

June 3, 1941.

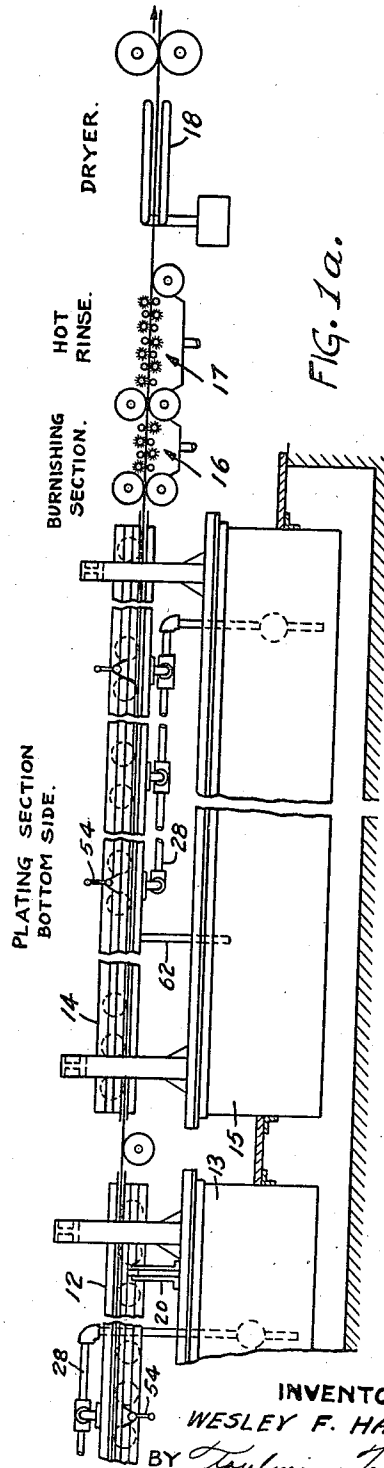
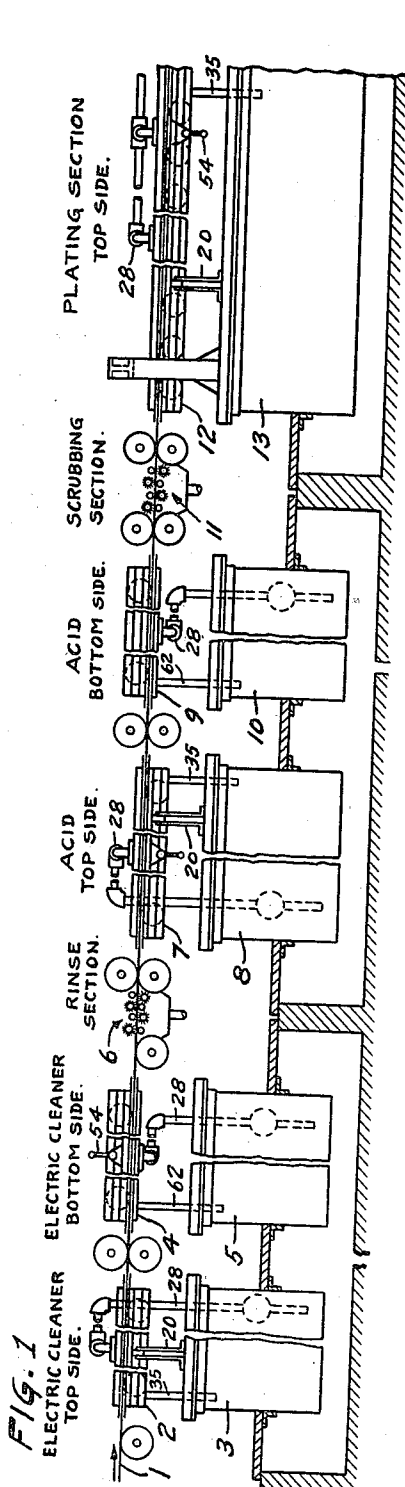
W. F. HALL

2,244,423

APPARATUS FOR STRIP PLATING

Filed June 28, 1938

7 Sheets-Sheet 1



INVENTOR
WESLEY F. HALL.

BY *Toulmin & Toulmin*
ATTORNEYS.

June 3, 1941.

