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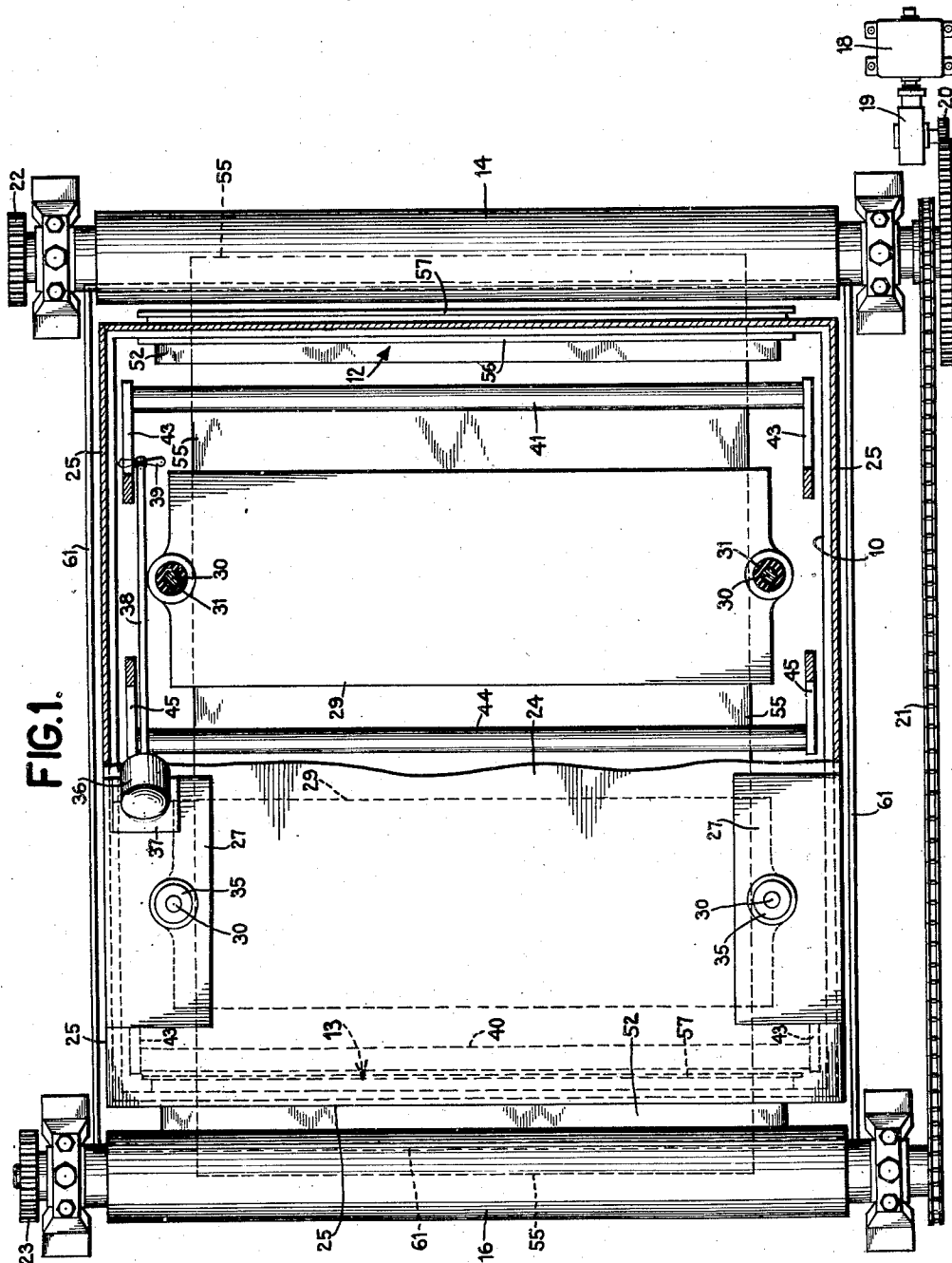
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2,212,588

APPARATUS FOR TREATING METAL

Filed Oct. 7, 1936

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

FIG. 5.

