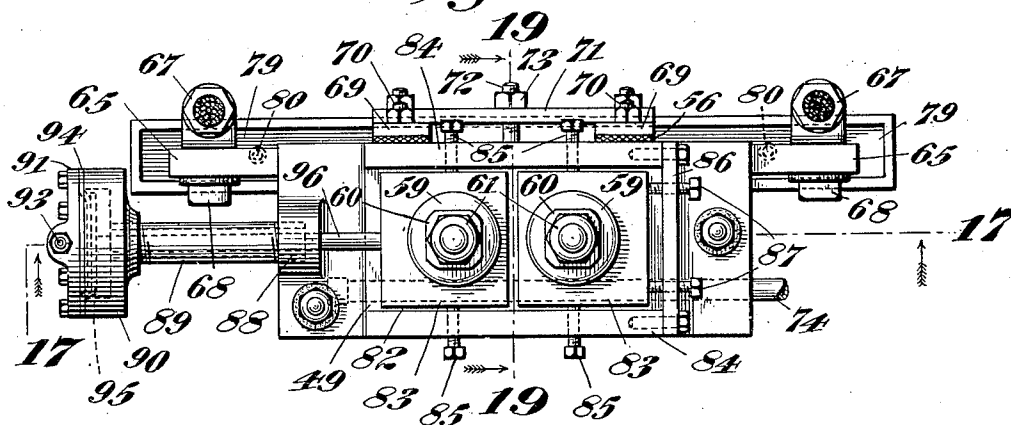
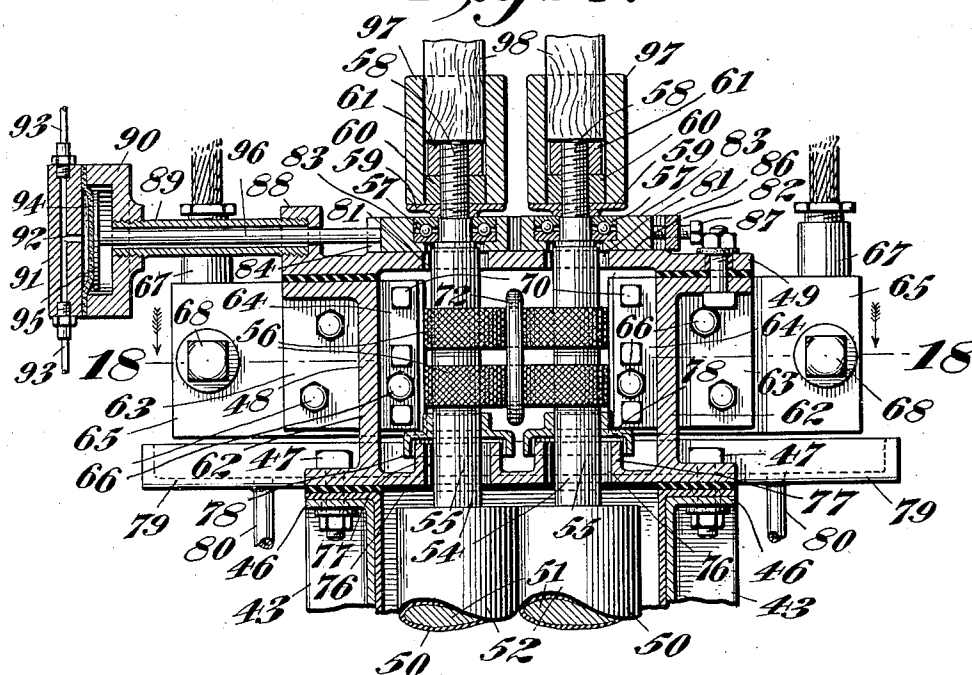


Fig. 17.



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Fig. 18.

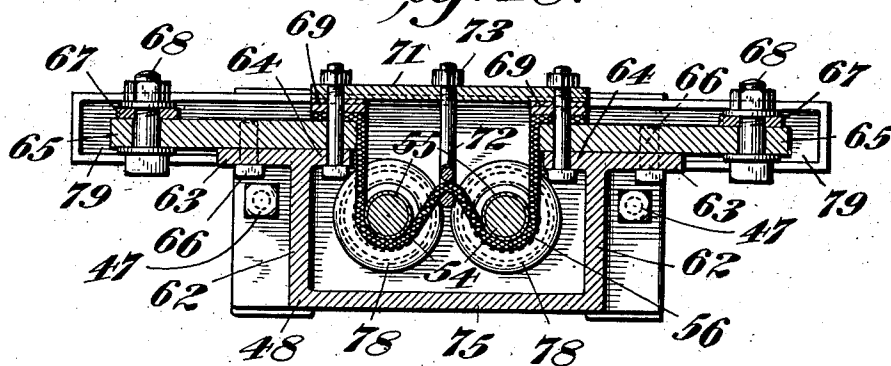


Fig. 19.

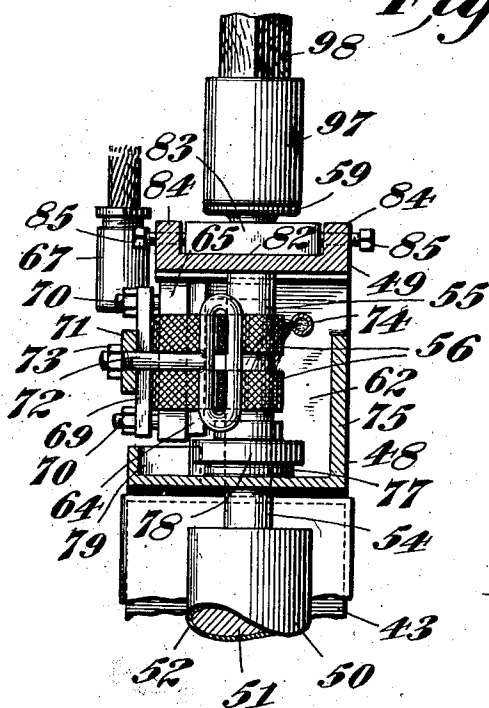
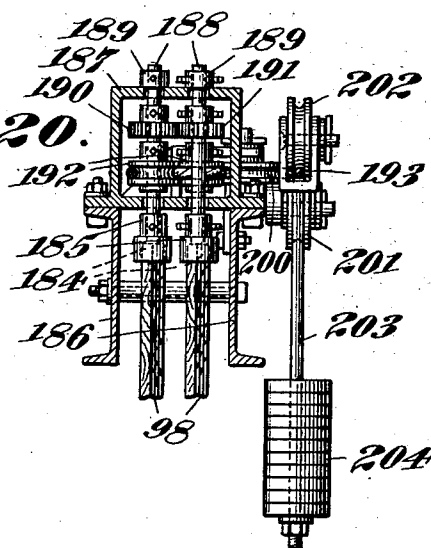


Fig. 20.



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Fig. 22.

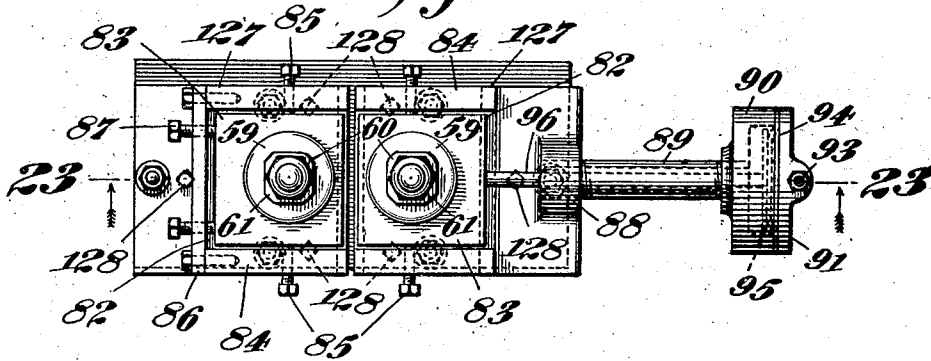
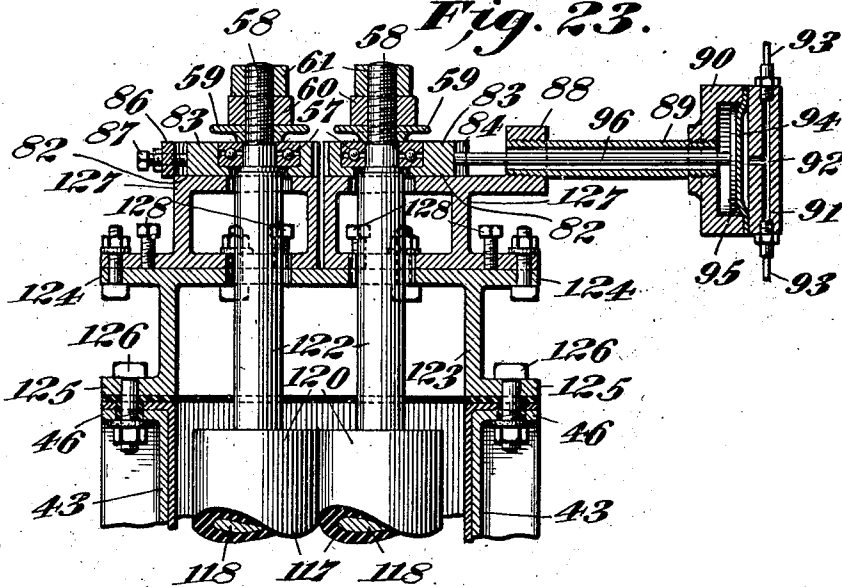


Fig. 23.



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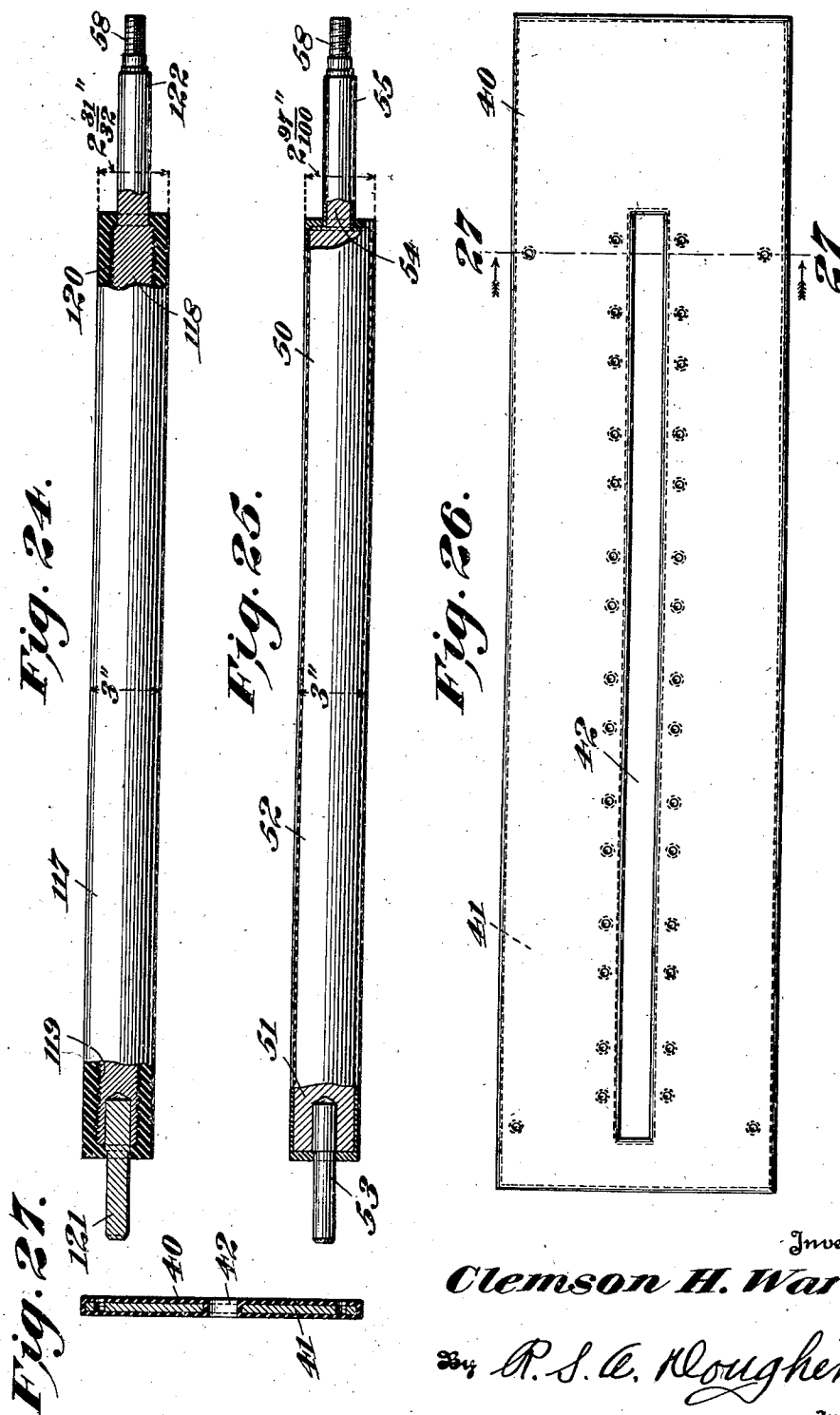
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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

Filed March 11, 1940

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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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Fig. 28. Fig. 29. Fig. 31. Fig. 33.