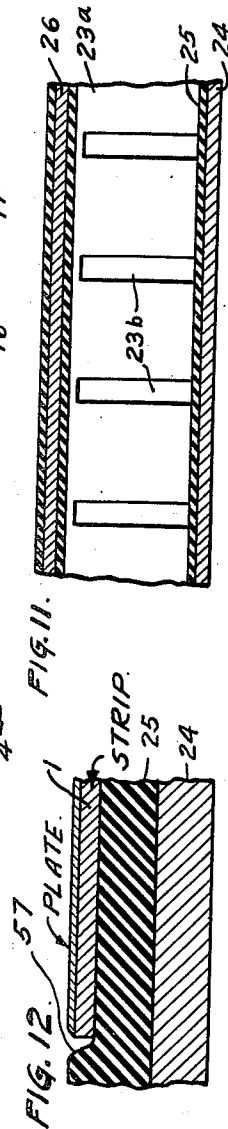
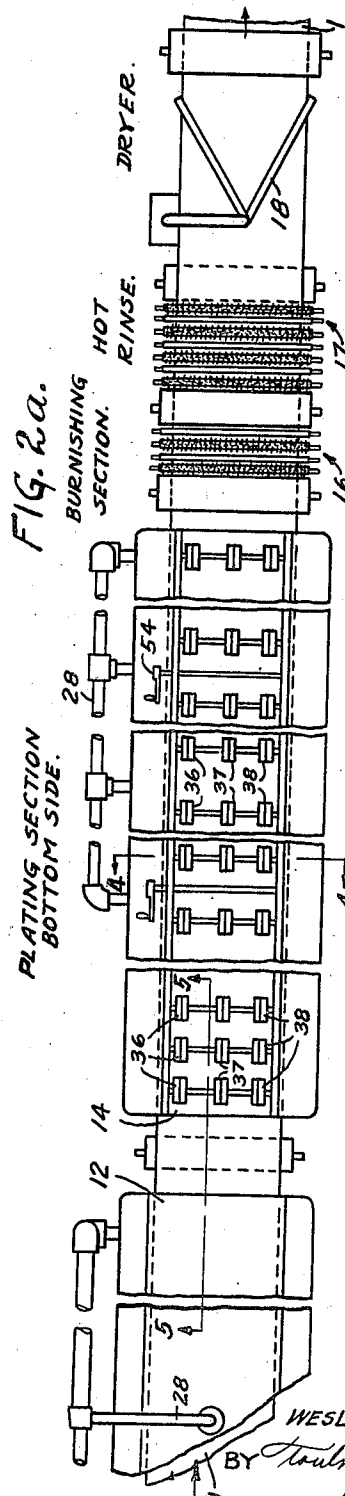
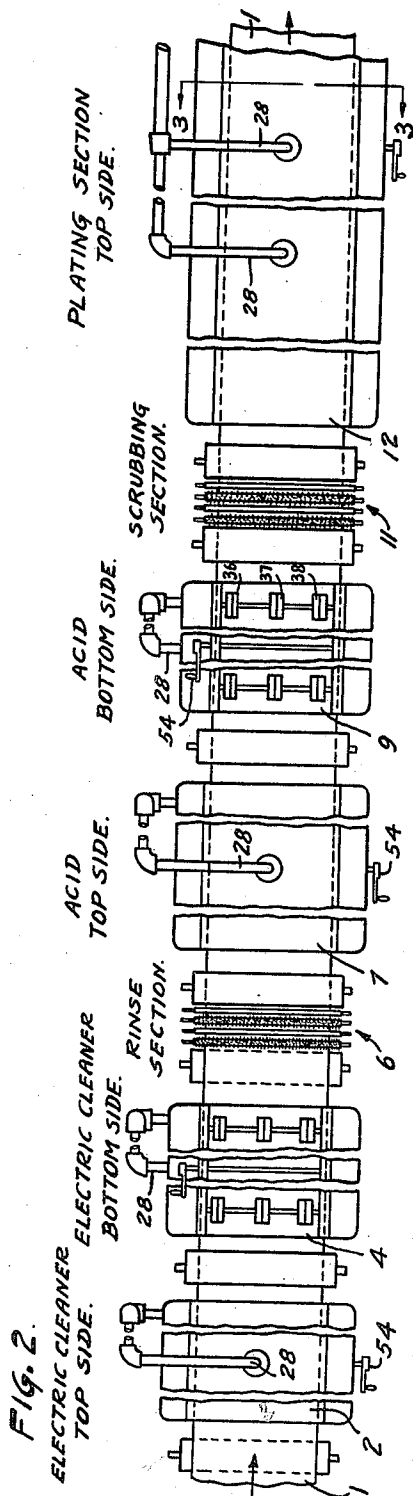
W. F. HALL

2,244,423

APPARATUS FOR STRIP PLATING

Filed June 28, 1938

7 Sheets-Sheet 2



INVENTOR
WESLEY F. HALL.
BY *Toulmin & Toulmin*
ATTORNEYS.

June 3, 1941.

W. F. HALL

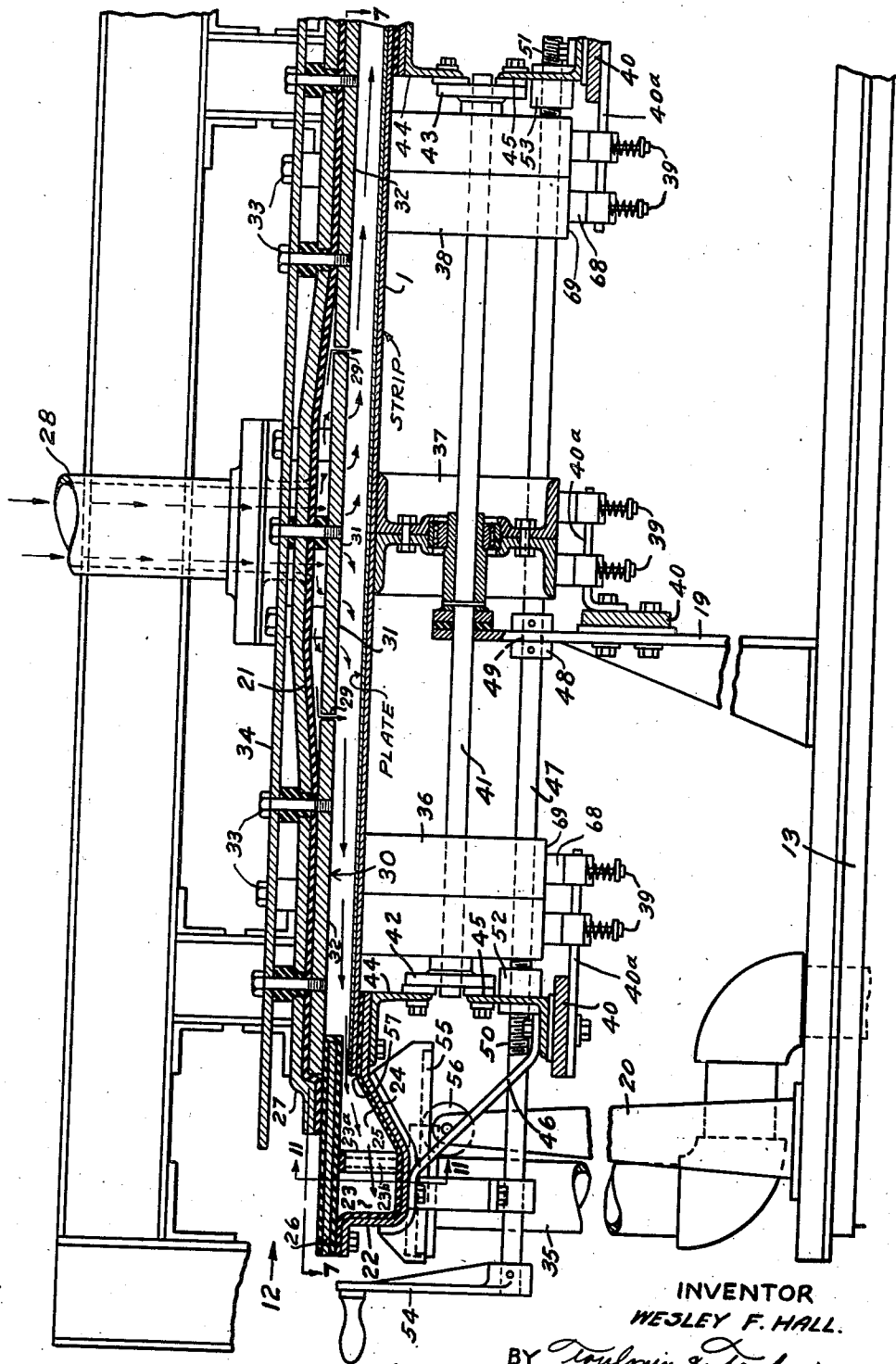
2,244,423

APPARATUS FOR STRIP PLATING

Filed June 28, 1938

7 Sheets-Sheet 3

FIG. 3.