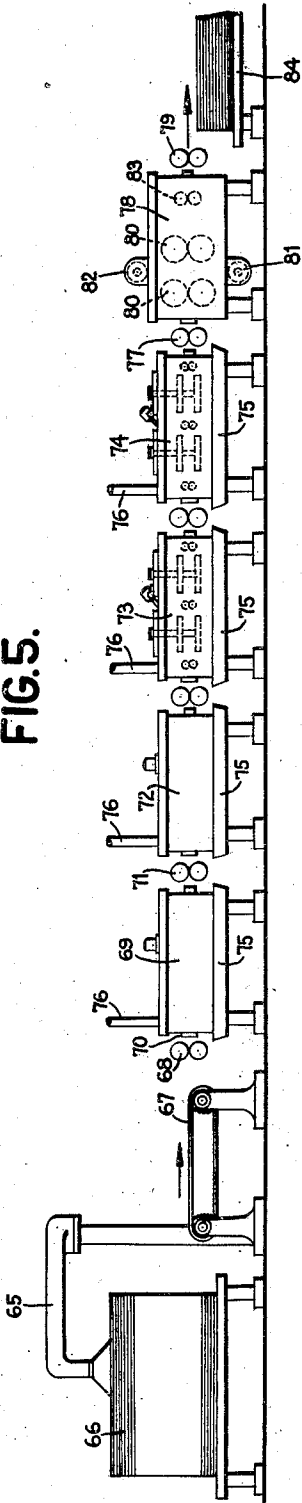
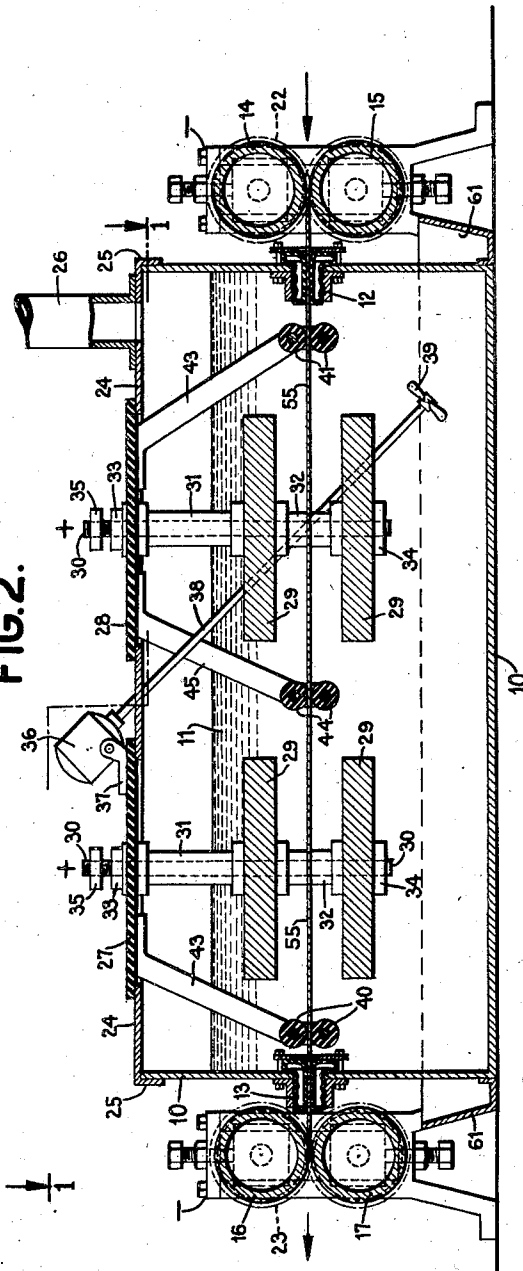


FIG. 2.