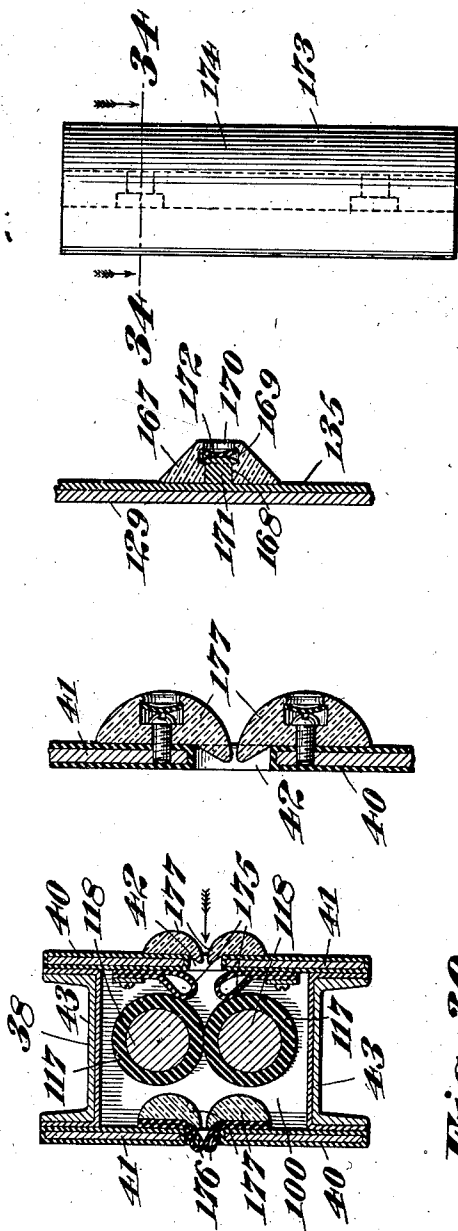


Fig. 30.

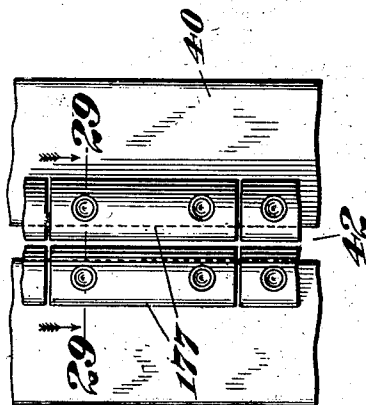


Fig. 32.

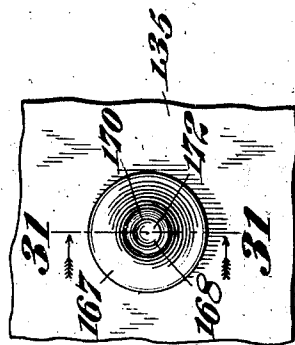
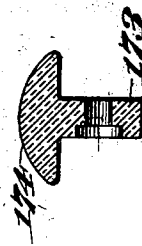


Fig. 34.



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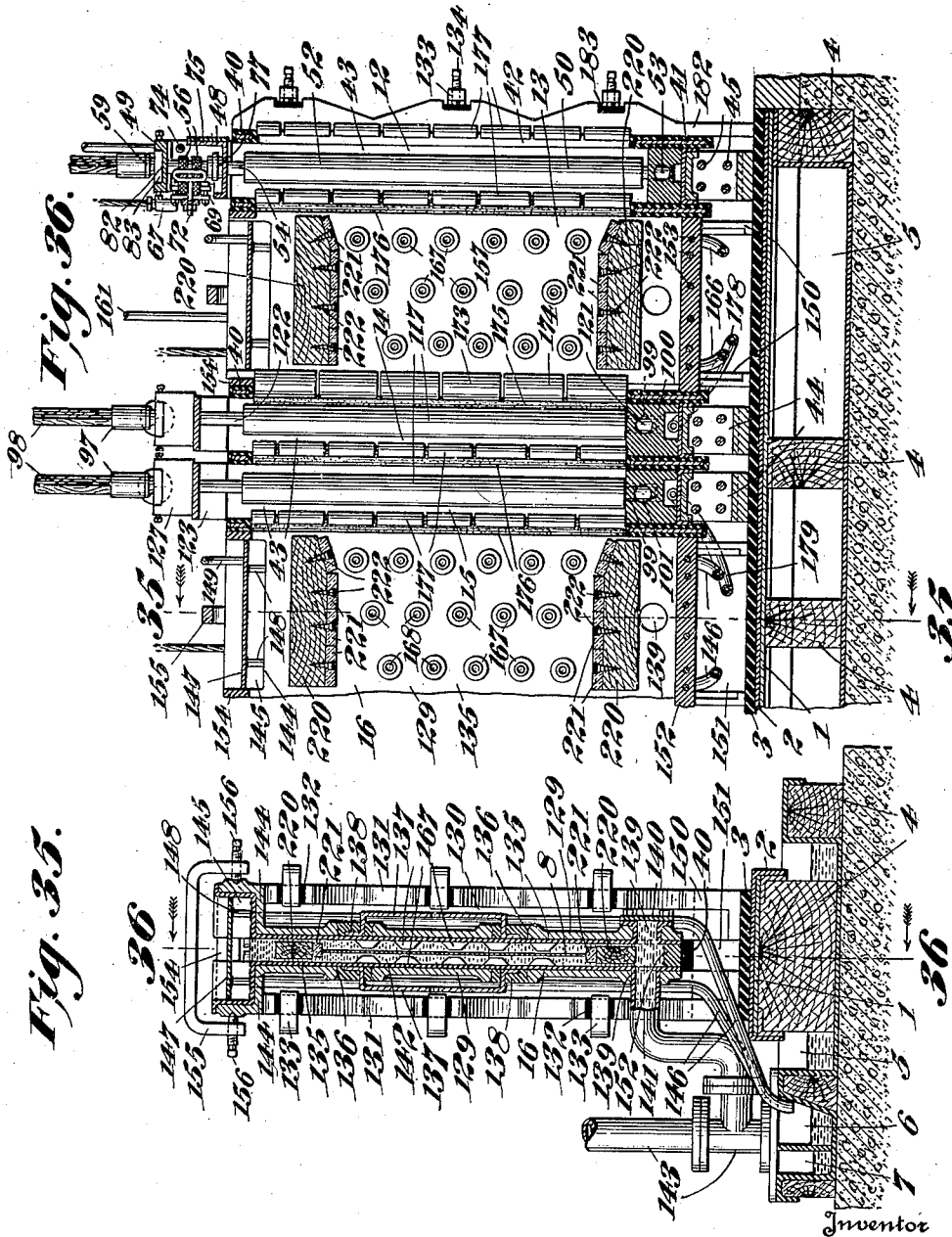
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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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17 Sheets-Sheet 13



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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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Fig. 39.

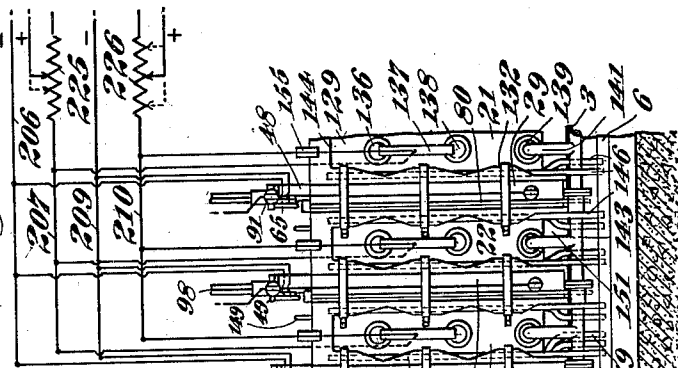


Fig. 38.

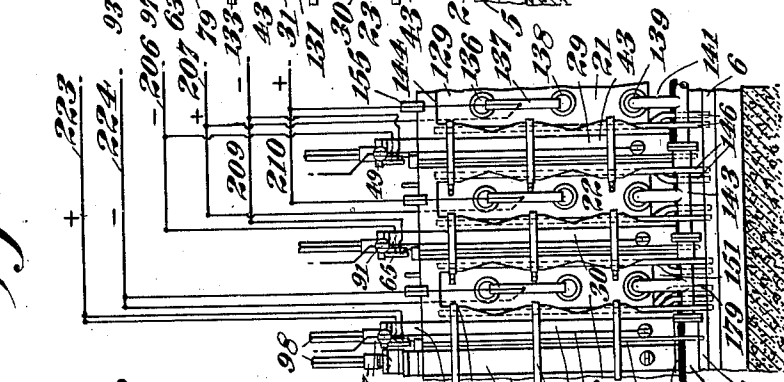
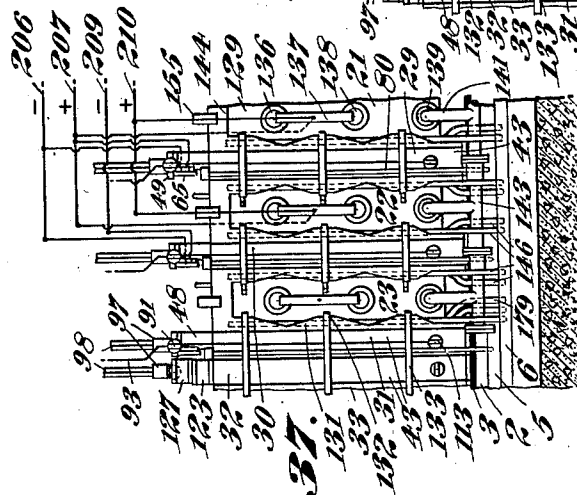


Fig. 37.



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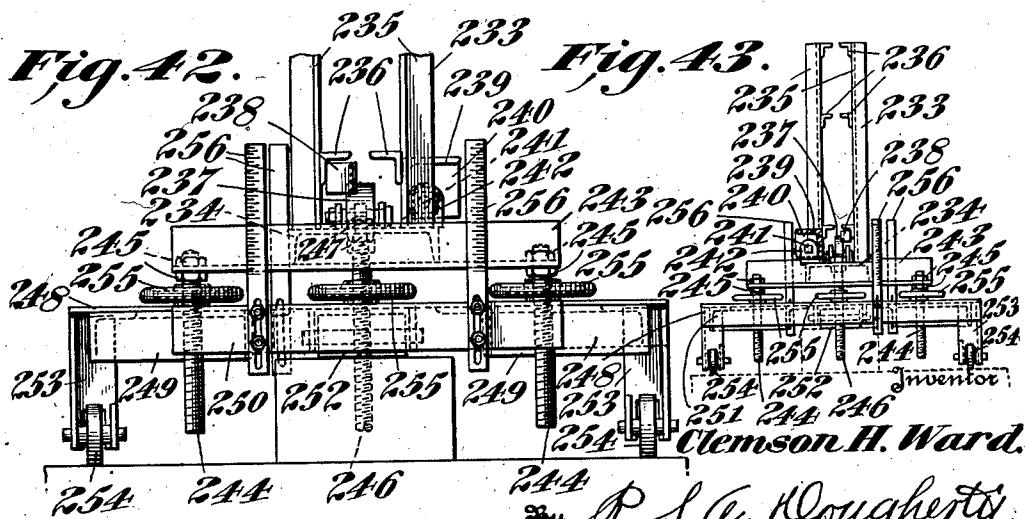
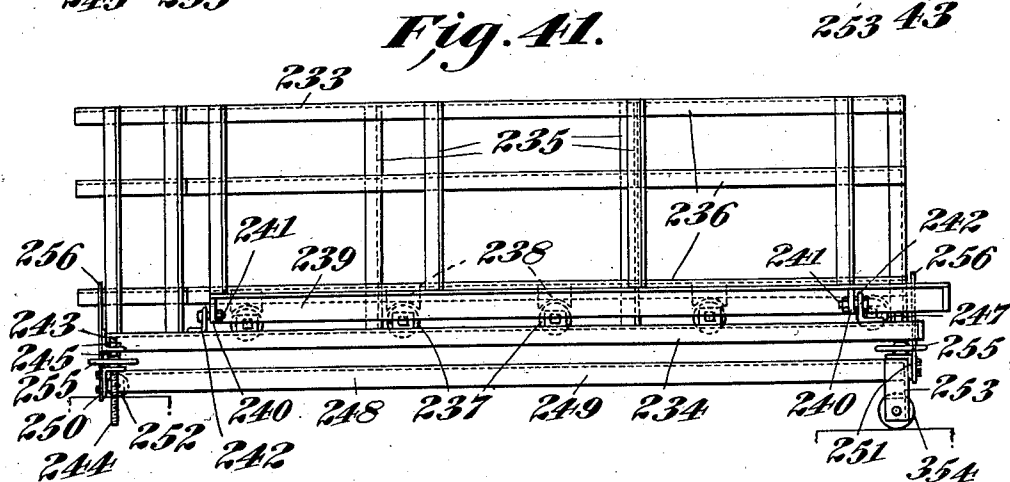
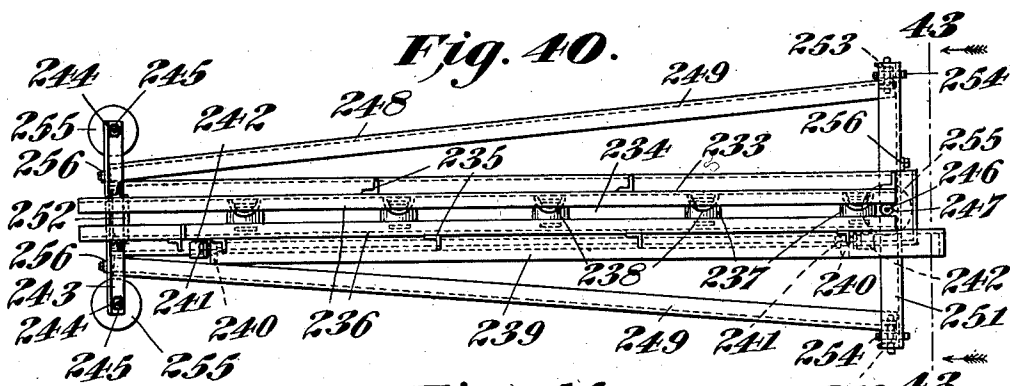
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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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Fig. 44.