INVENTOR
WESLEY F. HALL.
BY *Toulmin & Toulmin*
ATTORNEYS.

June 3, 1941.

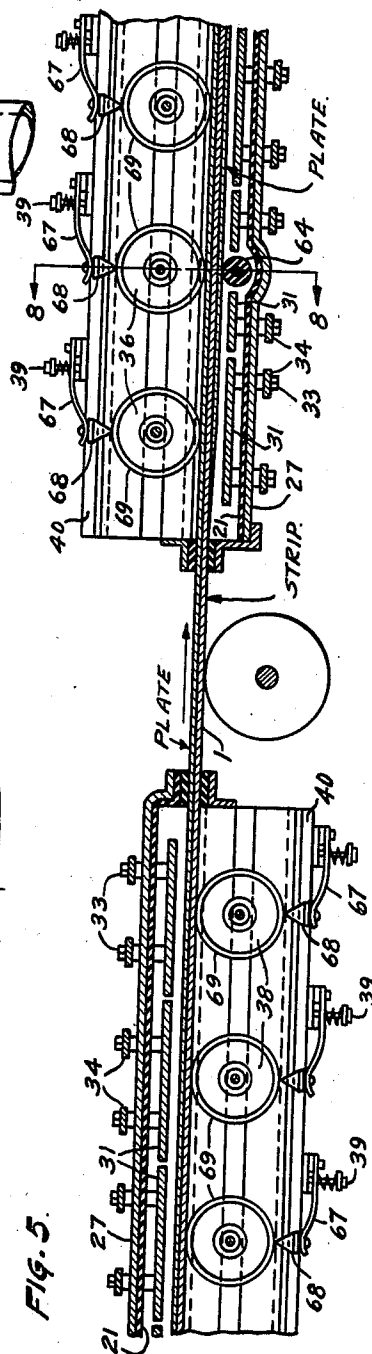
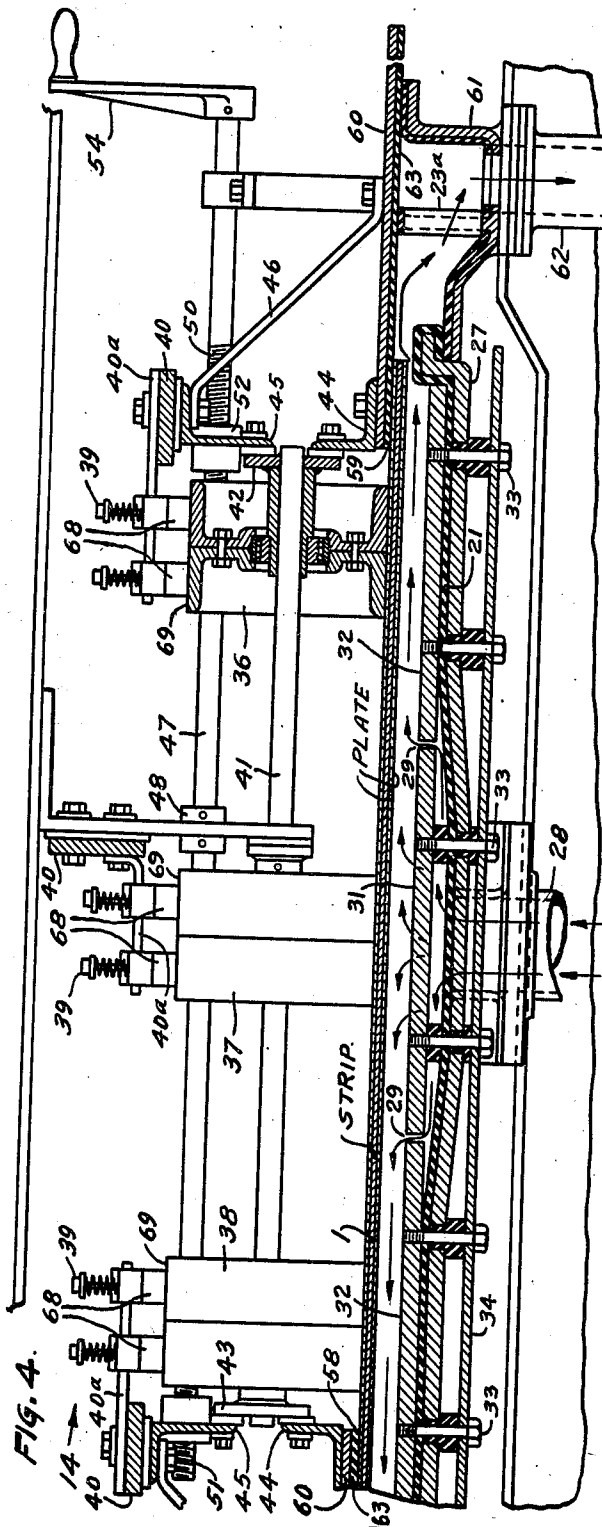
W. F. HALL

2,244,423

APPARATUS FOR STRIP PLATING

Filed June 28, 1938

7 Sheets-Sheet 4



INVENTOR
WESLEY F. HALL.
BY *Toulmin & Toulmin*
ATTORNEYS.

June 3, 1941.