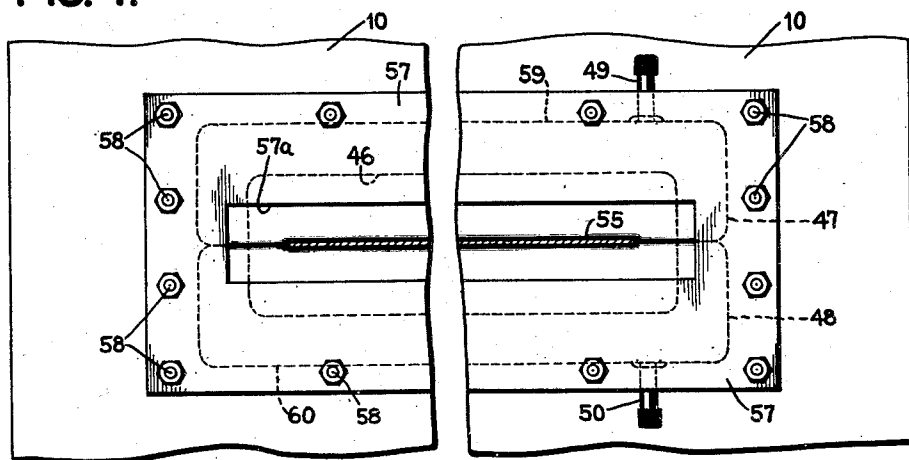
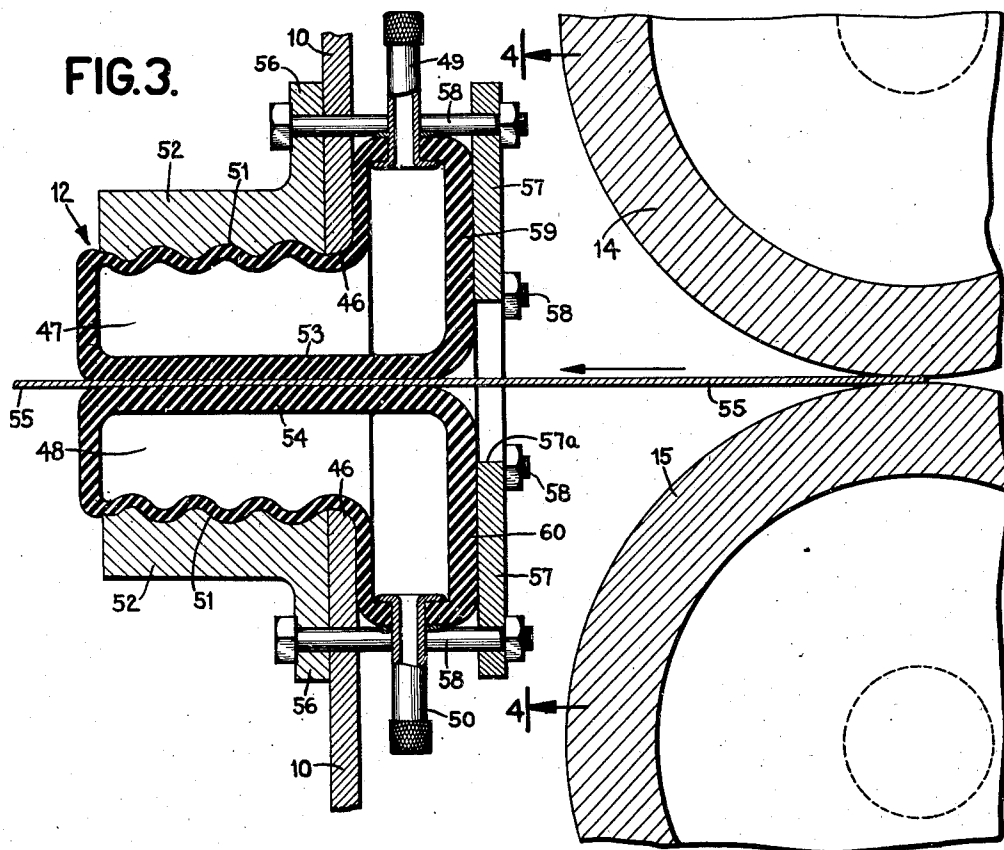


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3 Sheets-Sheet 3



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APPARATUS FOR TREATING METAL

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5 Claims. (Cl. 266—6)

This invention relates to method and apparatus for treating sheet and strip material, more particularly sheet and strip metal.