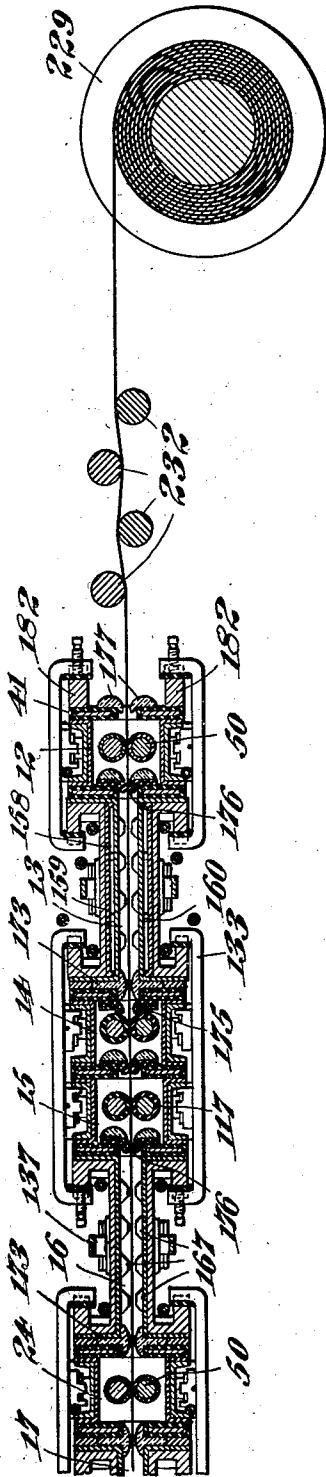
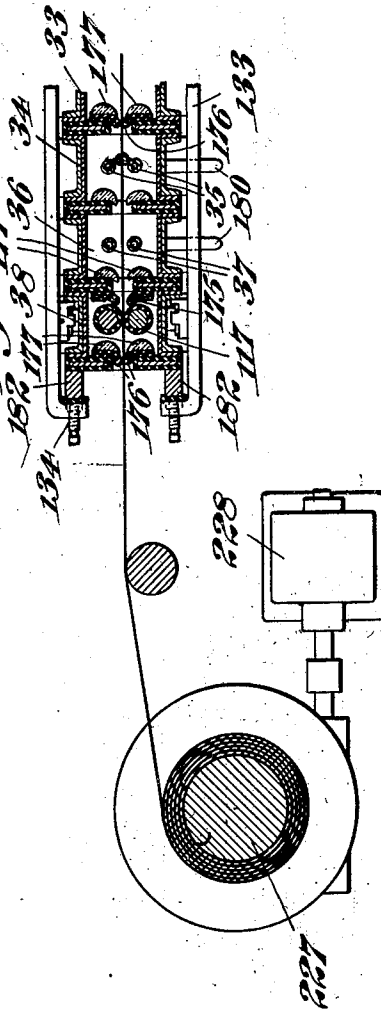


Fig. 45.



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APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

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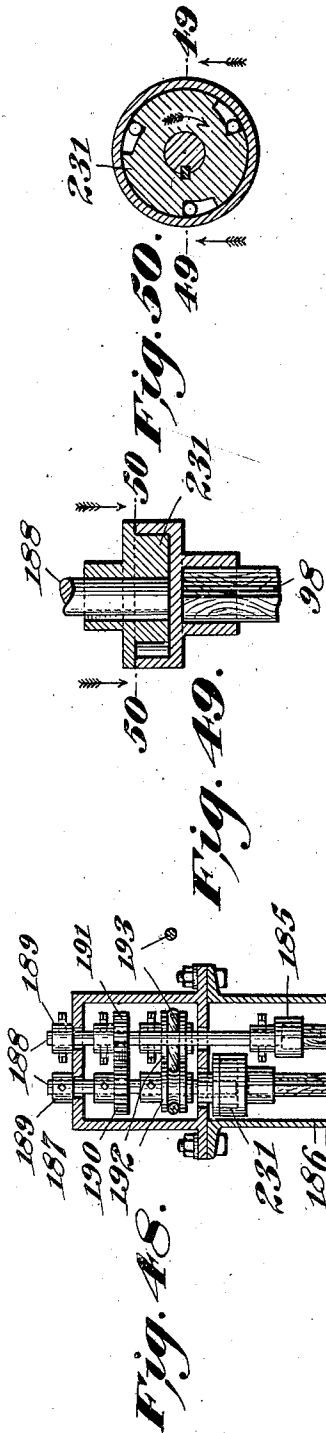
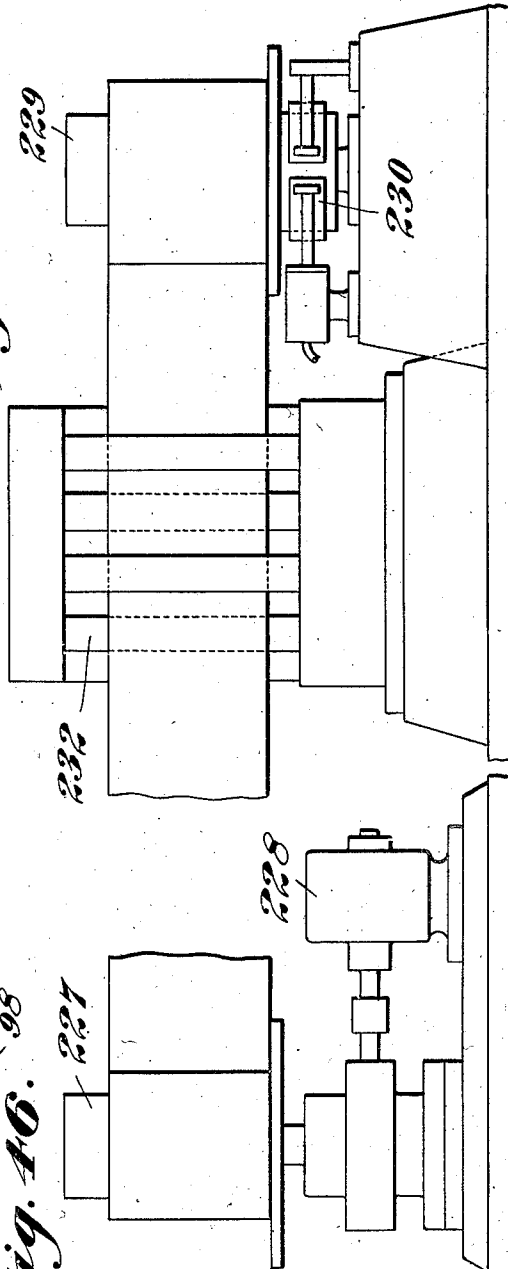


Fig. 47.



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UNITED STATES PATENT OFFICE

2,384,660

APPARATUS FOR ELECTROLYTIC GALVANIZING OF SHEETS

Clemson H. Ward, Baltimore, Md., assignor to Bethlehem Steel Company, a corporation of Pennsylvania

Application March 11, 1940, Serial No. 323,300

40 Claims. (Cl. 204—206)

This invention relates to an apparatus for treating flat rolled metal products, sheets, strip or plates, in one or more liquid baths in which said flat rolled products, disposed in a vertical plane are passed horizontally through cells or tanks containing the treating liquid. Important features of the invention are seals for permitting entrance and exit of the work from the tanks without undue leakage of liquid and guides for directing the ends of sheets or plate through said seals and through the tanks.

In particular the invention relates to apparatus for electroplating flat rolled products in which said products are passed, without deviating from a vertical plane, through a succession of cells or enclosures in which cleaning, electroplating, rinsing, drying and other operations are performed upon same.

In a specific embodiment of the invention zinc is electrodeposited upon the work in a plating cell or cells, the walls of which serve as insoluble anodes. In addition to said cells the apparatus comprises a plurality of roll boxes containing pairs of vertical contact and squeegee rolls which, when required to do so, may be used to support and advance the work through the apparatus.

One of the objects of the invention relates to the manner of constructing the cells and roll housing boxes so they can be assembled in alignment, taken apart for cleaning and repair, or a new unit installed when desired.

Another object of my invention relates to the panels which form gaskets and insulating means between the units.

Certain of the objects of my invention relate to the construction of the journal bearings for the contact and squeegee rolls, the manner of forming the contact between the electrodes and terminals of the electrical conductors and the neck of the contact rolls and for cooling the same.

A further object of my invention relates to forming and arranging the porcelain guides in the plating cells in such a manner as to allow a uniform rapid upward flow of electrolyte to stream off gas bubbles from the electrodes to maintain a constant supply of electrolyte at the electrode surfaces and also to carry away the heat generated by the plating current.

Another object of my invention relates to the means whereby a sheet may be given a heavier coat of plating on one side of the sheet than on the other.

Another object of my invention relates to the manner of connecting successive plating cells and contact rolls to separate sources of current of opposite polarity for the purpose of treating the work alternately anodically and cathodically; or to one or more sources of current through current controlling means whereby the current density

may be varied in successive plating cells containing the same or different electrolytes.

Another object of my invention relates to the manner of connecting either side of one or a succession of plating cells to separately controlled sources of current whereby a more intense electrochemical effect or a heavier coating of metal may be applied to one side of the work than to the other.

The construction of the squeegee and contact rolls and the mechanism for driving the same is another object of my invention.

Another object of my invention relates to the manner of adjusting the feed and receiving tables, to traverse the sheets up and down in small increments to avoid serious scoring of the rolls by the edges of the sheets.

Another object of my invention relates to the combination of vertical strip reels with plating equipment or the like including clutches which permit the rolls to rotate independently of the drive when the strip reels are advancing the work through the cells or tanks.

Another object of my invention relates to the method of treating the coating after the plating operation to produce a polished surface.

Other objects will appear hereinafter.

Having thus given a general description of my invention, I will now in order to make the same more clear refer to the annexed seventeen sheets of drawings forming a part of this specification and in which like characters of reference indicate like parts:

Figure 1 is a diagrammatic view in side elevation of my improved galvanizing plant illustrating the general arrangement of the complete apparatus for plating sheets;

Fig. 2 is a top plan view of the driving mechanism for rotating the contact and squeegee rolls; Figs. 3 and 4 show longitudinal transverse sections of the feeding in and discharge ends of the plant, respectively, taken on the lines 3—3 of Fig. 1;

Fig. 5 is a side elevation of the feed in or front end portion of the plant drawn on a larger scale;

Fig. 6 is a vertical longitudinal section taken centrally through the front end portion shown in Fig. 5;

Fig. 7 is a vertical transverse section taken on the line 7—7 of Fig. 5;

Fig. 8 is a vertical transverse section through one of the plating cells taken on the line 8—8 of Fig. 5;

Fig. 9 is a vertical transverse section of the anodic treatment cell taken on the line 9—9 of Fig. 5;

Fig. 10 is a vertical longitudinal section taken centrally through the discharge end portion of the plant and showing the wash and steam boxes;

Fig. 11 is a vertical transverse section of the feed table taken on the line 11—11 of Fig. 1;

Fig. 12 is a modification showing the sheet adapted to advance through the plating cells nearer one anode than the other so that the sheet will receive a thicker plate of coating on one side than the other;

Fig. 13 is a transverse section of a squeegee roll box in which the sealing flaps have hard rubber contact ends;

Fig. 14 is a transverse section through the lower portion of one of the contact roll housing boxes taken on the line 14—14 of Fig. 15;

Fig. 15 is a vertical transverse section of the lower portion of the contact roll housing box taken on the line 15—15 of Fig. 14 and showing the arrangement of the bearings for the lower ends of the contact and squeegee rolls.