W. F. HALL

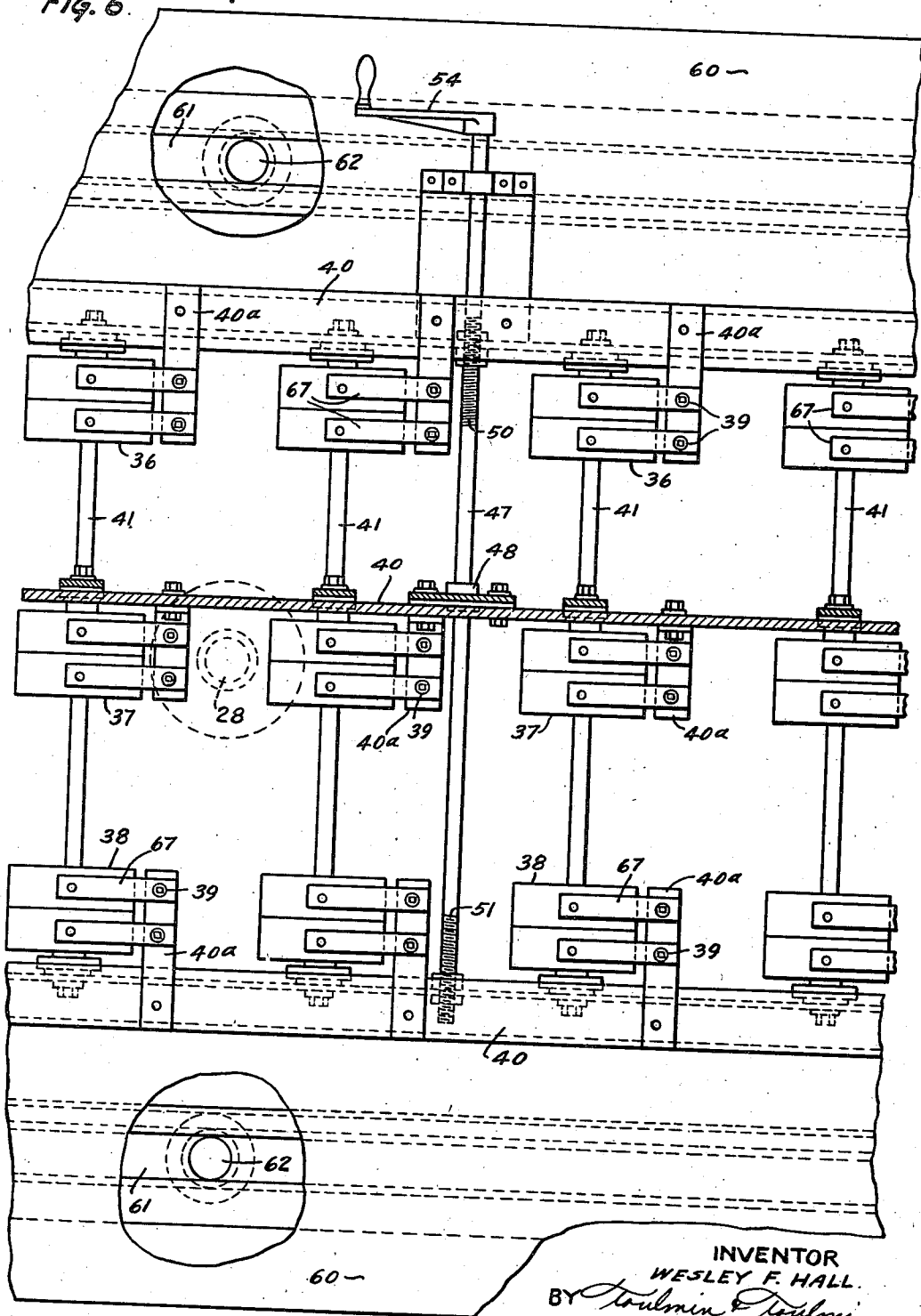
2,244,423

APPARATUS FOR STRIP PLATING

Filed June 28, 1938

7 Sheets--Sheet 5

FIG. 6.



INVENTOR
WESLEY F. HALL.
BY *Toulmin & Toulmin*
ATTORNEYS.

June 3, 1941.

W. F. HALL
APPARATUS FOR STRIP PLATING

Filed June 28, 1938

2,244,423

7 Sheets-Sheet 6

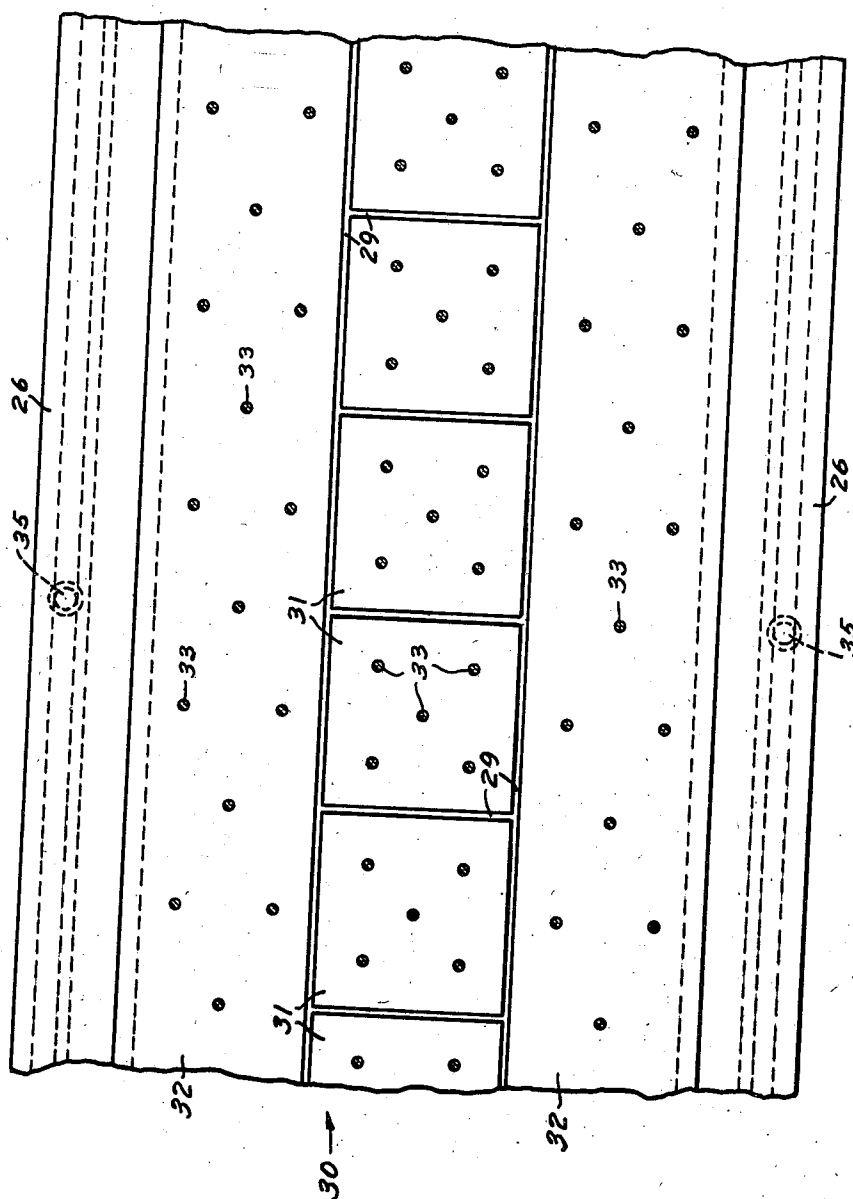


FIG. 7.

