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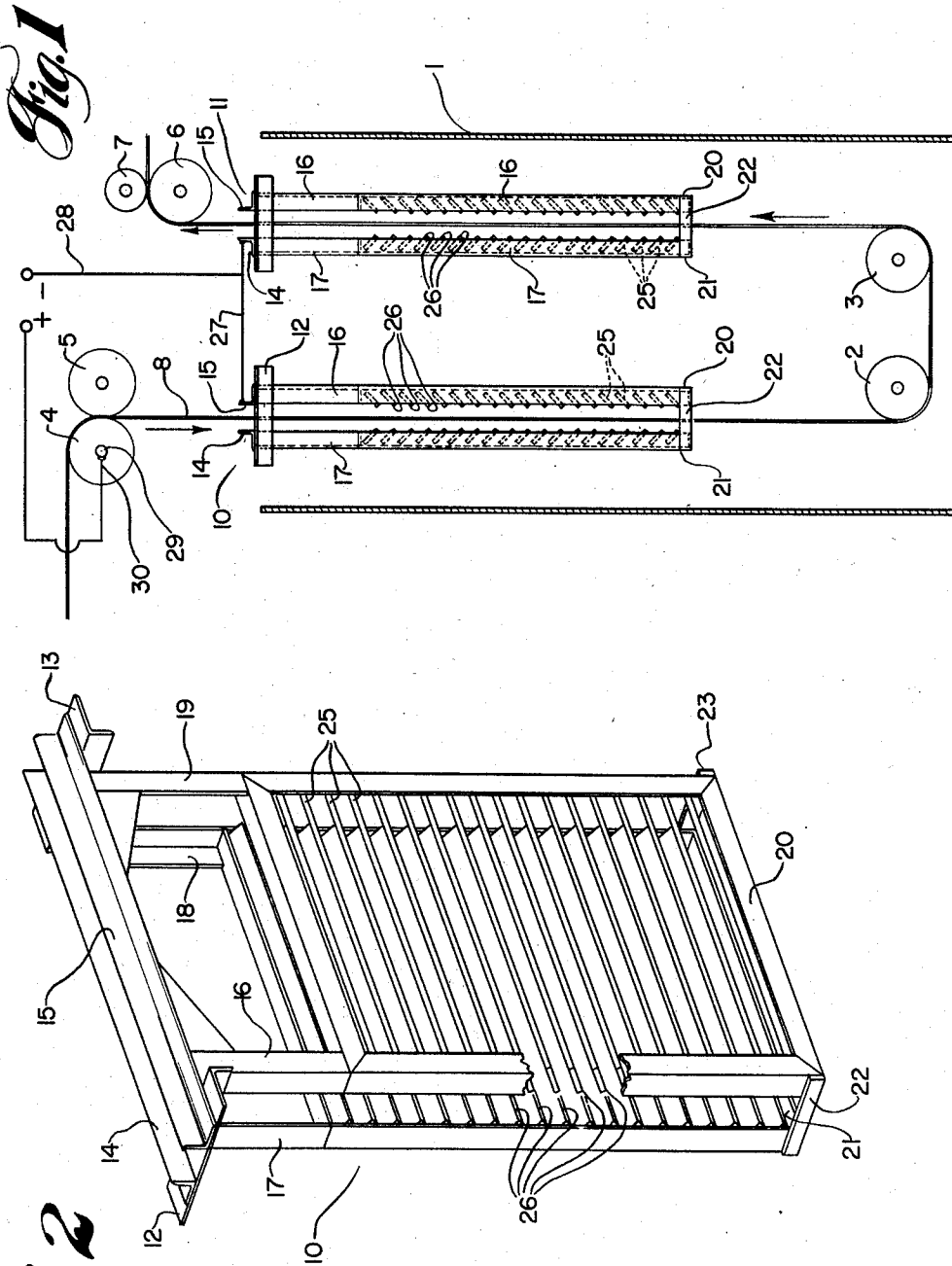
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ELECTRODE FOR ELECTROCLEANING APPARATUS