Fig. 16 is a top plan view of one of the journal bearings for the top ends of a pair of contact rolls and showing the terminal blocks and the terminals for the ends of the electric circuit attached thereto;

Fig. 17 is a vertical section of one of the journal bearings for the top ends of a pair of contact rolls taken on the line 17—17 of Fig. 16;

Fig. 18 is a horizontal section taken on the line 18—18 of Fig. 17;

Fig. 19 is a vertical section taken on line 19—19 of Fig. 16;

Fig. 20 is a transverse section of the driving mechanism for rotating the contact and squeegee rolls taken on the line 20—20 of Fig. 2;

Fig. 21 is an end elevation of one of the couplings for the lower ends of the contact and squeegee rolls;

Fig. 22 is a top plan view of one of the top bearings for the squeegee rolls;

Fig. 23 is a vertical section taken on the line 23—23 of Fig. 22;

Fig. 24 is a side elevation of one of the squeegee rolls with parts broken away to show more clearly the manner of construction;

Fig. 25 is a side elevation of one of the contact rolls with parts broken away to show the manner of constructing the end portions;

Fig. 26 is a front elevation of one of the panels used between the cells and the roll housing boxes;

Fig. 27 is a transverse section through the panel taken on the line 27—27 of Fig. 26;

Fig. 28 is a transverse section through one of the squeegee roll units and the panels adjacent thereto;

Fig. 29 is a transverse section taken on the line 29—29 of Fig. 30 showing the semi-cylindrical shaped porcelain guides for the sheets and the manner of attaching them to the panels adjacent to the slots formed therein;

Fig. 30 is a side elevation of a portion of one of the panels showing the semi-cylindrical shaped porcelain guides attached thereto;

Fig. 31 is a detail transverse section taken on the line 31—31 of Fig. 32 showing the manner of attaching the frustro-conical shaped porcelain guides for the sheets in the anodic treatment and plating cells;

Fig. 32 is a front elevation showing one of the frustro-conical shaped porcelain guides and a portion of a cell attached thereto;

Fig. 33 is a front elevation of one of the T-shaped porcelain guides used between some of the cells and the roll boxes;

Fig. 34 is a transverse section through one of the T-shaped porcelain guides taken on the line 34—34 of Fig. 33;

Fig. 35 is a transverse section of a modified form of plating cell taken on the line 35—35 of Fig. 36 showing a different manner of arranging the frustro-conical shaped porcelain guides in the plating cells and means for preventing edge treeing of the plate during the plating operation;

Fig. 36 is a vertical longitudinal section taken on the line 36—36 of Fig. 35;

Fig. 37 is a detail showing the last plating cell and the parts adjacent thereto with the electric circuit for the last cell omitted;

Fig. 38 is a view similar to Fig. 37 in which the last cell has its polarity reversed to that for the plating cells;

Fig. 39 illustrates a means for varying the amount of current for each side of the plating cells;

Fig. 40 is a top plan view of a modified form of a work receiving table having means for vertical adjustment;

Fig. 41 is a side elevation of the work receiving table shown in Fig. 40;

Fig. 42 is an elevation of the lower portion of the discharge end of the said table drawn on a larger scale;

Fig. 43 is a sectional elevation of the work receiving end of the table taken on the line 43—43 of Fig. 40;

Figs. 44 and 45 show longitudinal transverse sections of the feeding in, and discharge ends of a plant, respectively illustrating the manner of advancing strip through the plating cells or tanks;

Fig. 46 is a side elevation showing the power driven reel and driving mechanism for winding up and advancing the strip through the cells;

Fig. 47 is a side elevation showing the delivery reel and roller leveller for receiving a roll of strip from which the strip is fed through the cells;

Fig. 48 is a transverse section of the driving mechanism showing a friction clutch connection between one of the roll driving shafts and a spindle;

Fig. 49 is a vertical section through the friction clutch taken on the line 49—49 of Fig. 50; and

Fig. 50 is a transverse section through the friction clutch taken on the line 50—50 of Fig. 49.

Referring now to the various characters of reference on the drawings, the numeral 1 designates a longitudinal channel shaped base member having a lead covering 2 and a strip of insulation 3 thereon, upon which the cells and roll housing boxes are mounted and assembled together in longitudinal alignment. The channel shaped base member 1 is supported at each end and at intermediate points by means of wooden blocks 4, which are seated in the launder 5 extending under the apparatus for receiving the waste water discharged therefrom. Adjacent to the launder 5 and on the same level are the launders 6 and 7 for receiving the electrolyte from the plating and anodic cells, respectively, from which each are returned to a sump (not shown) where it is cooled and the electrolyte recirculated.

The sheet 8 to be plated is disposed in a vertical position between pairs of side guide rods 9 with its lower edge engaging grooved rollers 10 of a feed table 11 and advanced manually or in any approved manner into the electrolytic galvanizing plant from the right hand end of the apparatus as indicated in Figure 1, where it first passes between a pair of contact rolls in the roll

housing box 12, then into the pickling bath in the anodic cell 13, where the surface of the sheet is thoroughly cleaned and freed from rust, scale, oil, grease, etc. In the anodic cell 13 the polarity of the electric circuit is reversed to that in the plating cells and the sheet forms the anode and the lead inner lining of the cell the cathode as it passes through the bath in this cell. The sheet is then advanced and passes between a pair of sealing rolls in the roll housing box 14 and then advanced between another pair of squeegee rolls in roll box 15, which guides the advancing end of the sheet into the first of a series of plating cells, in which eight are shown for illustration numbered 16, 17, 18, 19, 20, 21, 22 and 23, but a greater or less number of plating cells may be used if desired. As shown in Figure 1 each plating cell has at its left hand end a contact roll housing box indicated as 24, 25, 26, 27, 28, 29, 30 and 31, respectively, in each of which is mounted a pair of contact rolls between which the sheet being plated is passed. After passing through the plating cells and between the pairs of contact rolls in sequence it is then fed into roll housing box 32, between a pair of squeegee rolls which retain the electrolyte in the plating cells and advances between another pair of squeegee rolls in roll housing box 33, thence into a wash box 34 having perforated pipes 35 for spraying water on each side of the sheet then into a drying box 36, having perforated steam pipes 37 for heating the sheet and finally the sheet passes between another pair of squeegee rolls in roll housing box 38 for wiping the surface of the sheet from which point it is ejected onto a receiving table 39 which is constructed in a similar manner as the feed table, having the vertical pairs of guide rods 9, and rollers 10.

The ends of the units are insulated from each other by means of panels 40 forming gaskets between the same, each comprising a central reinforcing plate 41 of steel to prevent warping which is covered with insulating material such as rubber or the like. These panels 40 have a vertical central slot formed therein as at 42 for the sheet to pass through. These panels also have attached thereto adjacent to the slots porcelain guides for guiding the sheet into or out of the different units and the input and output sealing flaps which will be described more fully hereinafter.

It will be noted by referring to the drawings that a number of the units and parts forming my apparatus are duplicated and a description of the construction of one of each will apply to all, and it will be understood that all of the roll housing boxes and parts for use in contact with the electrolyte are covered or lined with lead, rubber or other material suitable to withstand the attack of the electrolyte in use. For the most common electrolytes in which sulphuric acid and its salts are the active agents, lead is in general the most satisfactory material. I will hereinafter refer to lead as the lining material although this is not by way of limitation.

The contact roll units indicated at 12, 24, 25, 26, 27, 28, 29, 30 and 31 are all constructed in a similar manner as illustrated more clearly in Figures 14, 15, 16, 17, 18, 19 and 25, each comprising a pair of lead lined vertically disposed side frame members 43 of channel section with their flanges extending outwardly and connected together at their lower ends by means of a base casting 44 and bolts 45 and provided at their upper ends with a horizontally outwardly extend-

ing flange 46, which is insulated from, but attached by means of bolts 47 to the lower outwardly extending flange of the top bearing support 48 for the top bearing heads 49, for the contact rolls 50. These contact rolls 50 are arranged in pairs, each having a core of soft steel 51 covered on its cylindrical surface and ends with a layer of lead alloy and having at its lower end a stub shaft 53 of relatively hard wear and corrosion resistant metal, while the neck 54 at the upper end has a contact sleeve 55 of brass or other suitable material for engaging the braided wire contact bands 56. The upper end of each roll neck 54 is journaled in a roller bearing 57 and is further provided with a threaded end portion 58 for receiving a thrust washer 59 held in position by means of a nut 60 and lock nut 61.

The top bearing support 48 has upwardly extending side walls 62, each having at one edge outwardly and inwardly extending flanges 63 and 64, respectively, to which are attached a pair of terminal blocks 65 by means of bolts 66. Terminals 67 from one side of a source of current are attached to each terminal block 65 by means of bolts 68. The flexible contact bands 56 are arranged in pairs and have their ends attached to the inner ends of the two terminal blocks 65 and secured thereto by means of clamping bars 69 and bolts 70, and a tie bar 71 connects the central portions of the clamping bars 69 together. The intermediate portions of these two contact bands engage the contact sleeves 55 on the neck portions 54 of the contact rolls and in order to insure a good contact between the contact bands 56 and sleeves 55 the central portion of these contact bands extends through the elongated eye of an eye bolt 72. The shank of this eye bolt extends through the tie bar 71 and is threaded to receive a nut 73 which can be adjusted to take up any slack which may occur in the contact bands. As these contacts become heated during the rotation of the contact rolls in order to keep them cool they are sprayed with water from a spray pipe 74, and to prevent this water from escaping into the cells a wall 75 formed integral with the top bearing support 48 extends upwardly adjacent to the spray pipe 74, while the openings 76 in the bottom wall of the top bearing support for the passage of the contact roll necks each have an annular flange 77 extending upwardly around the same. Overlapping said flange is a cover or skirt 78 attached to the roll neck. The top bearing support is also provided with a drip pan 79 from which drain pipes 80 convey the waste water to the launder 5.

The contact roll bearing head 49 is insulated from the top bearing support 48 and is perforated at intermediate points as at 81 for the passage of the upper ends of the contact roll necks 54, and is provided on its upper surface with a slide way 82 for receiving adjustable bearing blocks 83 in which the roller bearings 57 on the upper ends of the roll necks 54 are seated. A flange 84 extends vertically upward from the opposite edges of the slide way 82 having set bolts 85 extending therethrough for engaging the sides of the bearing blocks 83 for laterally adjusting the same. One end of the flanges 84 are connected together by means of a pressure bar 86 which is bolted thereto and has set bolts 87 extending therethrough for engaging the end of one of the bearing blocks 83 to hold it in an adjusted position. The other contacting bearing block 83 is adapted to be held in position by fluid pressure and for this purpose a flange 88 extends upwardly from the base of the

top bearing head 49 adjacent to the outer end of this bearing block in which the inner end of a pipe section 89 is threaded, the outer end of said pipe section 89 is threaded for receiving a diaphragm box 90 having a cover 91 with ducts 92 formed therein and pipe connections 93 for supplying fluid pressure to operate a flexible diaphragm 94 which is adapted to engage a disk 95 in the diaphragm box to operate a push rod 96 which extends therefrom through the pipe section 89 with its inner end engaging the end of this bearing block 83 thereby normally holding the cylindrical surfaces of the upper portions of the contact rolls 50 in contact with each other or the sides of the sheet during the plating operation. In order to rotate the contact rolls more easily and to reduce friction they are held substantially suspended from the top ends, this is accomplished by having the thrust washers 59 directly engaging the roller bearings 57 and held in position by means of the nuts 60 and lock nuts 61. These thrust washers 59 also support the lower ends of the couplings 97 for the lower ends of the wooden driving spindles 98.

The lower ends of the contact rolls 50 have their stub shafts 53 extending into vertical cylindrical openings 99 in a hard lead bearing block 100. These cylindrical openings 99 are of somewhat larger diameter than the stubs 53 to allow them a certain amount of lateral movement. A cylindrical opening 101 extends horizontally through the hard lead bearing block in alignment with tubular extensions 102 providing openings of somewhat larger diameter at opposite sides of the roll housing box side frame members 43 in which is mounted a pair of journal bearing members 103 formed of hard rubber or the like having their inner ends formed arc shaped for engaging the outer side surface of each of the stubs 53. As shown more clearly in Figures 14 and 15 the tubular extensions 102 are each provided with a flange 104 at their outer edges for engaging flanges 105 of a diaphragm case 106. The outer end of each journal bearing member 103 engages a flexible diaphragm 107 which is held in position against the outer end of the tubular extension 102 by means of a bearing ring 108 and a locking ring 109 which is threaded into the diaphragm case 106 to hold the parts together. The diaphragm case on one side of the roll box is provided with a cover plate 110 having a set bolt 111 extending therethrough to engage a pressure block 112 to hold the diaphragm 107 against the outer end of the journal bearing member 103. The diaphragm case 106 on the opposite side of the roll housing box is mounted in a similar manner to the one above described having the flange 105 for engaging the flange 104 at the outer end of the tubular extension 102 and the diaphragm 107 and diaphragm case are held in position by means of a bearing ring 108 and locking ring 109. The journal bearing member 103 however on this side of the roll housing box is adapted to be held in position by means of fluid pressure, and the diaphragm cover 113 is provided with a duct 114 for receiving fluid pressure from the pipe connection 93 from the diaphragm box 90 to operate a flexible diaphragm 115 which is adapted to engage a pressure plate 116 having its inner end in contact with the diaphragm 107 thereby holding the arc shaped inner face of the journal bearing member 103 in contact with the stub 53 and the cylindrical surfaces of the lower portions of the rolls 50 in contact with each other or with the sides of the sheet.

The roll housings, journal bearings and manner of adjusting the squeegee rolls are constructed in substantially the same manner as described for the contact rolls and the same reference numerals will apply thereto, but as the squeegee rolls are used for a different purpose the rolls, top bearing support and bearing heads are of different construction, as illustrated more clearly in Figures 22, 23 and 24. The squeegee rolls 117 each have a soft steel core 118, the outer surface of which is serrated as at 119 to more firmly hold the outer covering 120 of rubber or the like material. The lower end of the roll is provided with a stub shaft 121 while the roll neck 122 at the upper end is adapted to receive the thrust washer 59, nut 60 and lock nut 61 as in the case of the contact rolls. The upper bearing head support 123 for the squeegee rolls is insulated from the side frame and is of channel shape with outwardly extending flanges at opposite sides at the top and bottom edges as at 124 and 125, respectively. The bottom flanges 125 are attached to the outwardly extending flanges 46 of the side frame members 43 by means of bolts 126. A separate roll bearing head 127 of rectangular shape each having an outwardly extending flange at its lower edge is attached by means of bolts to the flange 124 of the upper bearing head support 123 as indicated in Figures 22 and 23. The upper roll bearing head support 123 and heads 127 are provided with aligned holes for the passage of the roll necks 122. These holes are of somewhat larger diameter than the necks of the rolls to allow for lateral movement of the same, and as it is sometimes desirable to slightly adjust the roll bearing heads 127 vertically, they are each provided in the lower base portion with set bolts 128.