INVENTOR
WESLEY F. HALL.
BY *Toulmin & Toulmin*
ATTORNEYS.

June 3, 1941.

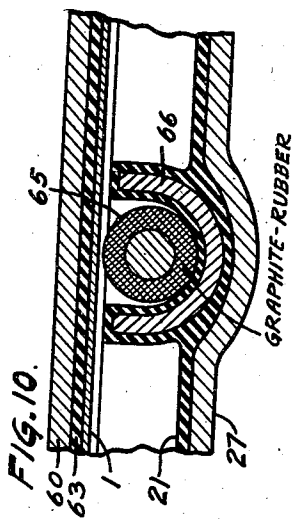
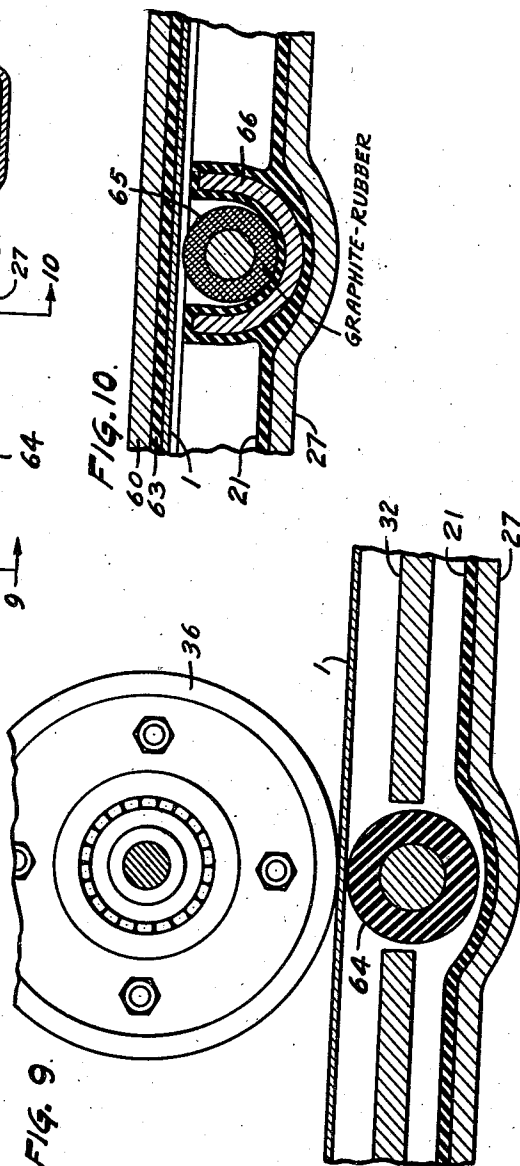
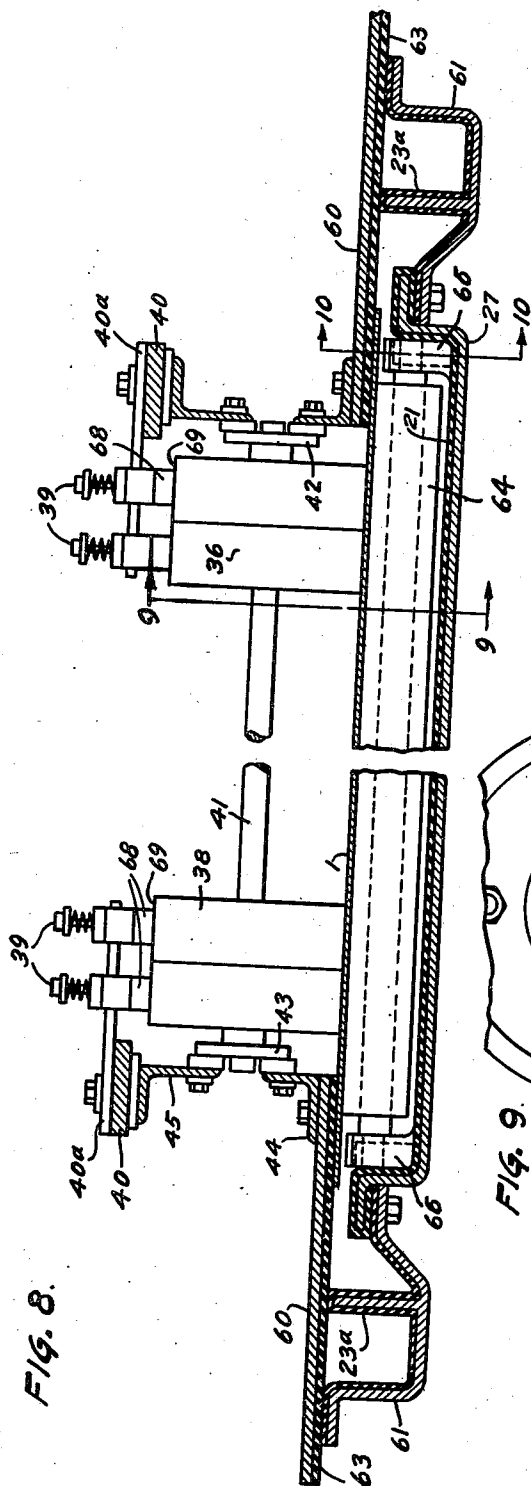
W. F. HALL

2,244,423

APPARATUS FOR STRIP PLATING

Filed June 28, 1938

7 Sheets-Sheet 7



INVENTOR
WESLEY F. HALL.
BY *Toulmin & Toulmin*
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,244,423

APPARATUS FOR STRIP PLATING

Wesley F. Hall, Matawan, N. J., assignor to Hanson-Van Winkle-Munning Company, Matawan, N. J., a corporation of New Jersey

Application June 28, 1938, Serial No. 216,322

6 Claims. (Cl. 204—209)

This invention relates to apparatus and method for electrocleaning and electroplating long lengths, strips or ribbons of material. The invention is particularly adapted to the electrolytic cleaning and tin plating of thin steel strips commonly used for producing cans. This invention, however, is also adapted to electroprocessing of long lengths of other material, both metallic and non-metallic, and with the use of various electrolytes.

An object of this invention is to provide an apparatus and method of treating strip material on one side at a time, the other side being held against rolling electric contacts and seals of rubber or equivalent resilient synthetic resinous material. In place of the electrical contact rolls other means of conducting the current to the strip material may be used, such as direct contact brushes or traveling flexible metallic belts. The rolling contacts are, however, preferable since they provide means for supporting and guiding the strip material through the apparatus as well as affording a suitable low friction contact with the strip being treated.