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2 Sheets-Sheet 1



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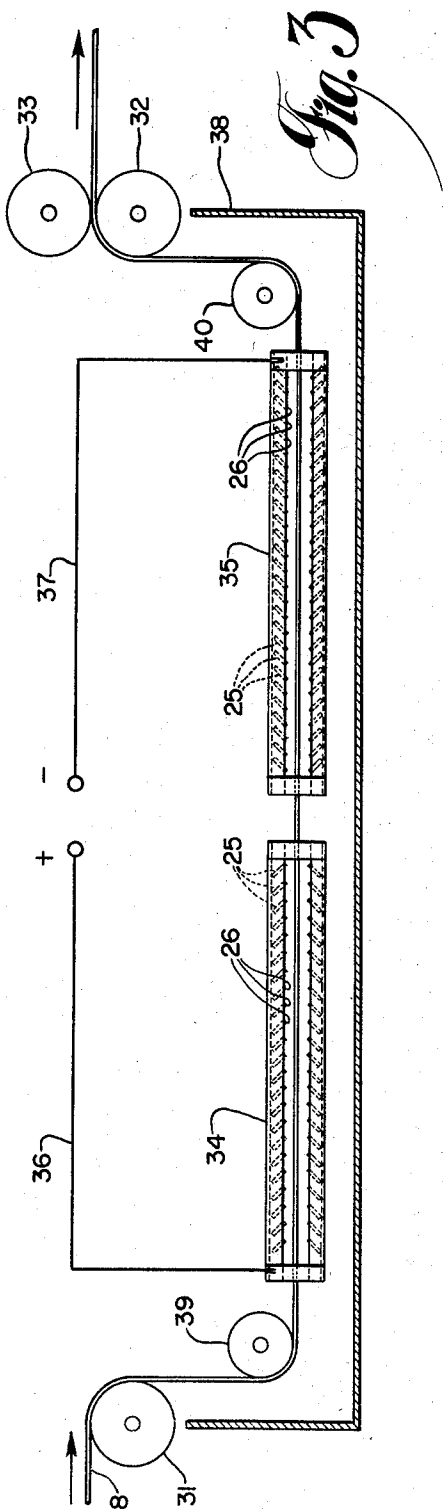
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ELECTRODE FOR ELECTROCLEANING APPARATUS

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6 Claims. (Cl. 204—206)

This invention relates to the electrocleaning of metals. It is more particularly concerned with an electrode structure used in apparatus for continuously electrocleaning metal strip.

My invention is particularly adapted to the cleaning of steel strip and will be described hereinafter in that connection, but it is not limited to that material. In the manufacture of steel strip it is usually necessary at some stage to clean the surface of the metal. This is a highly necessary operation in the manufacture of steel strip which is to be electroplated, for such material must have a thoroughly clean surface if the electroplated product is to display a uniform coating free of pin holes. Steel strip to be electrolytically tin plated is quite generally cleaned electrolytically. Such cleaning is accomplished on a continuous basis by passing the strip continuously through a tank containing an electrolyte and one and more electrodes disposed adjacent the moving strip, the strip and the electrodes being connected to a source of relatively low voltage direct current in such manner that the strip is the anode and the electrode is the cathode. Electrolytic action between strip and cathode in the electrolyte causes a small amount of metal from the surface of the strip to dissolve in the electrolyte and plate out upon the cathode. This surface metal dissolved carries with it surface contaminants and leaves the strip with a clean surface. The thoroughness of cleaning produced in an electrolytic cell is considerably influenced by the structure of the electrode and it is to this element that my invention is particularly directed.

It is an object of my invention to provide an electrode structure for electrocleaning apparatus which will facilitate uniform distribution of current across the surface of the strip forming the anode. It is another object of my invention to provide an electrode structure which promotes circulation of the electrolyte at the surface of the strip so as to facilitate removal therefrom of surface contaminants. Other objects of my invention will appear in the course of the description thereof to follow.

Embodiments of my invention presently preferred by me are illustrated in the attached figures, to which reference is now made.

Fig. 1 is a vertical section taken through an electrolytic cleaner cell provided with the electrode structure of my invention. The section is taken between one end of the cell and the end of my cathode structure.

