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S. S. JOHNSTON ET AL

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METHOD OF CLEANING STRIP

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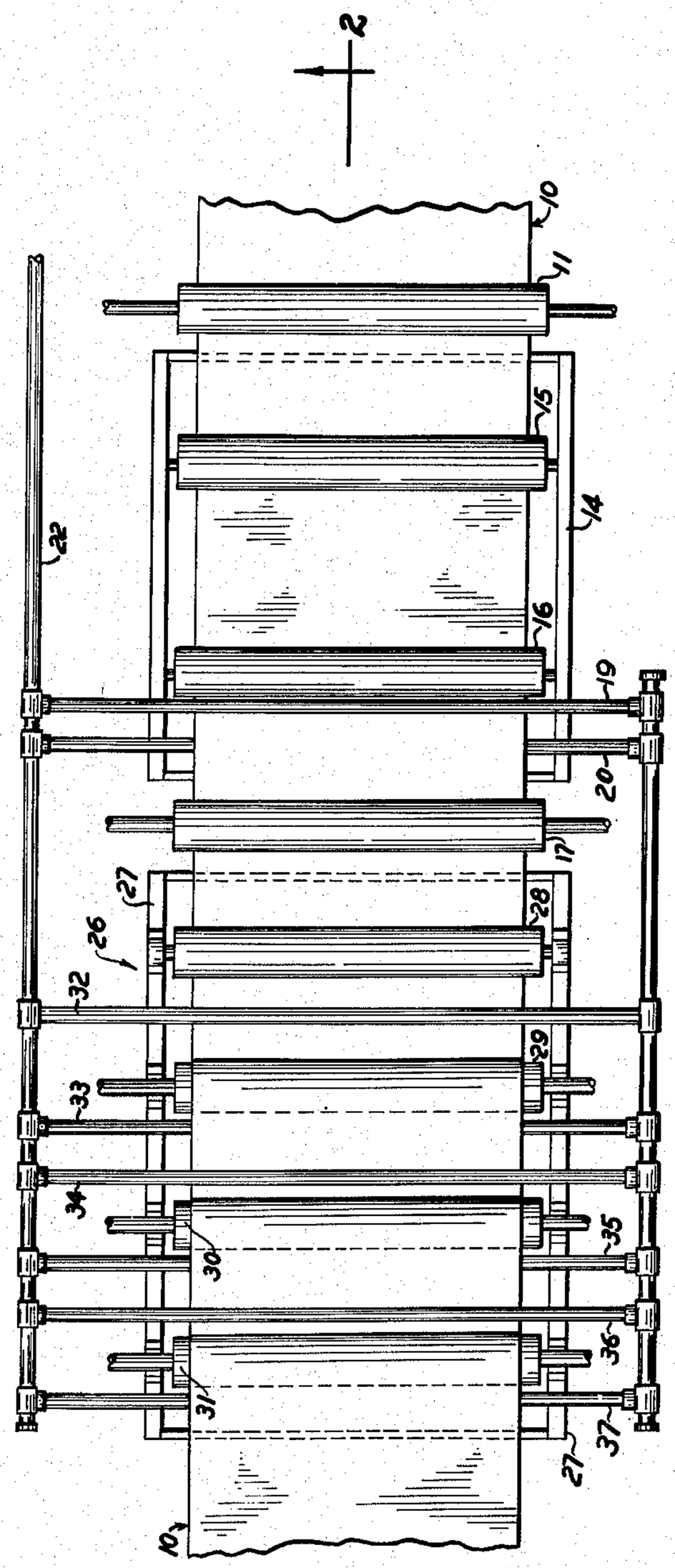