Another object is to provide a device of this type wherein by means of the novel construction it is possible to use high current densities, for instance 500 to 1000 amperes per square foot or higher in the electrolytic treatment of strip material.

Another object of this invention is to protect the edge of the strip being electroplated by yielding rubber backing or equivalent resilient electrical insulating material which is not attacked by the electrolyte. This prevents or greatly reduces the tendency to build up thicker coatings on the edges of the strip than in the central portion, which is a well known common fault of prior strip plating apparatus.

Another object of this invention is to provide an apparatus for electroprocessing metal wherein the metal is electrochemically treated with an electrolyte while current is supplied to the strip by means of dry electric rolling contacts.

Another object is to provide a method and apparatus for the alternate electro-process treating of moving metal strip or strips on one side and then on the other while continuously moving the metal strip and electrolyte.

Another object is to provide an apparatus for supporting and moving continuous metal strips into contact with an electrolyte and maintaining electrical contact with the metal strip adjacent the electrolyte but out of contact therewith.

Another object is to provide means for sub-

jecting the metal being electroprocessed to large currents of electricity while the metal is continuously moved through the electroprocessing apparatus.

5 Another object is to provide an apparatus which makes it possible to use higher current densities in electrochemically cleaning and plating strip material than heretofore employed.

A still further object is to provide electroplating apparatus wherein the electrical contact to the strip or material being plated is maintained at all times out of contact with the electrolyte to effect dry electrical contact on the side opposite that being plated.

15 Heretofore where one side only of a sheet of material was to be tin coated or otherwise plated the other side was coated with asphaltum or some other insulating varnish before immersion in the electrolyte. After the material had been electroplated the insulating coating on the opposite side was removed by a suitable solvent before heat treating the plated coating. By employing the apparatus and method for cleaning and electroplating strip material of this invention a product is obtained having a more uniform and superior coating than has heretofore been attained. Moreover the use of insulating coatings for protecting parts not to be plated with their attendant removal is eliminated.

30 Aside from the above mentioned improvements attained by this invention, very high current densities may be satisfactorily employed in electroprocessing materials by this invention. This is desirable since the electrocleaning and plating of the material can be effected in a much shorter time, increasing production with consequent lowering of electroplating costs.

The maximum current densities recommended heretofore for tin plating are of the order of 60 amperes per square foot. By the novel arrangement of this invention, however, unexpected high current densities on the order of 500 to 1000 amperes and higher can be used satisfactorily, particularly for tin plating thin metal strips.

45 This application is related to my copending applications No. 219,619, filed July 16, 1938, and No. 281,681, filed June 28, 1939. The latter is a continuation in part of application No. 219,619.

A related machine for electroplating strips or ribbons of material is disclosed in my co-pending application, Serial No. 281,682, filed June 28, 1939.

Referring to the drawings:

55 Figures 1 and 1A are diagrammatic side elevation views showing the complete electroprocessing

apparatus of this invention. It will be understood that this arrangement is merely illustrative and is not intended to limit the disposition of the different treating compartments, electrolytes or the sequence of treating the strip material;

Figures 2 and 2A are plan views of the preferred arrangement of the complete apparatus as illustrated in Figures 1 and 1A;

Figure 3 is a vertical section view through the apparatus taken along the line 3—3 of Figure 2;

Figure 4 is a vertical section taken along the line 4—4 of Figure 2;

Figure 5 is a vertical section of a part of the electroplating portion of the machine taken on the line 5—5 of Figure 2, looking in the direction of the arrows;

Figure 6 is a detailed plan view of a portion of the bottom plating section of the apparatus illustrated in Figure 4. The central bus bar is shown in section with certain parts being cut away to show the positioning of the electrolyte return conduits;

Figure 7 is a detailed plan view of the anode arrangement taken on the line 7—7 of Figure 3, looking in the direction of the arrows;

Figure 8 is a detailed vertical section of a part of the electroplating section taken on the line 8—8 of Figure 5;

Figure 9 is a view in section, partly broken away, taken along the line 9—9 of Figure 8, looking in the direction of the arrows;

Figure 10 is a detail section view taken on the line 10—10 of Figure 8, showing the bearing for the supporting roll;

Figure 11 is a detail section view taken on the line 11—11 of Figure 3 showing the arrangement of the apertured dam means in the electrolyte return trough member;

Figure 12 is an enlarged sectional view through a portion of the electroplating compartment showing the manner of shielding the edges of the strip by yielding rubber backing.

Referring to the drawings in detail, wherein like reference characters indicate similar parts throughout the drawings:

Figures 1 and 2 show the complete layout of the apparatus for electroprocessing continuous strips of material or pieces to be electroplated in horizontal position. This is the preferred form, but this invention also contemplates treating the strip while maintaining it vertically on an edge or in any other suitable position. It will be also understood that either alkaline or acid electrolyte cleaners may be employed when desired, and any one or more of the preliminary cleaning steps may be omitted prior to electroplating when it is unnecessary.

General treatment of strip material

The material to be treated is drawn through the apparatus from conventional uncoilers with looping towers, welding equipment, etc. and after being electroprocessed and plated is wound up on similar coilers on the delivery end. The strip material 1 is first passed through an electrolytic cleaning compartment 2 whereupon the top side of the strip is subjected to electrochemical cleaning with electrolyte supplied from the tank 3 adjacent thereto.

The strip then passes through the treating chamber 4 where the bottom side of the strip is submitted to electrochemical cleaning similar to the top side, the electrolyte being supplied to

chamber 4 from tank 5. Thereafter the strip or sheet passes over guide rolls and is subjected to rinsing and brushing by the revolving brushes 6.

Next the strip is treated on the top side with acid pickling solution while passing through the compartment 7 which is supplied with acid, such as dilute sulphuric or other suitable acid, from the storage tank 8 and thence through the compartment 9 where the bottom side is acid treated in like manner. The acid is pumped to chamber 9 from the tank 10. The strip is thereafter rinsed and scrubbed as indicated at 11.

In some cases where the metal sheet or strip to be cleaned and plated is coated with a heavy film of oil, grease or like fatty substance, it may be first subjected to a solvent degreasing treatment for the removal of the oil and grease from the strip or articles to be plated prior to being electrolytically cleaned and subsequently electroplated. The solvent degreasing treatment may comprise merely the dissolving of the oil and grease by non-inflammable chlorinated hydrocarbon, either in its heated liquid or vapor state. Various chlorinated hydrocarbon solvents may be employed, but trichlorethylene is preferable since it is most readily stabilized for continuous use.