Fig. 2 is a perspective view of a pair of electrode structures of my invention.

Fig. 3 is a vertical section taken through another form of electrolytic cleaner cell provided with the electrode structure of my invention. The section is taken at the same relative location as in Fig. 1.

The single electrolytic cleaner cell illustrated in Fig. 1 has a tank 1 adapted to contain the electrolyte and other structure to be described. Within tank 1 at the bottom thereof are journaled freely rotatable rolls 2 and 3, the journaling and supporting means for these rolls not being shown. Rolls 2 and 3 are placed parallel to each

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other in a plane parallel to the bottom of tank 1. Above the open top of tank 1 are journaled a pair of entry rolls 4 and 5. Rolls 4 and 5 are disposed parallel to rolls 2 and 3 so that rolls 2 and 5 are tangent to a vertical plane. Also above the open top of tank 1 are journaled rolls 6 and 7. Roll 6 is disposed parallel to roll 3 and tangent to a vertical plane which is also tangent to roll 3. Roll 7 is disposed parallel to roll 6 and immediately above it. Rolls 4 and 6 are conventionally supplied with driving means, not shown. These driving means may be torque motors, adjusted to balance the retarding or drag forces caused by friction.

The steel strip 8 to be cleaned is looped over roll 4 and passes downwardly between rolls 4 and 5 into tank 1. At the bottom of tank 1 it loops around roll 2 and passes under and upwardly around roll 3, from which it leaves tank 1 over roll 6. Roll 7 is a wringer roll adapted to squeeze excess electrolyte from strip 8 back into tank 1.

Electrical insulators, not shown, support within tank 1 a dual electrode structure 10 at the entry side of tank 1 and a similar dual electrode structure 11 at the exit side. Structure 10 is provided with a pair of supporting angles 12 and 13 which are adapted to rest upon insulators and which are joined by a pair of parallel transverse angles 14 and 15. Angle 16 extends vertically downward from the junction of angles 12 and 15 and angle 17 extends vertically downward from the junctions of angles 12 and 14. Angles 18 and 19 extend vertically downward from the junction of angle 13 and angles 14 and 15 respectively. Angles 16 and 19 are joined at the bottom by transverse angle 20 and angles 17 and 18 by a like transverse angle 21. Angles 16 and 17 are joined at the bottom by a short cross element 22 and angles 18 and 19 are joined at the bottom by a like cross element 23. Structure 10 is disposed within tank 1 so that the strip 8 moves in a path passing centrally between angles 14 and 15 at the top and angles 20 and 21 at the bottom.

Between upright angles 16 and 19 are positioned a number of transverse slats or slat-like members 25. Like slats are also positioned between angles 17 and 18. Each slat 25 is a flat rectangular metal element having square corners and sharp edges 26. Each slat element 25 is positioned so that its plane is inclined to the vertical by an angle preferably in the neighborhood of 45 degrees as measured clockwise from the vertical. It will be observed that the arrangement of slats 25 is quite similar to those in a Venetian blind, but my slat elements 25 need not be adjustable.

Electrode structure 11 at the exit end of tank 1 is constructed in exactly the same way as electrode structure 10 previously described.

Electrode structures 10 and 11 are connected together electrically by a conductor 27 which, by conductor 28, is connected to the negative terminal of a source of direct current, not shown. Roll 4 is provided at one end with a conducting slip ring 29 upon which rests a brush element 30, which in turn is connected to the positive terminal of the source of direct current.

The embodiment of my invention illustrated in Fig. 3 differs from that illustrated in Fig. 1 and described herein in that the strip moves in a horizontal path through the electrolyte and between electrodes of the type described. In this figure a tank 38 contains electrolyte and other structure to be described. Within tank 38 are journaled a freely-rotatable roll 39 at the entry end of the tank and a like roll 40 at the exit end, the journaling and supporting means for these rolls not being shown. Rolls 39 and 40 are placed with their axes parallel to each other in a plane parallel to the bottom of the tank 38. Above the open top of tank 38 at the entry end is journaled an entry roll 31 and at the exit end of the tank 38 a like exit roll 32. The axis of roll 31 is parallel to

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that of roll 39 and the axis of roll 32 is parallel to that of roll 40. Directly above roll 32 is positioned wringer roll 33 with the axis parallel to that of roll 32. Roll 32 is conventionally supplied with driving means not shown. The driving means may be a torque motor adjusted to balance the retarding drag forces caused by friction. The steel strip 8 to be cleaned is looped over roll 31 and downwardly under roll 39 from whence it moves in a horizontal path through the electrolyte until it reaches roll 40 under which it passes and is looped upwardly and over roll 32.