In the electro-plating of metal, especially sheet metal, the sheets have been heretofore suspended in the electrolyte from clips and either held stationary for batch treatment, or moved about to operate the process continuously. The sheets in this vertical position are frequently bent or curved as they move through the tank which disturbs the plating, and in any event the tanks must be very large for continuous operation and portions of each sheet are not satisfactorily plated. Another objection to the operation of such apparatus is that fumes and obnoxious gases almost invariably escape into the room, causing irritation to and impairing the health of workmen.

One object of this invention is to provide a method and apparatus for electro-plating metal stock which overcomes the aforementioned difficulties.

Another object of this invention is the provision of a method and apparatus for treating metal stock with a liquid by introducing the metal directly into the liquid at a point below the level thereof.

A further object is to provide for removing gases sticking to metal while such metal is moving through an electroplating bath.

Another object is the provision of a novel method, apparatus, and agent for cleaning plated metal.

These and other objects and advantages of my invention will be explained and will be more apparent from a description of the embodiments thereof illustrated in the accompanying drawings, in which,

Fig. 1 is a plan view, partly in section taken along the line 1—1 in Fig. 2, of an electroplating tank embodying my invention.

Fig. 2 is a vertical longitudinal section through substantially the center of the tank shown in Fig. 1.

Fig. 3 is a sectional view similar to Fig. 2 but illustrating the inlet portion of the tank on an enlarged scale.

Fig. 4 is a foreshortened end elevation of the tank taken on the line 4—4 of Fig. 3 and illustrating a metal sheet in section.

Fig. 5 is a diagrammatic view of apparatus for processing sheet or strip metal continuously.

The invention has been illustrated as applied to metal sheets but it is to be understood that

the invention is also applicable to other forms of metal with suitable modification.

With reference to the drawings, more particularly Figs. 1-4, numeral 10 indicates an electroplating tank which may be made of any suitable material such as metal lined with asphaltum, designed to contain a quantity of electrolyte 11. Sheet or strip material may be introduced into the tank below the level of liquid 11, and without substantial leakage thereof, through a stuffing box 12, and may be removed therefrom through a similar stuffing box 13. Suitable feed rolls such as pusher rolls 14, 15 at the inlet and puller rolls 16, 17 at the outlet may be provided near the stuffing boxes 12 and 13, and are preferably driven by power means such as the motor 18. One suitable form of drive is illustrated in Fig. 1 in which the motor 18 drives roll 14 directly, through the reduction gearing 19 and gear train 20. Roll 14 in turn drives the other upper feed roll 16 by means of sprockets and the chain 21. Upper rolls 14 and 16 are geared directly to lower rolls 15 and 17, by the gears 22 and 23, respectively. Thus all four feed rolls are driven at the same, or a substantially synchronized speed. Each pair of feed rolls may be suitably mounted in adjustable bearings or journal blocks, for adjustment toward or away from each other as is well understood in the art and are preferably connected to the negative pole of a source of electric current (not shown).

The tank may be provided with a cover 24, having overhanging edges 25, adapted to be placed over the entire top of the tank 10, and provided with an outlet pipe 26 for carrying off any gases or fumes inside the tank 10. Fixed to cover 24, or merely overlying openings in the cover if desired, are two pairs of plates 27, 27 and 28, 28 made of suitable insulating material such as Bakelite or hard rubber. Each pair of these plates support a pair of anodes 29 for suspension in the electrolyte, the composition of the anodes depending on the kind of plating to be performed. The ends of anodes 29 are fixed to rods 30, the anodes of each pair being spaced from each other a suitable distance to allow passage therebetween of the metal to be plated. The upper ends of rods 30 project through their respective plates 27, 28 and the exposed lengths of these rods below the plates are protected by tubular insulating members 31, 32 made of suitable material such as hard rubber. Nuts 33, 34 may be threaded on the ends of rods 30 and tightened to hold plates 27, 28, anodes 29, and insulating members 31, 32 in fixed relation.