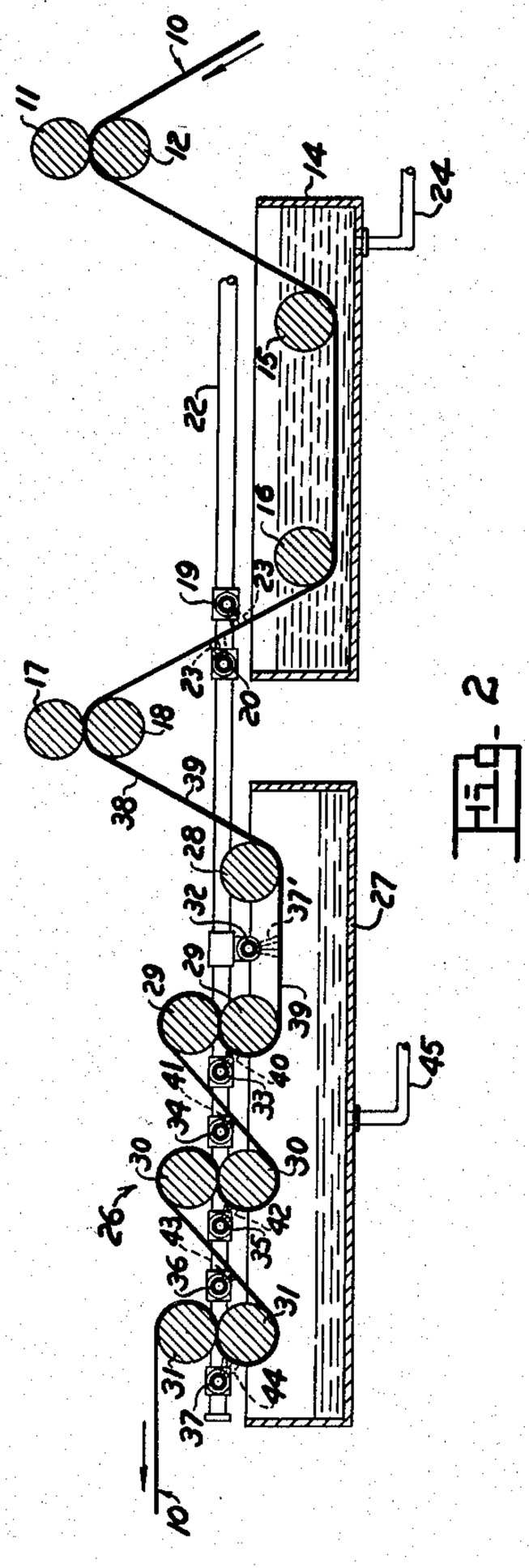

FIG. 2

INVENTOR.
SAMUEL S. JOHNSTON.
JOHN E. ELSWICK.

BY James J. Shanley

ATTORNEY.

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METHOD OF CLEANING STRIP

Samuel S. Johnston and John E. Elswick, Steubenville, Ohio, assignors to National Steel Corporation, a corporation of Delaware

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This invention relates to a method of cleaning strip and is primarily concerned with progressively and substantially completely removing residual electroplating electrolyte containing electrolytic salts from continuously moving electroplated strip.

The present invention will be described more particularly in connection with the removal of residual tin electroplating solution from electrolytically tinplated ferrous metal strip, but the present invention is not limited thereto and is applicable for removing other electrolytes from strips of other metals. The principles of the present invention may be applied to cleaning, for example, electrolytically cleaned, pickled or anodically polished metal strip having residual electrolytic solution on its surface.

In the present day practice of electroplating ferrous metal strip with tin, the strip is moved continuously through or across the electroplating cells at a high rate of speed. The higher the speed, the greater the quantity of strip plated in unit time. Many electroplating lines are operated today at speeds of about 1,000 to 1,500 feet per minute. As the strip leaves the last electroplating cell, it is subjected to a washing treatment to remove the electrolyte dragged out of the last electroplating cell. The washed strip after being dried usually is heated to reflow or flow-brighten the tin on the strip surface. The washing treatment supposedly removes all of the electrolyte. A customary treatment of the strip has been to pass the strip first through a pair of wringer rolls to reduce the quantity of electroplating solution on the strip and then through a bath to wash off the residual electrolyte. In some installations, the strip from this bath is further washed with sprays before being passed between a final pair of wringer rolls to remove the excess liquid. Solution from the bath has been returned to the electroplating cells to make up the liquid lost from the electroplating cells and to save the electrolytic salts removed from the strip by the bath.

We have discovered that this cleaning of the strip as practiced heretofore, does not, contrary to the general opinion, remove all of the electrolytic salts. It has been found that, especially at the high speeds of 1,000 to 1,500 feet per minute, such a large quantity of strip passes through the bath that the bath contains a sufficiently large amount of salts to prevent cleaning of the strip. The bath merely slightly dilutes the residual solution. It also has been discovered that passing the strip from the bath through water sprays and then through wringer rolls as practiced heretofore does not completely remove the residual electrolytic salts. Apparently, the wringer rolls leave a thin film of liquid on the strip and the wash water or sprays merely dilute this liquid to a limited extent. As a result, the strip is not substantially thoroughly cleaned of the residual salts.