The cells are all constructed in a similar manner each comprising a pair of spaced cast side frame members 129 of substantially channel shape in cross section disposed vertically with their legs 130 extending outwardly. The ends of these legs are provided with flanges 131 extending laterally from the legs toward each other in the same plane having notches 132 for receiving the ends of the legs of U-shaped clamps 133 which are each provided with a set bolt 134 in one leg by means of which the units are secured together. The cast side frame members 129 are each provided with a lining of suitable metal adapted to form the insoluble electrodes 135 in the cells. At intermediate points the cast side frame members are each formed with a pair of spaced openings 136 for receiving the ends of contact bars 137 which are burned to the lining as at 138. An opening 139 is formed in the lower portion of each cast side frame, one of which on one side of the cell forms a hand-hole for inspecting or cleaning out the bottom of the cell and is closed by means of a cover 140, while the other hole on the other side of the cell is for the passage of the pipe 141 which is adapted to supply the electrolyte 142 to the cell through the main pipe 143. The upper portion of the wall of the plating cell side frame members are offset as at 144 to form a froth box 145 into which the upper end of the pipes 146 extend for receiving the overflow of the electrolyte from the plating cell and conveying it to the launder 6 and thence to a sump. A cover 147 having legs 148 and a handle 149 is disposed in the froth box 145 to help prevent the fumes escaping from the cell. The two cast side frame members 129 have legs 150 for engaging the strip of insula-

tion 3, thereby forming a passage 151 below each cell, and are connected together at their lower ends by means of a lead spacing block 152 and bolts 153, while the top ends have a spacing block 154 and are held together by means of an inverted U-shaped clamp 155 having set bolts 156 in each leg portion for engaging the outer sides of the cells near their upper edges.

When necessary to cool the cell wall electrodes the cells may be water jacketed as shown in Fig. 9. This is particularly desirable when the cell walls are used as cathodes in an anodic treatment of the work since in this case a large portion of the ohmic heating of the solution occurs in the hydrogen gas layer at the cathode. To remove this heat with maximum efficiency the cell may be provided with a water jacket 158 formed by having a plate 159 secured to the lining 157 and held in spaced relation to the lining by means of studs 160. The jackets thus formed are supplied with inlet and outlet pipes 161 and 162, respectively.

The cell shown in Fig. 9 receives electrolyte from a main supply pipe 164 and connecting pipe 165 from whence electrolyte flows upwardly to the froth box and is conveyed by overflow pipes 166 to launder 7.

In order to secure substantially uniform electrolytic action on each side of the work as it passes through the plating cells it is necessary to hold the work in uniform spaced relation with the electrodes or sides of the cells. This is accomplished by securing a plurality of porcelain guides 167 of frusto-conical shape to the inner sides of the lining of the cells. Each guide on one side of the cell is in transverse alignment with the guide on the opposite side of the cell. These frusto-conical guides have their inner surfaces far enough apart to allow the sheet 3 to pass freely between them and are so disposed that the shielding effect will be as uniformly distributed as possible. The manner of attaching these porcelain frusto-conical shaped guides 167 to the lead linings of the cells is more clearly illustrated in Figures 31 and 32. These porcelain guides all have a hole 168 through the central portion and are provided with a counterbore 169 and an inwardly extending beaded outer edge 170. A short piece of lead bar is burned to the lead lining of cell to form a stud 171. The porcelain guide is then slipped over the stud and the end peened over inside the counterbore 169. A rubber disk 172 is then snapped in place under the beaded edge 170 to protect the lead stud from electrolytic action.

As the work passes through the insulating panels 40 at various points in the apparatus I use vertically extending T-shaped guides 173 of porcelain or other wear resistant insulating material, each having its leg secured between a panel 40 and the end of each of the side frame members of the cells. These T-shaped porcelain guides 173 at one side of the end of the cell are in transverse alignment, but in spaced relation with the guides at the adjacent end of the other side frame member of the cell and are disposed with their heads extending inwardly and provided with arc-shaped faces 174, for guiding the work as it is advanced between them.

These guides not only guide the leading edge of sheets when same are being plated through the slots in the panels but also serve to define a restricted passageway through which a minimum of current may flow (in electrolyte) between the plating cell and adjacent contact rolls in cases

where a plurality of plating cells and roll housing boxes are used in sequence and contain a single body of electrolyte.

When so arranged it is desired that current flow from the cell walls to the work, thence through the work into the roll boxes and to the contact rolls. Current may also flow from the cell walls directly through the electrolyte to the contact rolls which are immersed in same. This current not only represents lost energy but may deposit plating metal upon the contact rolls thereby impairing their surfaces for contacting purposes.

To minimize this flow of current the guide blocks are arranged to form a passageway for the work which is as narrow as possible and which therefore results in minimum cross section of electrolyte considered as a conductor and hence in maximum electrical resistance.

To permit entrance and egress of the work from the liquid containing portions of the apparatus without undue leakage of liquid, two types of seals or valves are provided—one for the entrance end and one for the exit end.

The work enters the liquid through a pair of flexible flaps attached to the panel or tank wall on either side of a slot in same. The flaps extend inwardly in the direction of travel of the work and contact the work at an acute angle. Liquid pressure holds the flaps in liquid retaining engagement with the surfaces of the work.

At the exit end of the liquid containing enclosure flaps directed inwardly to take advantage of liquid sealing pressure would, if sufficiently flexible to form an efficient sealing contact with the work, be dragged by the work through the slot. As the exit seal, a pair of resilient (squeegee) rolls is therefore used in conjunction with flexible flaps—the rolls being located outside the wall of the container and the flaps in this case being attached on either side of the slot and extending outwardly to contact the rolls within the reentrant space between same. The work passes through the rolls out of contact with the flaps which are, however, held in sealing contact with the rolls by liquid pressure.

The bottom ends of both rolls and flaps are maintained in liquid retaining abutment with a horizontal surface projecting under same from the tank wall. In the construction shown in the drawings this surface is the top surface of the bottom bearing block. As previously mentioned the top bearings from which the squeegee rolls are supported are adjustable vertically to secure the initial liquid retaining contact with the horizontal surface and to compensate for wear of the lower end of the roll.

In the drawings, the input flaps 176 are illustrated as folded members of sheet rubber attached to panels 40 adjacent to slot 42 and making contact with each other or with the work 3. The output flaps 175 are shown of the same construction engaging the squeegee rolls 117 and abutting the top surface of bearing block 100.

When treating discontinuous work (sheets as distinguished from strip) it is necessary that the leading end of the sheet be guided accurately to the line of contact between the input sealing flaps in order that neither flaps be pushed aside laterally—which would result in excessive leakage or damage to the flap. To this end porcelain guide blocks 177 are used to clamp the input flaps 176 to the panels 40 on either side of the slots 42, said blocks having a cylindrical surface facing the incoming work and having projections extending

into the slots, the rear surface of which parallels and is closely adjacent to the plane of the flap. By this means the edge of the sheet is guided laterally until almost in contact with the flaps.

A certain amount of leakage of the electrolyte will occur around the sealing flaps from the anodic cell 13 into the contact roll box 12 and the squeegee roll box 14 and to take care of this leakage a drain pipe 178 extends from each of these roll boxes to the launder 7. Similar drainage pipes 179 extend from each of the lower ends of the squeegee roll boxes 15 and 32 for conveying the leakage of the plating electrolyte to the launder 6, while the waste water from the squeegee roll box 33, wash box 34 and drying box 35 is conveyed to the launder 5, by means of drain pipes 180.

In view of the large number of water tight joints that must be maintained in equipment of this type I prefer to use clamps for assembling the various parts of same—shown in the drawings as 133. These avoid the use of numerous bolts passing through the flanges of the cells and roll boxes which would be subject to corrosion from the seepage between flanges and would in many cases require insulation.

To minimize the number of clamps required and to distribute the clamping pressure of those used uniformly over the flange surfaces, the outwardly extending flanges of the channel shaped cell sections are provided with thickened sections or stays on their inner opposed surfaces having notches to receive the legs of the clamps. At the ends of the unit, posts 182 of similar shape and having notches 183 are provided to receive the end clamps.

In apparatus such as that illustrated having a plurality of cells having walls maintained at the same voltage and polarity alternated with roll boxes of opposite polarity, the clamps engaging adjacent cells, span the intervening roll box out of contact with same and hence no insulation of the clamps is required. Where clamps engage cells of different voltage or polarity their ends are insulated from the cells with insulating shims in the notches of the stays.

For treating discontinuous work (sheets or plates) the pairs of contact rolls 56 and squeegee rolls 117 are each adapted to be continuously driven during the operation of the machine, and in order to produce a slight tension on the sheet to prevent it from buckling, each pair of rolls is driven at a slightly greater speed from the feeding to the discharge end of the apparatus. The driving mechanism for rotating the pairs of contact rolls 56 and squeegee rolls 117 is illustrated in Figures 1, 2 and 20. The wooden spindles 98 which are coupled to the upper ends of the contact and squeegee rolls extend upwardly therefrom and each has its upper end seated in a socket 184 of a coupling 185 located between a pair of spaced channel members 126 disposed with their webs vertically and their flanges extending outwardly therefrom. A plurality of hollow rectangular shaped brackets 187 connect the top flanges of the spaced channel frame members together, each adapted to form the support for one or more pairs of drive shafts 188. Each of these drive shafts 188 have a sleeve 189 secured to its upper end which engages the top surface of the bracket 186 in which it is mounted, while the lower end of each drive shaft is secured to the upper end of one of the couplings 185. The pairs of drive shafts 188 are geared together

by means of gears 190 and 191 and one of each pair of drive shafts is provided with a sheave 192 for engaging a driving cable 193. The sheave on one pair of drive shafts is disposed in staggered relation with the sheave on the adjacent pair of driving shafts as indicated in Figure 2 of the drawings. It will also be noted that each sheave from the motor 194 is of slightly smaller diameter so that the rotation of the pairs of rolls will be slightly increased from one end of the apparatus to the other. The motor 194 has a shaft with a worm 195 meshing with a worm wheel 196 on shaft 197 journaled in a bearing bracket 198. The shaft 197 also has a sheave 199 keyed thereto for driving the cable 193. This cable 193 engages the sheaves 192 and then passes around an idler sheave 200 at the opposite end of the driving mechanism to that where the motor 194 is located, thence over a pair of supporting idler sheaves 201 on its return to the driven sheave 199. In order to take up slack and to hold the cable 193 firmly in contact with the sheaves 192, a sheave 202 is mounted on the cable at an intermediate point between the supporting idler sheaves 201, which is supported in the forked upper end of a clevis bolt 203 having a counterweight 204 mounted thereon.

When treating continuous strip it is unnecessary to separately drive the contact and squeegee rolls provided a take-up reel 227 is provided to pull the strip through the apparatus as illustrated in Figs. 45 and 46. This reel is driven by motor 228 and a pay-off reel 229 is provided having a brake 230 by means of which the strip can be kept in tension as it passes through the apparatus as per usual practice in the strip treating art.

If successive coils of strip are welded or laced together end to end and the treating process thereby made entirely continuous it will be understood that the driving mechanism for the rolls as well as most of the guiding members within the apparatus may be eliminated. However, the joining of strips together requires an appreciable time, requires expensive equipment and results in the spoilage of some material in and near the joint.

Taking advantage of the straight line flow of work through my apparatus and the consequent ease of guiding the entering edge of a strip through same I prefer in some cases to introduce coils of strip separately into the apparatus, driving the entering edge through the apparatus by means of the roll driving mechanism above described until the strip has engaged the take-up reel.

To minimize wear of rolls and driving mechanism I prefer to transfer the driving energy to the take-up reel after the strip has engaged and been secured to same and for this purpose I provide friction clutches 231 between the driving sheaves and gearing for the individual drive units of the contact and squeegee rolls.

In order to remove the curvature of the coil from the leading end of the strip and thereby to permit its being guided accurately through the apparatus, I provide a roller leveller 232 at the input end of the apparatus.

Referring to Figure 1 it will be noted that the motor generator 205 furnishes the current through the bus bars 206 and 207 and terminal connections to the contact rolls and plating cells on one side of the apparatus, the negative side of the circuit extending to the contact rolls, while

the positive side of the circuit is connected to one side of the plating cells, and the motor generator 208 supplies the current through the bus bars 209 and 210 and terminal connections in a similar manner to the contact rolls and plating cells on the opposite side of the apparatus. With this system of connections and with opposite sides of the cells insulated from each other it is possible to vary the electrolytic effect on either side of the work by varying the current output of the two generators.

A more usual system of connections to a plurality of cells is to connect both sides of each cell to one generator as described in the following paragraph and, in case a plurality of generators are to be used, to connect each generator to a cell or group of cells in succession through the apparatus.