Nuts 35 may be employed for connecting rods 30 and anodes 29 to the positive pole of a suitable source of electric current (not shown). An electric motor 36 may be mounted on a bracket 37 fixed to one of the plates 27, for driving shaft 38 and fan 39, to provide a constant circulation of the electrolyte 11.

To assist in guiding the sheet material through the stuffing boxes 12 and 13, I prefer to employ two pairs of guide rolls 40, 41 which may be journaled in the ends of brackets 43 also fixed to insulating plates 27 and 28. Because these rolls 40, 41 contact the metal being plated, they are preferably constructed of some suitable material which will not be plated, such as Bakelite or hard rubber. Two distinct pairs of anodes have been illustrated, and, although I do not wish to be limited to this embodiment of my invention, I have discovered that where metal being plated is subjected to the influence of two or more successive anodes, greatly improved results may be obtained by removing any gas accumulated on the metal surface during the first portion of the plating and subjecting the cleaned surface immediately to the action of the plating instrumentalities. One way to accomplish this is to provide a pair of rolls 44, made of soft rubber or the like between the pairs of anodes 29. These rolls 44 may be journaled in brackets 45 fixed to plates 28 in a manner similar to guide rolls 41.

It will be seen that my improved construction of electro-plating tank provides an effective cover 24, with all of the equipment inside the tank such as anodes, guide rolls, gas removing rolls, and agitator, suspended from the cover. This simplifies repairs which can be easily made by simply removing the cover 24 and the equipment carried thereby.

The pneumatic stuffing boxes 12 and 13 are substantially alike and are mounted in the wall of tank 10 extending in the same direction. A description of stuffing box 12, illustrated in Figs. 3 and 4, will suffice for both, it being understood that the construction of stuffing box 13 is similar thereto. Stuffing box 12 is fitted to an elongated opening 46 in a side wall of tank 10 below the level of the liquid 11, and may be comprised of a pair of complementary pneumatic containers 47 and 48, made of soft rubber or the like, and inflated with air or other gas by means of the valves 49 and 50, respectively. An outer wall of each of the containers 47 and 48 may be supported by corrugated surfaces 51 on the supporting members 52. The opposite walls 53 and 54 of containers 47 and 48 are pressed against each other under the pressure of the compressed air therein and provide a self sealing opening to admit a sheet 55 to the tank without allowing the liquid 11 to escape. Flanges 56 on supports 52 are fastened to the wall of tank 10 and to a retaining member 57 by means of bolts 58; retaining member 57 is provided with a central opening 57a to permit passage of a sheet 55. Pneumatic containers 47 and 48 are preferably formed with an L shaped cross section, with the shorter sections 59 and 60 between the wall of tank 10 and the retaining members 57. The pneumatic containers acting through member 57 and bolts 58 thus serve to hold the supporting members 52 tightly against the wall of tank 10. The walls 53 and 54 of containers 47 and 48 will be naturally curved at one side of the stuffing box to allow for easy insertion of the sheet 55. The shape of the pneumatic containers may, if desired, be suitably modified to

accommodate other forms of material such as wire, rods, bars, etc.