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Accordingly, the primary object of the present invention is to provide an improved method of substantially completely removing all of the residual electrolyte solution from strip.

Another object of the present invention is to provide a method of more nearly completely flushing the residual electrolyte off of the strip.

A further object of the present invention is to provide more complete mixing of the wash water with the residual electrolytic solution on the strip to dilute the solution.

Another object of the present invention is to pass strip through a series of sprays and wringer rolls so arranged that the residual electrolyte is substantially completely removed by a combination of flushing the electrolyte off the strip and more thorough mixing of the decreased quantity of residual electrolyte with the wash water to increase the dilution effect of the wash water.

In accordance with our invention, the strip from the final electroplating cell is repeatedly subjected to sprays of fresh wash water and is repeatedly passed between wringer rolls to remove the major portion of the liquid on the strip. The strip and sprays are so arranged that the sprays of wash water are directed downwardly against the strip. By this arrangement, the water from the sprays spreads laterally both across and along the surface of the strip to provide a more thorough flushing off of the residual electroplating salts. After each surface of the strip has been sprayed with wash water, the strip is wrung by passing it between wringer rolls so that a greater degree of dilution of the residual solution is obtained as a result of a more thorough mixing of the liquids. Fresh water is used in these sprays.

These and other objects and advantages will become more apparent from the following detailed description, taken with the accompanying drawings, in which:

Figure 1 is a plan view of apparatus embodying the features of the present invention; and,

Figure 2 is a sectional view taken along line 2—2 of Figure 1.

Referring to the drawings, a strip 10 which is being progressively and continuously withdrawn from the electroplating cell (not shown) is passed

through a first pair of wringer rolls 11 and 12 which remove most but not all of electroplating solution dragged from the electroplating cell. The present invention is not limited to any particular means for moving the strip along its path of travel through the washer, although it is preferable to rotate the wringer rolls by a suitable drive means of the type customarily used in mills for rotating rolls. The speed of strip is high and may, for example, be about 1,000 to 1,500 feet per minute. The higher the speed the greater the amount of solution that is dragged out of the electroplating cell by the moving strip.

The wringer rolls 11 and 12 are rotatably mounted and one or both of these wringer rolls may be formed of metal or rubber coated metal. The rolls 11 and 12 remove most but not all of the electroplating solution so that a thin film of solution remains on the strip. Strip 10 moves from these wringer rolls through a wash tank 14. Two similar rolls 15 and 16 are rotatably mounted in the tank to hold the moving strip below the surface of the liquid in the tank. The strip 10 when it leaves tank 14 drags out a considerable quantity of the wash liquid and is passed between a second pair of rotatable wringer rolls 17 and 18.

The strip 10 is moved at a high rate of speed and as a consequence the amount of electrolyte in the bath in tank 14 rapidly builds up so that the strip leaving tank 14 has liquid on it containing a relatively large amount of electrolytic salts originally dragged from the electroplating cell. A pair of apertured pipes 19 and 20 are positioned on opposite sides of the strip and are connected to a water supply pipe 22 which is in turn connected to source of fresh wash water. Each apertured pipe 19 and 20 directs a water spray 23 against the corresponding surface of the strip 10. The sprays 23 dilute the liquid on the strip so that the liquid on the strip will contain a smaller percentage of salts than the bath in tank 14.

The tank 14 is provided with an outlet connection 24 which preferably communicates with the electroplating cells so that the liquid in tank 14 can be used to replace at least part of the liquid lost from the cells by drag out and other causes. By using the bath liquid from tank 14 to replace the liquid lost from the cells, a large portion of the electroplating salts removed from the strip by the bath in tank 14 are recovered. The amount of solution dragged out of the last electroplating cell is so large that recovery of at least part of the salts is an important economic advantage. The sprays 23 are located so that the excess liquid which contains some of the electrolytic salts and which falls away from or flows back along the strip will be deposited in the tank 14. Preferably, the rate of flow of the sprays 23 is approximately equal to the rate of flow of solution from tank 14 to the electroplating cells.

The sprays 23 dilute the solution on strip 10 to a limited extent but do not remove all of the salts so that the film left on the strip after the strip passes through wringer rolls 17 and 18 contains an appreciable quantity of salts. The strip 10 moves from the wringer rolls 17 and 18 through a rinsing apparatus shown generally at 26. The rinsing apparatus 26 includes a collector tank 27, a rotatable guide roll 28 and three pairs of similar wringer rolls 29, 30 and 31, respectively, which may or may not be driven by any one of the usual roll driving means. Six similar apertured pipes 32, 33, 34, 35, 36 and 37

are each connected to water supply pipe 22 for discharging sprays of fresh wash water against the surfaces of the strip as will be more fully hereinafter described.