The polarity for the anodic cell 13 is reversed to that for the plating cells. In this cell the positive side of the circuit 211 from the motor generator 212 is connected to both of the contact rolls, while the negative side 213 is connected to both sides of the cell. In this manner of connecting up the circuit the work 8 will be the anode and the lining of the cell the cathode.

In Figure 12 I have illustrated a modification in which the frusto-conical shaped porcelain spacing guides 214 and 215 and the T-shaped porcelain guides 216 and 217 extend a greater distance into the cells on one side, and the work 8 is advanced through the plating cells nearer one anode than the other; in this manner a thicker plate will be deposited on one side of the work when equal voltage is maintained on opposite sides of the cells.

In Figure 13 I have shown sealing flaps for an output seal in which the flaps engaging the squeegee rolls are formed of a strip of soft rubber or the like 218 having a thickened contact end portion 219 of hard rubber or similar material. Sealing flaps formed in this manner do not gall the rolls as much as the flaps made of folded material and last much longer.

In Figures 35 and 36 I have illustrated means for preventing treeing on the edges of the sheet. This is caused by the concentration of plating current on the edges of the sheet thereby producing rough edges which sometimes have to be removed by trimming, and to prevent this treeing I insert shields in the cells near the top and bottom ends, each comprising a wooden strip 220 with porcelain blocks 221 secured thereto by means of screws 22. These shields engage the top and bottom edges of the sheet as it passes through the cells and prevents excess plating at this point by preventing access of current from the anodes above and below the sheet to the edges. In this manner smooth edges are produced on the sheet.

In many cases, a metallic coating deposited electrolytically upon sheet or strip is of dull appearance and relatively rough texture. It may also be discolored by oxidation after emerging from the plating bath or by chemical attack of the electrolyte upon it. In addition to washing the work at the exit end of the plating apparatus as elsewhere described I may therefore apply one or more chemical or electrochemical treatments to the work in cells located adjacent to the plating cells at the exit end of the apparatus.

In particular I may omit positive connections to one or more cells at the exit end of the plating section of the apparatus thus allowing the plating

electrolyte to react chemically upon the coating. Or I may provide one or more cells of reversed polarity in which the electrodeposited coating is acted upon anodically in the plating electrolyte or in a separate electrolyte for the purposes of brightening or smoothing by partially deplating the work.

In Figure 37 I have shown the last plating cell and the parts adjacent thereto. In this figure the electric circuit for the last cell is omitted.

In Figure 38 I have shown a view similar to Figures 37 in which the last cell has its polarity reversed to that for the plating cells. In this case the sheet would form the anode and the lining of the cell the cathode, the positive side 223 of the circuit extending to the contact rolls and the negative side of the circuit 224 to the sides of the cell, and in Figure 39 I have indicated means for varying the current density on each side of the plating cells thereby producing a thicker plating on one side of the sheet than that on the other. This is accomplished by having an adjustable resistance 225 in the circuit for one side of the plating cells and another adjustable resistance 226 in the circuit for opposite side of the plating cells.

Having thus given the foregoing general and detailed description of my apparatus, I will now further describe, by way of illustration, the operation of same in plating sheets with zinc in a bath containing sulphuric acid and zinc sulphate, using insoluble cell wall anodes.

The sheet to be plated is disposed in a vertical position and supported at its lower edge on the feed table 11 and then fed horizontally into the first contact roll housing box 12 between a pair of contact rolls 50 which connect the sheet to the positive terminal of generator 212 and the negative terminals of generators 205 and 208. As all of the pairs of squeegee rolls 117 and contact rolls 50 are continuously driven the sheet is advanced by them through the apparatus, and in order to create a slight tension on the sheet to prevent it from buckling each successive pair of rolls is driven at a slightly greater speed. The first pair of contact rolls advance the sheet between the flaps of an input seal 176 and into a pickling bath 163 in the anodic cell 13, the lead side walls being connected to the negative of generator 212 and forming the cathode of the cell. In this pickling bath the sheet is thoroughly cleaned and then advanced between the sealing rolls in roll housing box 14 and further advanced between another pair of squeegee rolls in roll housing box 15 for removing adhering pickling solution, thence through an input seal into the plating cells 16, 17, 18, 19, 20, 21, 22 and 23 to the lead lining of which at each side of each of the cells is connected the positive side of an electric circuit, thereby forming insoluble plating anodes. Each plating cell has associated therewith a pair of contact rolls journaled in roll housing boxes 24, 25, 26, 27, 28, 29, 30 and 31, respectively, each of which is connected in common to the negative terminals of generators 205 and 208. These contact rolls are adapted to engage the sides of the sheet which forms the negative electrode during the plating operation. After the plating operation the sheet is advanced between the sealing rolls in roll box 32 and then passed between another pair of squeegee rolls in roll housing box 33, then into the wash box 34, drying box 36 having steam pipes therein and finally between a pair of squeegee rolls in roll housing box 38, from which it is ejected onto the receiving table 39.

Any leakage from the bath in the anodic cell 13 around the output and input seals 175 and 176 in roll housing boxes 14 and 12 will be conveyed by means of the drain pipes 178 to the launder 7, the leakage of the plating solution into roll housing boxes 15 and 32 will be conveyed by the drain pipes 179 to the launder 6, and the waste water in roll box 33, wash box 34 and drying box 36 will be conveyed by means of the drainage pipes 180 to the launder 5.

The porcelain members 173 of T-shape and the semi-cylindrical ones 177 at the entrance and exit ends of the roll housing boxes guide the sheet into and out of the same, while the frusto-conical shaped porcelain guides attached to the lead linings of the cells guide the sheet and hold it in uniform spaced relation therewith, without obstructing the upward flow of the electrolyte from the intake at the lower portion of the cell to the froth box above.

I have found when running a considerable quantity of one width of sheet through the apparatus that it is desirable to traverse the sheets up and down in small increments to avoid serious scoring of the rolls by the edges of the sheets. To accomplish this the tables for feeding or receiving the sheets are periodically raised and lowered so that the edges of the sheets will pass between the surfaces of the rolls at different heights.

In Figures 40 to 43, inclusive, I have illustrated a table 233 having means for vertically adjusting the feed of the sheet, comprising a channel-shaped longitudinally extending bottom member 234 disposed with its flanges extending downwardly upon which is mounted vertically posts 235, longitudinal guide rails 236, rollers 237 for supporting the sheet and roller guides 238. A hinge slide angle 239 is also secured to the lower portion of one side of the table and is provided with flanged end bearing plates 240 which are pivotally connected as at 241 to angular brackets 242 secured to the top of the channel-shaped bottom member 234. An angle 243 is secured centrally to one end of the channel-shaped bottom member 234, the ends of which extend laterally therefrom and are each provided with a downwardly extending adjusting screw 244 which are secured thereto by means of nuts 245. The opposite end of the channel-shaped bottom member 234 is also provided with a similar downwardly extending adjusting screw 246 which is secured thereto by means of nuts 247. The table 233 is mounted on a movable base frame 248 which is supported on rollers having inclined side angular members 249 and end angular-shaped members 250 and 251. A roller 252 is secured centrally to the end member 250 while the outer ends of the angular end member 251 are provided with short legs 253 with casters mounted in their lower ends as at 254. A hand wheel 255 having a hub is threaded on each of the adjusting screws 244 and 246, said adjusting screw extending through the top flanges of the end members 250 and 251 of the base frame 248. The lower ends of the hubs of the hand wheels 255 engage the top surfaces of the inwardly extending horizontal flanges of the end members 250 and 251, and by rotating each hand wheel a required turn the table can be raised or lowered as desired, and in order to properly adjust the table gages 256 are adjustably attached to each end of the base frame 248 having scales or graduations thereon for indicating the amount of adjustment.

The length of the individual cells and hence the number of plating cells and roll housing boxes used in the plating section of an apparatus of any given capacity depends in part on the lengths of sheets to be treated but in larger measure upon the current density to be used in the plating operation and the contacting capacity of the rolls. Obviously, since the contact rolls are used to hold the sheets suspended within the apparatus and to advance them through same the spacing of the rolls must not exceed the length of the shortest sheets to be plated—preferably the roll spacing should be less than half said length. In most cases, however, the number of contact rolls required to economically supply current to the sheets will considerably exceed the number required merely to mechanically handle sheets of commercial length.

In the sheet plating art it has heretofore been the practice to contact the sheets and suspend them in the bath by means of clips—the disadvantages of which are obvious. In strip plating it is common practice in large capacity or high current density apparatus to repeatedly bring the strip out of the plating bath and over external contact rolls. This is necessary to avoid loss of current and plating upon the contact roll which would occur if the latter were submerged.

However, it has been found that the total current which can be transmitted from a sliding or rolling contact to work being plated without damage to the contact or the work is several times greater when the contact is submerged in the electrolyte than when exposed to the air. Furthermore, since the voltage drop due to current flow in the work and the consequent power loss and heating of work and electrolyte is proportional to the square of the distance between contacts it is highly desirable to eliminate the inactive length of the work extending from the surface of the electrolyte to external contacts. Incidentally, it will be recognized by those skilled in the plating art that it is often undesirable to expose the work to the air between successive plating immersions in the electrolyte.

The apparatus of my invention offers the advantages of maintaining the work during the entire plating operation under the surface of the electrolyte, of contacting the work while submerged, of contacting the work uniformly with respect to its width with crowned rolls, and of minimizing the inactive length of the work subject to voltage drop. (The roll housing boxes are only slightly longer than the diameter of the rolls.)

The apparatus is particularly desirable in the plating of zinc from high acid solution where high current densities (of the order of 300 to 1000 amperes per square foot) must be used. For this application, a cell length of 10' to 20' (contact roll spacing of 15' to 25') has been found most economical. The voltage drop in the work is in this case of the order of 0.1 volt. Current leakage between contact rolls and adjacent anodes is less than 2% of total plating current. Due to the characteristics of the high acid electrolyte this leakage causes no deposition of zinc whatever upon the contact rolls.

The combination of straight line travel of the work through the cells and the use of cell wall anodes with integral insulating guide members permits accurate and close spacing of anode and work ($\frac{1}{2}$ inch has been found satisfactory for commercial sheet plating) thus providing minimum voltage drop in the electrolyte.

The use of crowned contact rolls in conjunction with the above described fluid pressure system for applying pressure to the roll journals is an important part of my invention. In order to obtain maximum electrical contacting capacity without local arcing or overheating and to assure uniform longitudinal flow of current throughout the width of the sheet it is necessary to maintain a substantially line contact between the contact rolls and the work and to maintain this contact at considerable pressure.

As is well known in the art of rolling flat products the necessary parallelism of the rolls can be obtained by giving same a convex contour and, in service, flexing them by pressure on the ends until the roll contact is substantially a straight line. In metal rolling the attainment of the proper roll pressure to bring this about can be judged by the flatness of the product.

In subject plating apparatus, however, a large number of rolls must be kept under proper pressure and this pressure must be varied in accordance with the width of the work being treated, there being no visual method of adjustment. I therefore provide rolls all having the same diameter, stiffness and contour and apply the same pressure to top and bottom journals of all rolls by means of diaphragms of equal size acted upon from a common source of fluid pressure. The pressure supplied by said source is controlled to suit the width of work being treated in accordance with observations as to the response of individual pairs of rolls to varying pressure when contacting various widths of work. The inherent flexibility of the fluid pressure—diaphragm arrangement maintains the selected roll pressure regardless of the thickness of the work being treated, which otherwise would of course have to be compensated for.

The above illustrations and descriptions of plating cells are confined to those having electrodes integral with the cell walls and hence of insoluble type. It will be obvious to those skilled in the art however that soluble anodes when required may be suspended within the plating cells on either side of the work between the lateral guides which are attached to the cell walls, and that said anodes may be supplied with current from the cell walls or be insulated from same and supplied with current by external conductors.

By the use of the term "sheet" in the foregoing description and in the claims is meant sheeted material of any size or shape including sheet, plate, and strip material.

Although I have shown and described my invention in considerable detail, I do not wish to be limited to the exact and specific details shown and described, but may use such substitutions, modifications or equivalents thereof as are embraced within the scope of my invention or as pointed out in the claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An electrolytic apparatus for continuously treating sheets, comprising a plurality of plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment in alternate relation to each other, an insulating panel between each plating cell and roll housing box each having a vertical central slot forming restricted passageways between the plating cells and the roll housing boxes through which the sheet can pass, means for securing each of the

roll housing boxes to the adjacent ends of a pair of plating cells, a pair of contact rolls in each of the roll housing boxes adapted to engage the opposite sides of the sheet, liquid seals at the inlet and outlet ends of the apparatus, and means for rotating the pairs of contact rolls to advance the sheet submerged in the electrolyte through the plating cells and roll housing boxes.

2. An electrolytic apparatus for continuously treating sheets, comprising a succession of alternately arranged plating cells and roll housing boxes disposed in longitudinal alignment and containing an electrolyte, clamps for securing the plating cells and roll housing boxes together, an insulating panel between each plating cell and roll housing box having a vertical central slot forming a restricted passageway between each plating cell and roll housing box through which the sheet can pass, a pair of contact rolls having vertical axes journaled in each roll housing box adapted to engage the opposite sides of the sheet disposed in a vertical plane, said contact rolls and the sides of said plating cells being connected to opposite poles of a source of electric current, liquid seals at the inlet and outlet ends of the apparatus, and means for rotating the pairs of contact rolls to advance the sheet longitudinally submerged in electrolyte through the plating cells and roll housing boxes.