In the operation of the above described embodiment of my invention, a sheet, plate, or strip of metal 55 to be electro-plated is started between the feed rolls 14 and 15 which flatten and smooth out any irregularities therein and push the sheet through stuffing box 12 into the tank 10. The sheet moves continuously along a path through guide rolls 41, between one pair of anodes 29, 10 through rolls 44 for wiping off gas bubbles, between the second pair of anodes, and through guide rolls 40, out of the tank through stuffing box 13 and the puller rolls 16 and 17. Rolls 14, 15, 16, and 17 are preferably made of a material which is a good conductor of electricity to make a good electrical contact with the sheet being treated. The sheet which is thus the cathode, should always be in contact with one of the pairs of feed rolls so as not to interrupt the plating operation, or the movement of the sheet through the tank. If desired, pieces of some porous material such as cheese cloth may be interposed between the sheet 55 and the anodes 29, to prevent the possibility of the sheet contacting one of the anodes and causing a short circuit. As the sheet 55 emerges through stuffing box 13, the surplus electrolyte is wiped off by the action of the soft rubber of the pneumatic containers. The sheet may then be dried, cleaned, buffed, and/or finished in any suitable manner.

As a precautionary measure, I prefer to employ a trough 61 surrounding the outside of the tank below the stuffing boxes 12 and 13, in order to catch any electrolyte which may escape, if the pneumatic containers of the stuffing boxes should be punctured or deflated.

During the electro-plating process, a rapid circulation of the electrolyte greatly enhances the speed of plating. I have found that it is preferable to operate the agitator fan 39 at such a speed that the circulation within the tank is at least 1 foot per second. That is, the rate of flow of a given portion of electrolyte from one portion of the tank to another should be at least 1 foot per second to obtain the best results. A slower circulation can, of course, be employed but proportionately decrease the thickness of the plate for a given time, or increases the time required to form a plate of a given thickness.

My invention makes possible the easy covering of an electroplating or other tank to prevent the escape of fumes and gases into the room. A further and important advantage is the elimination of clips or the like which as heretofore employed always left a certain area of the sheet unplated. These unplated or imperfectly plated portions must almost always be removed and discarded. In accordance with my invention, the whole sheet is evenly plated and this waste is eliminated. By passing the sheets through the tank in a horizontal position, the cumbersome overhead conveyors used to carry suspended sheets through the plating tank are also eliminated. The size of the plating tank, in accordance with my invention, may be very substantially reduced, thus requiring a lesser amount of the expensive electrolyte.

The mounting of the anodes, guides, and agitating mechanism from the cover of the tank greatly facilitates any repairs and replacements which may be necessary. To install a fresh anode in place of a used one, the cover or other member carrying the anodes may be lifted out of the tank, and the replacement effected without removing or

interfering with the electrolyte or the other parts of the tank. If desired, however, these members may be fixed to the tank or mounted in any other appropriate manner.

5 Many modifications of the apparatus shown in the drawings may be made without departing from the scope of my invention. Any number of anodes may be employed and they may be arranged in other ways. Although the rubber rolls 10 44 are not necessary to the operation of the process, they remove any gas sticking to the sheet, which otherwise seriously hinders the plating action. Additional guide members and/or gas removing members may be employed in the tank, 15 and these members do not need to be rolls. For example, a fixed plate, or pair of plates, may be employed between the anodes, set at an angle to assist in guiding the leading edge of the sheet 55 through the tank.

20 Although my invention has been described in connection with the electro-plating of metals for which it is especially useful, it may also be adopted to other treatments of sheet material with a liquid, such as the pickling of metal 25 sheets or strip.

One arrangement for the continuous treatment of sheet metal by a series of processing treatments is illustrated in Fig. 5. In this apparatus a suction operated swivel arm 65 picks up sheets 30 one at a time from the pile 66 and deposits them on the continuously moving conveyor 67. The sheets are moved forward by the conveyor 67 to the feed rolls 68 which push the sheet into the pickling tank 69, through a stuffing box 70, similar to stuffing box 12. As the sheets emerge 35 through a similar stuffing box, they are passed by the feed rolls 71 into a second tank 72 in which they are washed in any suitable manner to remove the pickling fluid and prepare them for electroplating. Guide rolls similar to those described for the plating tank may be employed in the pickling and washing apparatus, 73 and 74 are plating tanks, such as the tank 10, arranged in tandem. The sheets may thus be plated with 45 first one metal and then another, or may be given a two step plating with the same metal. Each of these tanks may be equipped with pneumatic stuffing boxes, troughs 75, and gas outlets 76, in accordance with my invention.