The strip material after it has been thoroughly deoxidized and cleaned so that the surfaces present a substantially chemically pure metal surface is now ready to be electroplated and is passed into the electroplating chamber 12 where the top side of the strip is made the cathode in a suitable electrolyte containing the metal to be plated on the strip. The electroplating electrolyte solution is supplied to the electroplating chamber 12 from the tank 13. Thereafter the strip is passed into compartment 14 where it is similarly electroplated on the opposite or bottom side by the plating solution pumped from tank 15.

The material, after it has been plated on both sides, is burnished, rinsed and dried as indicated at 16, 17 and 18. The finished material is then delivered to conventional coilers and is ready for shipment or use.

Electroplating procedure

In the electroplating part of the apparatus of this invention the strip is plated on one side at a time and high current densities are employed without the necessity of carrying the current through the strip for a long distance. Provision is also made to prevent excessive concentration of electric current at the edges of the strip with the resultant building up of the deposit along the edges, which is highly undesirable. Ordinarily a comparatively wide and thin strip of material is treated, and only one side is treated at a time. The other side is held against a cushion of soft rubber or the like resilient material which forms a seal around the edges of the strip.

The back side of the strip is connected to the electric circuit at points closely adjacent to where the current enters the other side from the electrolyte. The electric circuit contact to the back of the strip is preferably made through rollers; however, sliding or movable belt contacts, as heretofore mentioned, may be used if desired.

In Figure 3 the strip material 1 is shown passing through the plating compartment 12 which is supported on the top or side of the electrolytic supply tank 13 by means of the brackets 19 and 20. The plating chamber 12 is provided with a rubber lining 21 which is arranged to contact other rubber portions to seal the outer edges of

the strip and affords a liquid tight chamber on the upper side of the strip. The outer edges of the strip are sealed by a rubber lined adjustable trough 22 enclosing the edges of the strip. The trough 22 is provided with a gutter 23 for collecting electrolyte introduced on top of the sheet or strip.

A rubber walled partition 23a having openings 23b is disposed in the trough 23, as shown in Figure 11, through which the electrolyte passes outward from the plating chamber overflowing into the electrolyte collecting troughs or gutters 23 disposed adjacent the edges of the strip. The slotted partition aids in maintaining the plating compartment completely full of electrolyte during operation to obtain a uniform plating of the strip as it is moved therethrough.

The trough is provided with a lateral inward extension 24 which is covered with a rubber sealing member 25, and the outer portion of the strip engages against this rubber covered extension member 24. This effectively seals the under side of the strip and prevents passage of electrolyte thereunder. Over the top of the trough 22 is a rubber covered lateral inward extending cover plate 26. The upper side of this plate 26 slidably contacts the rubber covered wall 27 of the plate chamber so as to produce a liquid seal therebetween.

The electrolyte containing the salt of the metal to be plated onto the strip is pumped or otherwise conducted from the storage tank 13 to the plating compartment 12 and enters through the conduit 28 passing through the perforations 29 of the anode 30 and on to the top side of the strip 1 as indicated by the arrows in Figure 3. In operation the electrolyte fills the space between the anode and strip. The anodes are preferably formed of a material which is insoluble in the electrolyte, for example carbon, lead or the like.

The anode 30 is formed of spaced apart central segments 31 and adjacent sections 32, as illustrated in Figure 7. The segments are connected by insulated studs 33 to the bus bars 34 which are electrically in contact with the positive side of a generator or other source of electricity.

The electrolyte entering on top of the strip near the center divides and flows uniformly outward to the edges of the sheet or strip and over into the trough 22 where it is returned to the storage tank through the pipe 35. The returned electrolyte is filtered, heated or cooled and replenished with the necessary chemical constituents while it is being recirculated from the troughs to the inlets of the apparatus.

Wheels 36, 37 and 38 mounted on ball bearings make rolling electrical contact with the under side of the strip 1 and carry the current to the stationary brushes 39, which slidably contact the wheels. The brushes are likewise connected to the bus bars 40 by means of the electric conducting members 40a. The bus bars are in turn electrically connected to the negative side of an electric generator or source of electricity to complete the electrical circuit. The wheels are spaced along the shaft 41 and the outside wheel supports 42 and 43, together with the adjacent respective trough portion, are bolted together.

It will be understood that an adjustable trough will be provided adjacent the wheel support 43 similar to that shown at the left in Figure 3. The outside wheel supports 42 and 43 are thus attached to the angle members 44 and 45 and the

brace arms 46 so as to afford a slidable arrangement of the parts on the shaft 41. The shaft 47 is rotatably mounted in the support 48 through the aperture 49 in the upper part of the bracket 19. The shaft 47 is provided with right and left hand threaded portions 50 and 51 respectively which are in threaded engagement with the lugs 52 and 53 so that by turning the crank 54 the outer wheels and trough members may be adjusted for accommodating the apparatus to wider or narrower strip material for treatment. The supporting base member 55 for the trough engages the roller 56 during this movement.

The outer edge of the strip material is afforded protection by the yielding rubber backing support 25 against which the outer edges of the strip rest, as indicated at 57 in the enlarged view Figure 12. The rubber covered trough 22 and plate 26 may be adjusted inwardly to shield the outer edge of the strip from being subjected to excessive amounts of current causing building up of the metal deposit at the edges.

After the strip has been plated on the top side it is withdrawn from compartment 12 and enters the plating chamber 14 which is similar to the plating compartment 12 except that the rolling contact wheels 36, 37 and 38 are arranged to contact the plated top side of the strip. The outer edges of the strip are held against the rubber seal backing to provide a fluid seal therebetween as at 58 and 59 illustrated in Figure 4. The electrolyte is in this case admitted upward and centrally against the bottom of the strip through the conduit 28 which in turn is connected to the electrolyte storage tank 15. In this arrangement the crank 54 and threaded shaft member 47 afford means for moving the wheels 36 and 38 slidably on the shaft 41, carrying therewith the attached rubber covered trough plates 60 so as to adjust the apparatus for receiving wide or narrow strips.

In this instance the electrolyte enters the compartment 14 between the segments of the anode 30 and upward against the central bottom surface of the strip. The electrolyte divides and flows outward to the edges of the strip and over into the rubber lined troughs 61 disposed at opposite sides of the strip edges, where it is returned to the storage tank through the pipe 62. The trough 61 is provided with slotted rubber walled partition 23a likewise as in trough 23, which aids in retarding the outflow of the electrolyte from the plating chamber 14 so that the chamber can be readily maintained full during operation.