3. An electrolytic apparatus for continuously treating sheets, comprising a succession of alternate plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, insulating means between each of the plating cells and roll housing boxes, clamps for securing the plating cells and roll housing boxes together, a centrally disposed restricted passageway connecting the plating cells and the roll housing boxes, a pair of contact rolls for engaging and supporting the sheet in each of the roll housing boxes, each of said pairs of contact rolls having a connection to the negative side of a separate electric circuit, an anode secured to the inner surface of each side of the plating cell, said anodes each having a connection to a separate positive side of an electric circuit, and means for rotating the contact rolls for advancing the sheet submerged in the electrolyte through the plating cells and roll housing boxes.

4. An electrolytic apparatus for continuously treating sheets, comprising a succession of alternate plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, a resilient insulating panel adapted to form a gasket and a liquid sealing means between the abutting ends of each of the plating cells and roll housing boxes, a reinforcing plate embedded in each panel, a vertical centrally disposed slot formed in the panel through which the sheet and electrolyte may pass, means for advancing the sheet submerged in the electrolyte through the plating cells and roll housing boxes, and clamps for securing the plating cells and roll housing boxes together.

5. An electrolytic apparatus for continuously treating sheets, comprising a plurality of plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment in alternate relation to each other, an insulating panel between each plating cell and roll housing box having a vertical central slot through which the sheet and electrolyte can pass, a pair of contact rolls having vertical axes journaled for rotation in each of the roll housing boxes, fluid

pressure means for simultaneously applying uniform pressure to both ends of the rolls for holding each pair of contact rolls in line contact with the opposite sides of the sheet, means for rotating the contact rolls to continuously advance the sheet submerged through the electrolyte in the plating cells and roll housing boxes, and means for passing a separate electric current through the electrolyte in each plating cell on opposite sides of the sheet.

6. An electrolytic apparatus for continuously treating sheets, comprising a plating cell and a roll housing box containing an electrolyte, an insulating panel between the abutting ends of the plating cell and the roll housing box, means for securing the plating cell and roll housing box together, a central vertically disposed slot in the panel through which the sheet and electrolyte can pass, a pair of contact rolls having vertical axes journaled for rotation in the roll housing box, means for rotating the contact rolls to continuously advance the sheet submerged in the electrolyte through the plating cells and the roll housing boxes, an anode secured to the inner face of each side of the plating cell, means for passing an electric current through the electrolyte from the anode at one side of the plating cell to said contact rolls engaging one side of the sheet, and means for passing a separate electric current through the electrolyte from the anode at the other side of the plating cell to said contact rolls engaging the other side of the sheet.

7. An electrolytic apparatus for continuously treating sheets embodying a succession of alternate plating cells containing an electrolyte and roll housing boxes secured together in longitudinal alignment, an insulating gasket between each end of the plating cells and roll housing boxes, means for advancing the sheets through the plating cells and roll housing boxes, said plating cells each comprising a pair of channel shaped members disposed vertically in spaced relation with their legs extending outwardly at right angles thereto to form the ends of the cell, an anode secured to the inner face of each channel shaped member, a spacing block connecting the lower ends of the channel shaped cell members together and adapted to form the bottom closure for the cell, an offset portion at the upper end of the channel shaped side members adapted to form a froth box for the cell, and a faced outer surface on the legs and on each end of the said spacing block at the ends of the cell adapted to form a seating surface for a gasket or the like.

8. An electrolytic apparatus for continuously treating sheets embodying a succession of alternate plating cells containing an electrolyte and roll housing boxes secured together in longitudinal alignment, an insulating gasket between each end of the plating cells and roll housing boxes, means for advancing the sheets through the plating cells and roll housing boxes, said plating cells each comprising a pair of channel shaped side members disposed vertically in spaced relation with their legs extending outwardly to form the ends of the cell, a flange at the outer end of each leg, said flange on one leg of each channel shaped side member extending toward the flange on the adjacent leg, notches formed in each flange, an anode secured to the inner face of each channel shaped member, an offset portion at the upper end of the channel shaped side frame members adapted to form a froth box for the cell, overflow pipes for the elec-

trolyte extending into the froth box, a spacing block connecting the lower ends of the channel shaped cell members together and adapted to form the bottom closure for the cell, and a faced outer surface on the legs and on each end of the said spacing block at the ends of the cell adapted to form a seating surface for a gasket or the like.

9. An electrolytic apparatus for continuously treating sheets, comprising a plurality of plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment in alternate relation to each other, an anode secured to the inner surface of the cell, an insulating panel between each plating cell and roll housing box, clamps for securing the plating cells and roll housing boxes together, a pair of rolls in each of the roll housing boxes, non-conductive guiding members attached to the inner faces of each of the cell anodes adapted to hold the sheet in fixed spaced relation to the anode of the plating cell, said non-conductive guiding members on one anode of the plating cell being shorter than those on the opposite anode of the plating cell thereby producing a thicker plate on one side of the sheet, and means for rotating the pairs of rolls in each of the roll housing boxes to advance the sheet through the apparatus.

10. An electrolytic apparatus for continuously treating sheets, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, means for securing the plating cell and roll housing box together in insulated relation, a pair of rotating contact rolls journaled in the roll housing box adapted to engage a sheet and feed it forward submerged in the electrolyte through the plating cell and roll housing box, a separate electrical circuit connection between the contact rolls and each side of the plating cell, and means for varying the current density in each side of the plating cell.

11. An electrolytic apparatus for continuously treating sheets, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, a restricted passageway between the plating cell and the roll housing box, means for securing the plating cell and roll housing box together in insulated relation, a pair of contact rolls having vertical axes journaled for rotation in the roll housing box, means actuated by fluid pressure applied uniformly to both ends of the contact rolls for keeping the said contact rolls in driving contact with the sheet, a lead lining secured to the inner surface of the cell adapted to form a cell wall electrode at each side of the plating cell, a plurality of insulating guiding members for the sheet secured to the inner surfaces of the cell wall electrodes of frusto-conical shape, an electrical circuit connection between the contact rolls and opposite sides of the plating cell, and means for rotating the contact rolls to advance the sheet submerged in the electrolyte through the plating cell and roll housing box.

12. An electrolytic apparatus for continuously treating sheets, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, means for securing the plating cell and roll housing box together in insulated relation, a restricted passageway between the plating cell and the roll housing box, a pair of rotating contact rolls having vertical axes journaled for rotation in the roll housing box adapted to engage a sheet and feed it forward submerged in the electrolyte through the plating cell and roll housing box, a separate electrical circuit connection be-

tween said contact rolls and the opposite sides of the plating cell, an adjustable resistance in each of the separate electrical circuit connections for varying the current density in each side of the plating cell.

13. An electrolytic apparatus for treating sheets, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, a wall electrode at opposite sides of the cell, a plurality of insulating guiding members adapted to be secured to the inner surfaces of the plating cell wall electrodes, each of said guiding members comprising a frustro-conical shaped article having an axial hole for the attaching member, a counterbore in the small end of the conical section for receiving the head of the attaching member, an inwardly projecting bead at the outer end of the counterbore, and an expansive sealing member inserted in the counterbore and retained in position by the bead.

14. An electrolytic apparatus for treating sheets, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, a wall electrode at opposite sides of the plating cell, a plurality of insulating guiding members each adapted to be attached by means of a rivet to the inner surface of a plating cell wall electrode, each of said guiding members comprising a frustro-conical glass or porcelain article having an axial hole for receiving the attaching rivet, a counterbore in the small end of the conical section for receiving the head of the rivet, an inwardly projecting bead at the outer end of the counterbore, and an expansive sealing disk adapted to be inserted in the counterbore and retained in position by means of the bead.

15. In an electrolytic sheet treating apparatus formed of a plurality of units disposed in longitudinal alignment, an insulating panel disposed between the adjacent ends of each two units of the apparatus, a vertical centrally disposed slot in said panel, an input seal comprising flexible flaps secured to said panel on either side of said slot and extending inwardly in the direction of travel of the sheet at an acute angle with respect to the plane of the sheet with their inner ends normally engaging each other at the center line of the slot, guide members for the sheet secured to the panel at either side of said slot, said guide members each having an arc shaped outer guiding surface on one side, a flat surface on the other side adapted to engage the ends of the flaps and to be attached to the panel, a plane surface extending at an obtuse angle to said flat surface, said plane surface being approximately parallel to the plane of the flap and intersecting said flat surface in a line adjacent to and parallel with the engaging edges of the flaps, and fastening means for attaching the guide members to the panel adapted to hold the flaps in compression between said guide members and said panel to form a liquid-tight joint.

16. In an electrolytic sheet treating apparatus of the type described, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, a slotted panel of insulating material adapted to be clamped between the plating cell and the roll housing box with the slot extending vertically in said panel and aligned centrally with the interior of the roll housing box and plating cell, guide members of insulating material substantially T-shape in cross-section at each side of the ends of the plating cell having their legs secured between the end of the plating cell and attached to the panel with their opposed

head flanges extending laterally into the plating cell and slot in the panel at each side of the plating cell, said opposed head flanges having arc shaped outer faces adapted to form a restricted passageway for the sheet and electrolyte, and means for advancing the sheet through the plating cell and roll housing box submerged in the electrolyte.

17. In an electrolytic sheet treating apparatus of the type described, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, an insulating panel clamped between the roll housing box and plating cell, a vertically extending centrally disposed slot formed in the insulating panel, a pair of rolls having a resilient outer surface disposed with their axes vertically and journaled in the roll housing box, and output sealing flaps secured to the panel at each side of the slot in the panel, said sealing flaps each having a resilient portion attached to the panel and an end portion of flexible but substantially non-resilient rubber adapted to engage the resilient roll surface.

18. In an electrolytic sheet treating apparatus of the type described, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, a pair of crowned contact rolls having vertical axes journaled in the roll housing box, said pair of rolls each having a steel core, a hard acid resisting metal alloy stub shaft attached to the lower end of said core and journaled in a bearing immersed in the electrolyte, a roll neck formed at the upper end of the core, a contact metal covering on the roll neck, an anti-friction bearing fixed to the upper end of the roll neck adapted to serve as a journal and to support the weight of the roll, and an acid resisting metal covering extending over the outer surface of the steel core and homogeneously attached thereto.

19. In an electrolytic sheet treating apparatus of the type described, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, means for insulating the plating cell from the roll housing box, a pair of crowned contact rolls having vertical axes located in the roll housing boxes, a head structure mounted on top of said roll housing box having contacting means for connecting said rolls to one terminal of a source of electric current, anti-friction bearings mounted on the head structure for supporting the weight of the rolls, journal bearings for the lower ends of said contact rolls immersed in the electrolyte, fluid pressure operated means applied uniformly to both ends of the contact rolls for maintaining a substantially line contact between the rolls and sheets of variable width to be treated, and means for rotating the contact rolls to advance the sheet through the electrolyte.

20. In an electrolytic sheet treating apparatus of the type described, comprising a plating cell and a roll housing box associated therewith containing an electrolyte, means for insulating the roll housing box from the plating cell, a pair of rotating contact rolls journaled in the roll housing box having roll necks, a top journal bearing support attached to the top of the roll housing box, a terminal block secured to the top journal bearing support, a band of braided wire attached to said terminal block and adapted to extend around the neck of the contact rolls, and means for applying a coolant to the band of braided wire.

21. In an electrolytic sheet treating apparatus of the type described having a plating cell and a roll housing box associated therewith containing an electrolyte, means for insulating the roll housing box from the plating cell, a pair of rotating contact rolls journaled in the roll housing box, a top journal bearing support attached to the top of the roll housing box, a contacting device for transmitting heavy electric currents to the rotating contact rolls comprising a pair of terminal blocks secured to the top journal bearing support, a band of braided wire connecting the terminal blocks and adapted to be looped around a portion of the circumference of the roll necks, means for applying a liquid coolant to the band of braided wire, and adjustable means for holding the band in contact with the roll necks.

22. An electrolytic apparatus for cleaning sheets, comprising an anodic cell containing an electrolyte and a roll housing box associated therewith, an insulating panel between the anodic cell and the roll housing box, a centrally disposed vertical slot in the insulating panel forming a restricted passageway between the anodic cell and the roll housing box, means for securing the anodic cell and roll box together, a lead lining in the anodic cell, a pair of contact rolls for engaging opposite sides of the sheets having vertical axes journaled in the roll housing box, fluid actuated means for applying simultaneously a uniform pressure to both ends of the contact rolls, means for rotating the contact rolls for advancing the sheet disposed in a vertical plane horizontally through the electrolyte in the anodic cell, a positive side of an electric circuit connection extending to the contact rolls engaging the sheet to form one electrode, a negative side of an electric circuit extending to the lead lining at each side of the anodic cell to form the negative electrode, and insulating guiding means attached to the lead lining of the anodic cell for holding the sheet in fixed spaced relation therewith.

23. An electrolytic apparatus for cleaning sheets, comprising an anodic cell containing an electrolyte having vertical side walls and a roll housing box associated therewith, a slotted insulating panel forming a central restricted passageway between the anodic cell and the roll housing box, a lead lining having a water jacket secured to each of the inner opposite vertical faces of the side walls of the anodic cell, a pair of contact rolls for engaging opposite sides of the sheet having vertical axes journaled in the roll housing box, fluid actuated means for applying simultaneously a uniform pressure to both ends of the contact rolls, means for rotating the contact rolls for advancing the sheet disposed in a vertical plane horizontally through the electrolyte in the anodic cell, a positive side of an electric circuit connection extending to the contact rolls engaging the sheet to form one electrode, a negative side of an electric circuit connection extending to the lead lining secured to each of the vertical side walls of the anodic cell to form the negative electrode, insulating guiding means attached to the lead linings at each side of the anodic cell for holding the sheet in fixed spaced relation therewith, and sealing means at the opposite ends of the anodic cell for retaining the electrolyte therein.