Electrical insulators, not shown, support within tank 38 a dual electrode structure 34 at the entry end of tank 38 and a similar dual electrode structure 35 at the exit end. Structures 34 and 35 are essentially the same as structures 10 and 11 shown in Fig. 2 and described herein. The electrode members of structures 34 and 35 are the same transverse slat or slat-like members 25 as are shown in Figs. 1 and 2, and they are formed with sharp edges 26 adjacent the path of travel of strip 8. The slat-like members 25 in electrode structure 34 which are positioned above the strip 8, are inclined toward the strip and in the direction of movement of the strip. The slat-like members 25 in electrode structure 34 which are positioned below the strip are inclined in the same manner. The slat-like members 25 both above and below the strip in electrode structure 35 are inclined toward the strip and opposite to the direction of strip movement.

Electrode structure 34 is connected by conductor 36 to the positive terminal of a source of direct current, which is not shown, and electrode structure 35 is connected by conductor 37 to the negative terminal of the same source.

The operation of my apparatus may be understood by reference to the foregoing description and the figures and will first be discussed with respect to the embodiment illustrated in Figs. 1 and 2. The level of electrolyte in tank 1 is maintained somewhat above the uppermost slats 25 of electrode structures 10 and 11. The steel strip 8 passes continuously between rolls 4 and 5 down into tank 1, between the slats 25 on each side of its downward path, around rolls 2 and 3, and vertically up out of tank 1 also between slats 25 on each side of its path. Strip 8 is caused to move in this manner by pulling means not shown. Since roll 4 is connected to the positive terminal of the direct current source and electrode structures 10 and 11 are connected to the negative terminal, the steel strip 8 which is in electrical contact with the roll 4 is anodic with respect to the electrolyte and the slats 25 are cathodic with respect thereto. Electrolytic action, therefore, dissolves some of the surface metal from strip 8 and deposits it on electrode slats 25. Since each slat 25 is formed with square corners and sharp edges, the sharp edge 26, which is nearest strip 8, provides a projection which facilitates the passage of current into the electrolyte from electrode slats 25. The plurality of sharp edges 26 provided by my multiple electrode slats 25 evenly spaced along strip 8 as it passes through the electrolyte brings about remarkably even distribution of current over the area of strip 8 being cleaned.

It will be observed that slat elements 25 in electrode structure 10 are inclined toward strip 8 in the direction of movement of strip 8 between them. The movement of strip 8 through the electrolyte drags or pulls the electrolyte along with the strip to a certain extent, and my inclined slats 25 facilitate access of electrolyte to strip 8 as it passes downwardly on the entry side of my cell. In my identical electrode structure 11 at the exit end of my cell it will be observed that slats 25 are inclined away from strip 8 in the direction of the motion of strip 8. The moving strip 8 tends to pull the electrolyte up along with it and my slats act to direct the electrolyte away from the strip during this much of its travel. At the entry side of the cell, therefore, my slats act to bring in fresh electrolyte toward the strip and at the exit side to direct electrolyte away from the strip. Thus my apparatus assists in set-

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ting up a circulation of electrolyte inside the cell which is beneficial to the cleaning of the strip surface.

The operation of the embodiment of my apparatus illustrated in Fig. 3 differs from that of the embodiment of Fig. 1 in that electrode 34 is anodic with respect to the strip 8 and only electrode 35 is cathodic with respect to the strip 8. It is known to utilize a pair of electrodes connected anodically and cathodically as shown in Fig. 3 in order to avoid the necessity of making an electrical connection to the moving strip. In the apparatus of Fig. 3 the level of the electrolyte in tank 38 is maintained above the slat-like members in the upper sections of electrode structures 34 and 35. The movement of the strip 8 through the electrolyte drags or pulls electrolyte along with the strip to a certain extent, just as has been previously described with respect to the embodiment of Fig. 1, and the inclined slats 25 in the embodiment of Fig. 3 act to direct the electrolyte toward the strip as it passes between the slats of electrode structure 34 and away from the strip as it passes between the slats of electrode structure 35.