The yielding rubber backing 63 provides sufficient protection to the outer edges of the strip reducing the tendency to build up thicker coatings thereon than at the center of the sheet.

The supporting rolls 64 are used when necessary to hold the strip up while plating the under side as illustrated in Figures 8 and 9. The supporting rolls 64 are provided with graphite, rubber or other oilless bearings 65 which are designed to operate under water. The bearings 65 are disposed in rubber covered U-shaped sockets 66, as illustrated in Figure 10.

The number of rolling contacts for each electroprocessing compartment will, of course, depend upon the size of the compartment, as indicated in Figure 5, and their spacing may be varied to accommodate the weight and size of the strip or sheet being treated. The contact brushes are provided with the conventional spring pressed bars 67 and wedge shaped electrical con-

tact members 88 which engage the electrical conducting surfaces 89 of the wheels as illustrated in Figures 5 and 6, providing a dry rolling electrical contact with the strip 1.

The scrubbing section 11 consists of long, revolving brushes with a supporting roll to hold the strip against the brushes. The first brush is on top and the second one below.

The burnishing section is similar to the scrubbing section but the brushes have fine wire bristles to burnish the soft plate, which in this case would be tin plate. Instead of burnishing rolls the plating may be followed by fluxing and heating or other methods of improving the physical characteristic of the deposit, according to the particular metal or alloy forming the plating coating.

It will be obvious that the details of this apparatus and the method of electroprocessing strips may be widely varied while preserving the principles of this invention, and it will be understood that such modifications as come within the scope of the claims are comprehended to be within this invention.

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

1. In a machine for electroprocessing long continuous flat strips of metal, a tank for holding treating solution, a trough elongated in the direction of the strip travel arranged adjacent said tank, said trough having laterally adjustable side wall portions for varying the size of said trough to accommodate strips of different width, a series of rollers mounted on spaced axle members, said rollers and members being spaced along said trough in the direction of strip travel and arranged adjacent the open side of said trough for supporting and guiding said strip, said strip forming a closure for the open side of said trough, means comprising liquid conduits interconnecting said tank and trough for conducting strip treating liquid into said trough from said tank, liquid distributing means forcing said treating solution to flow uniformly over and in contact with said strip as the strip material is moved along through said trough, and means sealing the back side edges of said moving strip which are not in contact with the electrolyte to the laterally adjustable side portions of said trough.

2. In a machine for electroprocessing long continuous substantially flat strips of metal, a container for holding treating solution, a substantially horizontal trough elongated in the direction of the strip travel arranged over said container, said trough having side wall portions which are movable laterally to adjust the size of said trough to accommodate strips of different width, a series of rollers spacedly arranged in the direction of strip travel mounted adjacent the open side of said trough for supporting and guiding the strip through said trough, said strip forming a closure for the open side of said trough, means for admitting strip treating solution under pressure centrally into said trough and in contact with said strip as it is moved along, and means sealing said moving strip along its marginal back side edges which are not in contact with the electrolyte to said trough.

3. In a machine for electroprocessing long continuous substantially flat strips of metal of different width, a tank for holding strip treating solution, a trough elongated in the direction of strip travel positioned adjacent said tank and in

communication therewith, said trough having laterally adjustable side wall portions, means for adjustably positioning said side wall portions to vary the size of said trough to accommodate different widths of strip, a series of rollers spacedly arranged adjacent the open side of said trough for supporting and guiding said strip along, said strip forming a closure for the open side of said trough, said spaced rollers including electrical contact means for conducting electric current through said strip as it is moved along through said trough, conduit means for circulating the strip treating solution from said tank into said trough and in contact with the strip as it is moved along, baffle plate means arranged in said trough to distribute said treating solution evenly over said strip, means sealing said moving strip to said trough along the back side of its outer edges which are not in contact with the electrolyte, and electrical conductor means for passing electric current through said electrolyte and said strip as it is moved along.

4. In a machine for electroprocessing long continuous substantially flat strips of metal, a tank for holding electrolyte, a trough arranged over said tank and elongated in the direction of the strip travel, said trough enclosing the side edges of said strip means sealing the back side edges of said strip which are not in contact with the electrolyte to said trough, a series of rollers arranged on spaced axle members, said members being spaced along said trough in the direction of strip travel and arranged adjacent the open side of said trough for supporting and guiding said continuous strip along, liquid conduit means interconnecting said tank and trough for conducting electrolyte into said trough from said tank, and means comprising a perforated electrode plate arranged centrally and longitudinally of said trough for uniformly distributing said electrolyte over said strip, means for maintaining the outer side of said strip in direct electrical connection with a plurality of electric conductors, and means for conducting electric current through said electrolyte and to said strip while the strip is moved along through said trough.

5. In a machine for electroplating long continuous substantially flat strips of metal, a tank for holding electrolyte, a trough arranged over said tank and elongated in the direction of the strip travel, said trough comprising adjustable sections for accommodating different size strips, a series of rollers mounted on spaced axle members, said axle members being spaced along said trough in the direction of strip travel and arranged adjacent the open side of said trough for supporting and guiding said continuous strip, liquid conduit means interconnecting said tank and trough for conducting electrolyte into said trough from said tank, a segmented electrode member arranged centrally and longitudinally of said trough for distributing the electrolyte over said strip as the strip is moved along through said trough, said strip forming a closure for the open side of said trough, means sealing the back side edges of said strip which are not in contact with the electrolyte to said trough, a plurality of spaced electric conductors for making electrical contact with the outer side of said strip material to conduct electric current through said electrolyte and said strip while the strip is being moved through said trough.

6. In a machine for electroplating long continuous substantially flat strips of metal, a tank for holding plating electrolyte, a trough arranged

adjacent thereto and elongated in the direction of the strip travel, said trough comprising side wall and laterally extending portions forming a chamber for collecting electrolyte, means sealing each of the back side edges of said moving strip 5 which are not in contact with the electrolyte to one of said laterally extending side wall portions at opposite sides of said trough so that the strip forms a closure for one side of said trough, fluid conduit means interconnecting said tank and 10 trough for conducting plating electrolyte into said trough from said tank, a series of rollers mounted on spaced axle members, said members being spaced along said trough in the direction of strip travel and arranged adjacent the open side of said trough to support and guide said continuous strip as it is moved along through said trough, a perforated anode plate arranged in said trough and spaced from the moving strip, and means for passing electric current to said anode plate and through said electrolyte to said strip as it is moved therealong.

WESLEY F. HALL.