50 As the plated sheets emerge from tank 74, they are still moist with electrolyte and require drying and finishing. Feed rolls 77, push the sheets into the chamber 78 for such a treatment and puller rolls 79 remove the sheets from this chamber. One treatment which I have found satisfactory for plated metal, especially a plating of the softer metals such as tin, zinc, copper and the like, is a buffing treatment with a mixture of a finely divided drying agent and a buffing agent. 60 Sawdust is economically advantageous and is very suitable as a drying agent; one suitable buffing agent for softer metals is finely divided calcium carbonate, such as precipitated chalk of about 200 mesh or finer. Chamber 78 may be 65 substantially filled with a mixture of about 80 to 98% sawdust and about 20-2% chalk; for example, 95% sawdust mixed with 5% chalk by weight. A plurality of buffing rolls 80 may be operated within chamber 78 at a peripheral speed 70 substantially greater than the speed of the sheet being treated. Rolls 80 are preferably soft and may be made of suitable buffing material such as cloth or felt. To recirculate the buffing and drying mixture and prevent its becoming saturated with moisture, the material may be with-

drawn from the lower part of chamber 78 by a screw conveyor 81, heated by suitable means (not shown), and returned to the upper part of chamber 78 by the screw conveyor 82. Guide rolls 83, or other suitable device, may be employed to prevent the buffing and drying material from flowing 5 out of the chamber with the dried and cleaned sheets. The finished sheets are finally deposited in a stack on table 84 by puller rolls 79.

The apparatus of Fig. 5 is especially arranged 10 to avoid the necessity of touching the sheets with the fingers before, after, or during the processing treatments. Finger marks are very objectionable inasmuch as the metal plated over them very 15 readily cracks and peels off. Its adhesion is very poor. The arrangement illustrated is designed particularly for treating individual sheets although it is equally capable of treating a continuous strip of material. The speed at which 20 all of the feed rolls are driven is preferably substantially synchronized.

For treating strip, the apparatus may be somewhat simplified by substituting a feed roll for conveyor 67, a driven winding roll for table 84, 25 and omitting the individual pairs of feed and guide rolls. One pair of feed rolls or other suitable electric contact means may be employed however between the electro-plating tanks.

By the use of the term "sheet" in the foregoing description and in the claims is meant sheet- 30 ed material of any size or shape including sheet, plate, and strip material.

The term "stock" as used in the specification and claims is intended to include sheet materials and also other forms such as wire, rods, bars, 35 strip sheeting and the like.

I claim:

1. Means for sealing an aperture in the wall of a tank comprising a plurality of pneumatic containers arranged in contact with each other 40 across the aperture to close the same but adapted to be forced apart by metal stock passed therebetween.

2. A seal for an aperture in a substantially vertical wall of a metal treating tank adapted to contain a liquid comprising means filling said aperture to prevent escape of liquid therethrough, said means including readily deformable walls held in contact with each other by pneumatic 50 pressure but capable of being forced apart by metal stock passed therebetween.

3. Sealing apparatus for an aperture in the wall of a tank through which metal stock may be passed directly into the tank comprising means substantially filling and sealing said aperture, said means including at least one pneumatic container having a wall formed of resilient material adapted to be held in contact throughout a substantial portion of its surface with a sheet 60 of resilient material but capable of being forced away from said sheet and of being deformed to conform to the shape of metal stock passed between said wall and sheet.

4. Means for sealing an aperture in the wall of a tank as defined in claim 1 in which the pneumatic containers are substantially L-shaped in cross-section and are removably held within said aperture. 65

5. Means for sealing an aperture in the wall of a tank as defined in claim 1 in which the pneumatic containers have walls engaging irregular fixed surfaces surrounding said aperture to hold said containers in place within said aperture. 70