It will be understood that the apparatus of Fig. 1 can be operated with the same electrical connections as are shown in Fig. 3, and that the apparatus of Fig. 3 can be operated with the same electrical connections as are shown in Fig. 1.

I claim:

1. In apparatus for electrolytically cleaning moving metal strip, including means for containing an electrolyte, means defining a path of travel of the strip through the electrolyte, a source of direct current and an electrode disposed in the electrolyte adjacent the path of travel of the strip and cathodically connected with respect to the strip adjacent thereto to the source of direct current, the improvement in electrodes comprising a plurality of elongated slat-like members each positioned transversely of the path of travel of the strip and inclined thereto but terminating short thereof in a sharp edge parallel thereto.

2. Apparatus of claim 1 in which the elongated slat-like members are divided into two groups of adjacent slat-like members positioned on the same side of the path of travel of the strip in spaced relation therealong and in which the slat-like members of the first group are all inclined to the path of travel of the strip in the same sense and the slat-like members of the second group are all inclined to the path of travel of the strip in the sense opposite to that of the first group.

3. Apparatus of claim 1 in which the slat-like members are positioned on both sides of the path of travel of the strip and in which the slat-like members on one side of the path of travel of the strip are inclined thereto in the opposite sense from the slat-like members opposite them on the other side of the path of travel of the strip.

4. In apparatus for electrolytically cleaning moving metal strip including means for containing an electrolyte, means defining a path of travel of the strip through the electrolyte, a source of direct current and a pair of electrodes disposed in the electrolyte adjacent the path of travel of the strip in spaced relation therealong and connected one to the positive and the other to the negative terminal of the source of direct current, the improvement in electrodes comprising a plurality of elongated slat-like members each positioned on the same side of the path of travel of the strip and transversely thereto but terminating short thereof in a sharp edge parallel thereto, the slat-like members of the first electrode being inclined to the path of travel of the strip all in the same sense and the slat-like members of the second electrode being inclined to the path of travel of the strip all in the sense opposite to that of the first electrode.

5. In apparatus for electrolytically cleaning moving metal strip including means for containing an electrolyte, means defining a path of travel of the strip therethrough, a source of direct current and an electrode disposed in the electrolyte adjacent the path of travel of the strip

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and cathodically connected with respect to the strip adjacent thereto to the source of direct current, the improvement in electrodes comprising a plurality of elongated slat-like members each positioned transversely of the path of travel of the strip and inclined thereto but terminating short thereof in a sharp edge parallel thereto, the elongated slat-like members being divided into two groups of adjacent slat-like members arranged in spaced relation along the path of travel of the strip, the second group being downstream of the first group, the slat-like members of the first group being inclined to the path of travel of the strip so as to direct electrolyte dragged along by the strip toward the strip and the slat-like members of the second group being inclined to the path of travel of the strip so as to direct electrolyte dragged along by the strip away from the strip.

6. In apparatus for electrolytically cleaning moving metal strip including means for containing an electrolyte, means defining a path of travel of the strip through the electrolyte, a source of direct current and a pair of electrodes disposed in the electrolyte adjacent the path of travel of the strip in spaced relation therealong and connected one to the positive and the other to the negative terminal of the source of direct current, the second elec-

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trode being downstream of the first electrode, the improvement in electrodes comprising a plurality of elongated slat-like members each positioned transversely of the path of travel of the strip and inclined thereto but terminating short thereof in a sharp edge parallel thereto, the slat-like members of the first electrode being inclined to the path of travel of the strip so as to direct electrolyte dragged along by the strip toward the strip and the slat-like members of the second electrode being inclined to the path of travel of the strip so as to direct electrolyte dragged along by the strip away from the strip.

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