24. An electrolytic apparatus for treating sheets, comprising a succession of plating cells

and roll housing boxes containing an electrolyte arranged in longitudinal alignment, clamps for securing the roll housing boxes and the plating cells together, an insulating panel between each of the roll housing boxes and plating cells, a pair of rolls having vertical axes journaled in each of the roll housing boxes for engaging opposite sides of the sheet, means for rotating each pair of rolls simultaneously for advancing a sheet disposed in a vertical plane horizontally through the apparatus, and means for producing tension on the sheet by driving each pair of rolls at a slightly greater surface velocity than the preceding pair as the sheet is advanced through the apparatus.

25. An electrolytic apparatus for treating sheets, comprising a succession of alternate plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, means for clamping the plating cells and roll housing boxes together in insulated relation, a central vertically disposed restricted passageway between the plating cells and the roll housing boxes, sealing flaps in the roll housing boxes for retaining the electrolyte in the plating cells, a pair of vertically disposed rollers mounted for rotation in each roll housing box adapted to support and convey a sheet disposed in a vertical plane longitudinally through the apparatus, and means for producing tension on the sheet by driving each pair of said rollers at a slightly greater surface velocity than the preceding pair as it passes through the apparatus.

26. An electrolytic apparatus for continuously treating sheets, comprising a succession of alternate plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, means for clamping the plating cells and roll housing boxes together in insulated relation, a pair of vertically disposed rollers journaled for rotation in each roll housing box adapted to support and convey a sheet disposed in a vertical plane longitudinally through the apparatus, a spindle having its lower end coupled to the upper end of each of the pair of rollers, a drive shaft coupled to the upper end of each spindle, means for gearing the drive shafts for each pair of rollers together, a sheave on one of the drive shafts for each pair of rollers, each of said sheaves on the drive shafts toward the discharge end of the apparatus having a slightly smaller diameter than the preceding one, a cable for engaging the sheaves on the drive shafts, and means for driving the cable to rotate the drive shafts and rollers.

27. An electrolytic apparatus for continuously treating sheets, comprising a succession of alternate plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, means for clamping the plating cells and roll housing boxes together in insulated relation, a pair of vertically disposed rollers journaled in each roll housing box adapted to convey a sheet disposed in a vertical plane longitudinally through the apparatus, a spindle having one end coupled to the upper end of each of the pair of rollers, a drive shaft coupled to the other end of each spindle, means for gearing the drive shafts for each pair of rollers together, a sheave on one of the drive shafts for each pair of rollers, each of said sheaves on the drive shafts toward the discharge end of the apparatus being in staggered relation and having a slightly smaller diameter than the preceding one, a cable for engaging

the sheaves on the drive shafts, means for driving the cable to rotate the driving shafts and pair of rollers, a pair of spaced supporting sheaves for the cable, and a counterweight suspended from the cable between the pair of spaced supporting sheaves for holding the cable in driving contact with the sheaves on the drive shafts at all times.

28. An electrolytic apparatus for treating sheets, comprising a succession of alternate plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, means for clamping the plating cells and roll housing boxes together in insulated relation, a pair of vertically disposed rollers journaled in each of the roll housing boxes, a top bearing support secured to the upper end of each roll housing box, a top bearing head mounted thereon and attached thereto, a slide-way formed in the upper surface of the top bearing head, adjustable bearing blocks mounted in the slide-way, an anti-friction bearing mounted in each of the adjustable bearing blocks adapted to be secured to the upper end of a roller and form a journal therefor to support the weight of the roller, and means operated by fluid pressure engaging the journal bearing for holding the rollers in driving contact with the sheet.

29. An electrolytic apparatus for treating sheets, comprising a succession of alternate plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, means for clamping the plating cells and roll housing boxes together in insulated relation, a restricted passageway between the plating cells and the roll housing boxes, a pair of vertically disposed rollers in each of the roll housing boxes adapted to convey a sheet vertically through the apparatus, journal bearings at the top and bottom ends of each roll housing box, means for supporting the weight of the rollers by the top journal bearings, and fluid pressure operated means for engaging the top and bottom journal bearings for applying a uniform pressure to the top and bottom ends of each pair of rollers to hold them simultaneously in driving contact with the sheet.

30. An electrolytic apparatus for galvanizing sheets, a plurality of units clamped together in longitudinal alignment, comprising an anodic cell containing an electrolyte through which the sheet is passed as an anode for cleaning, a plurality of plating cells and roll housing boxes containing and electrolyte through which the sheet is passed continuously submerged as a cathode for plating, a wash box for receiving the sheet to wash the same after the plating operation, a drying box for receiving the sheet at the end of the sheet treating operations, and a plurality of pairs of contact and squeegee rollers having vertical axes journaled for rotation in the roll housing boxes adapted to support and convey the sheet vertically disposed horizontally through the apparatus.

31. An electrolytic apparatus for galvanizing sheets, a plurality of units clamped together in longitudinal alignment, comprising an anodic cell containing an electrolyte through which the sheet is passed as an electrode of one polarity for cleaning, a plurality of plating cells and roll housing boxes each containing an electrolyte and a separate electric circuit connection through which the sheet is passed continuously submerged as an electrode of the reverse polarity for plating, a wash box for receiving the sheet after the plating

operation, a drying box for receiving the sheet at the end of the sheet treating operations, an insulating panel between each unit, a pair of squeegee rollers having vertical axes at the end of each operation for removing the solution from the sheet and for supporting and advancing the said sheet vertically disposed horizontally in the apparatus, and a pair of contact rollers having vertical axes disposed adjacent to one end of each of the plating cells each adapted to be connected to one side of the electric circuit for each of the plating cells and to support and advance the sheet in the apparatus.

32. An electrolytic apparatus for treating sheets, comprising a succession of alternate plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, a pair of vertically disposed contact rollers mounted in the roll housing box at the end of each plating cell having upwardly extending roll necks, a top bearing support mounted on the top end of each roll housing box, a top bearing head secured to the top bearing support, anti-friction bearings carried by the top bearing head secured to the top ends of the roll necks adapted to support the weight of the contact rollers, a contact sleeve on each of the upwardly extending neck of each roller, a terminal block attached to each side of the top bearing support, a band of braided wire connecting the inner ends of the terminal blocks together and adapted to have its intermediate portion looped around a portion of the circumference of the contact sleeves on the necks of the rollers, an adjustable eye bolt engaging the central portion of the band of braided wire for holding said band in contact with the sleeves, means for spraying the contact sleeves and band with a cooling fluid, a drip pan for receiving the cooling fluid formed with the top bearing support, and drainage pipes connected to the drip pan.

33. An electrolytic apparatus for continuously treating sheets, comprising a succession of plating cells and roll housing boxes containing an electrolyte arranged in longitudinal alignment, a pair of vertically disposed squeegee rollers journaled in a plurality of the roll housing boxes each having a steel core with a crowned resilient surface, an acid resisting alloy stub shaft attached to the lower end of the steel core journaled in a bearing at the base of the roll housing box, a neck extending from the upper end of the steel core having a threaded upper end, an upper bearing support mounted on top of the roll housing box, a pair of roller bearing heads mounted on the upper bearing support, means for vertically adjusting the roll bearing heads, a slide-way formed on the upper surface of each of the roll bearing heads, an adjustable bearing block mounted in each slide-way, an anti-friction bearing block seated in a socket in each of the adjustable bearing blocks and mounted on the upper end of the necks of each of the rollers below the threaded portions to serve as the upper journal for each roller, a thrust washer on the threaded portion of the upper end of each of the necks for engaging the top surface of the anti-friction bearings and nuts on the said threaded portions for locking the thrust washers in position to support the weight of the rollers, and fluid pressure operated means for engaging and applying uniform pressure to the top and bottom bearings for the rollers for simultaneously holding said rollers in driving contact with the sheet.

34. In electrolytic apparatus for continuously treating strip, a succession of alternately arranged plating cells and roll housing boxes disposed in longitudinal alignment and containing electrolyte, insulating panels disposed between said plating cells and roll housing boxes, vertical centrally disposed restricted openings in said panels connecting the plating cells with the roll housing boxes for the passage of the strip continuously submerged in the electrolyte, pairs of contact rolls in said roll housing boxes, electrodes in said plating cells, electrical connections from said rolls and said electrodes to opposite poles of a source of electric current, a feed reel for the strip, and a power driven take-up reel for winding up and advancing the strip through the plating cells and roll housing boxes.

35. An electrolytic apparatus for treating strip, a succession of alternately arranged plating cells and roll housing boxes disposed in longitudinal alignment and containing electrolyte, insulating panels disposed between said plating cells and roll housing boxes, vertical centrally disposed restricted openings in said panels connecting the plating cells with the roll housing boxes for the passage of the strip continuously submerged in the electrolyte, pairs of vertically disposed contact and squeegee rolls in said housing boxes, electrical connections between said contact rolls and said plating cells and the opposite poles of a source of electric current, oppositely disposed, non-continuous guiding means in said plating cells and in the restricted openings in said panels, a feed reel and a power driven take-up reel for the strip having vertical axes, a common driving means for all the said contact and squeegee rolls and overrunning clutches whereby said rolls may rotate independently of said driving means when said strip is being pulled by said take-up reel.

36. An electrolytic apparatus for treating sheets, comprising a plurality of roll housing boxes and plating cells containing an electrolyte secured together in longitudinal alignment, a pair of coating rolls in each roll housing box for engaging opposite sides of the sheets, a feed table for holding the sheets supported at their lower edges in a vertical plane and for advancing said sheets longitudinally into the roll housing boxes and plating cells, means for rotating the rolls to support and advance the sheets submerged in the electrolyte through the roll housing boxes and plating cells, and means for periodically raising and lowering the feed table to traverse the sheets up and down in small increments to avoid scoring of the rolls by the edges of the sheets.

37. An electrolytic apparatus for treating sheets, comprising a succession of roll housing boxes and plating cells containing an electrolyte arranged in longitudinal alignment, a pair of coating rolls in each roll housing box for engaging opposite sides of the sheets, a feed table for holding the sheets supported at their lower edges in a vertical plane and for advancing said sheets longitudinally into the roll housing boxes and plating cells, means for vertically raising and lowering the feed table to raise and lower the sheets, and means for rotating the pairs of coating rolls simultaneously to support and advance the sheets through the roll housing boxes and plating cells.

38. An electrolytic apparatus for treating sheets, comprising a succession of roll housing boxes and plating cells containing an electrolyte, means for securing the roll housing boxes and

plating cells together in longitudinal alignment, a pair of coating rolls in each roll housing box for engaging opposite sides of the sheets, a feed table for holding the sheets supported at their lower edges in a vertical plane and for advancing said sheets longitudinally into the roll housing boxes and plating cells, a movable base frame for supporting the feed table, vertically extending adjusting screws secured to the feed table, a hand wheel having a hub threaded on each of the adjusting screws for raising and lowering the feed table to raise and lower the sheets, and means for rotating the coating pairs of rolls simultaneously in each roll housing box to support and advance the sheets through the roll housing boxes and plating cells.

39. An electrolytic apparatus for treating sheets, comprising a succession of roll housing boxes and plating cells containing an electrolyte, means for securing the roll housing boxes and plating cells together in longitudinal alignment, a pair of coating rolls in each roll housing box for engaging opposite sides of the sheets, a feed table for holding the sheets supported at their lower edges in a vertical plane and for advancing said sheets longitudinally into the roll housing boxes and plating cells, a movable base frame for supporting the feed table, end and side frame members for the base frame, vertically extending adjusting screws having their upper ends secured to the feed table and extending downwardly therefrom through the end members of the movable base frame for the feed table, a hand wheel having a hub threaded on each of the adjusting screws and engaging the end members of the base frame for raising and lowering the feed table and the sheets supported thereon, and means for rotating the coating pairs of rolls simultaneously in each roll housing box to support and advance the sheets through the roll housing boxes and plating cells.

40. An electrolytic apparatus for treating sheets, comprising a succession of roll housing boxes and plating cells containing an electrolyte, insulating means between each of the roll housing boxes and plating cells, means for securing the roll housing boxes and plating cells together in longitudinal alignment, a pair of coating rolls in each roll housing box for engaging opposite sides of the sheets, a feed table having vertically extending posts and longitudinally extending guide rails for holding the sheets supported at their lower edges in a vertical plane and for advancing said sheets longitudinally into the roll housing boxes and plating cells, a movable base frame for supporting the feed table, end and side frame members for the base frame, vertically extending adjusting screws at each end of the table having their upper ends secured to the feed table and extending downwardly therefrom through the end members of the movable base frame for the table, a hand wheel having a hub threaded on each of the adjusting screws and engaging the end members of the base frame for raising and lowering the feed table and the sheets supported thereon, gauges adjustably secured to opposite ends of the base frame and extending upwardly therefrom for indicating the adjustment of the feed table, and means for simultaneously rotating the coating pairs of rolls in each roll housing box to support and advance the sheets through the roll housing boxes and plating cells.