The strip 10 passes from wringer rolls 17 and 18 beneath guide roll 28 and then moves horizontally past the water spray 37' issuing from apertured pipe 32. The spray 37' is directed downwardly against the top surface 38 of strip 10. The strip 10 passes beneath and then up and around the horizontal, bottom wringer roll 29 before passing between the wringer rolls so that the bottom surface 39 of the strip is uppermost when the strip passes beneath spray 40 discharged from pipe 33. After passing between wringer rolls 29, the strip passes up and around the upper wringer roll 29 and then downwardly beneath lower wringer roll 30. As the strip passes pipe 34 the surface 38 is again uppermost and the spray 41 from this pipe is directed downwardly against the top surface 38 of the strip. The strip 10 then moves between wringer rolls 30 in a rearward direction and the bottom surface 39 is again uppermost as the strip moves past spray 42 discharged from pipe 35 and directed downwardly against surface 39 of the rearwardly moving strip. The strip next travels between wringer rolls 30 which remove the excess liquid and then passes around upper roll 30 and forwardly and downwardly beneath the lower wringer roll 31. The top surface 38 is uppermost when the strip moves past spray 43 discharged from the apertured pipe 36. Before the strip 10 passes rearwardly between wringer rolls 31 and while surface 39 is uppermost, the spray 44 from pipe 37 is directed downwardly onto surface 39. After the strip passes between rolls 31, it is free of or substantially free of all electrolytic salts dragged out of the electroplating cell and after being dried, the strip can be heated in the usual manner to flow-brighten the tin coating and produce a better grade of electrolytic tinplate.

The sprays in the final rinsing apparatus 26 preferably are sprays of hot water. The water is fresh, that is, the water has not been previously used to wash the strip and contains no salts from the electroplating solution. The water may contain the usual small amount of metals and impurities normally present in the water supply for mills. The water sprays 37', 40, 41, 42, 43 and 44 are each directed downwardly against the strip while the corresponding surface 38 or 39 is uppermost. With this arrangement, the wash water spreads laterally over the strip and clings to the strip so that the wash water does a much better job of flushing off the residual thin film of electrolyte left on the strip after it has been wrung by the preceding pair of wringer rolls. In addition, as each spray is directed downwardly against the strip, the wash water from the sprays clings to the moving strip and does not quickly fall away from the strip. Consequently, as the moving strip starts to pass around each lower wringer roll or starts to pass between each pair of wringer rolls, the wash water which is clinging to the strip piles up ahead of the wringer roll at the nip of the roll. This water which is piled up ahead of each wringer roll between the wringer roll and the surface just sprayed is in a highly turbulent state so that the wash water is thoroughly mixed with the residual film of salt-containing solution left on the strip by each pair of preceding wringer rolls. This thorough mixing increases the dilution of the residual, con-

taminated film of liquid on the strip and more thoroughly cleans the strip.

The tank 27 is provided with an outlet 45 communicating with a sewer or other place of disposal. The outlet 45 is of such a size that the strip 10 does not pass through a bath in tank 27. The excess wash water containing some electrolyte falls free of the strip and does not recontaminate the strip. The clean strip which we obtain would not be obtained if a bath were maintained in tank 27 of sufficient depth so that the strip passed through the bath as it does in the reclaimed or cell-replenishing bath in tank 14.

In practice, for example, it has been found that the strip 10 as it enters the three stand, rinsing apparatus 26, will have a film of liquid on its surface containing about 1,000 parts per million of solids. After passing through the rinsing apparatus 26, the liquid film on the strip will contain only about 200 parts of total solids per million parts, or only about 15 parts per million more than the solids in the wash water which in this instance contained about 185 parts per million of solids. Reducing the amount of solids in the liquid film on the strip so that the film contains less than only 25 parts per million of solids more than number of parts per million of solids in the fresh wash water is both unusual and highly desirable as the final, flow-brightened sheets will not be appreciably contaminated with residual salts from the electrolytic cells.

We claim:

1. In the process of removing a solution of electroplating salts from a moving metal strip electroplated with metal, the steps of directing the strip along a predetermined path with one surface uppermost and directing a stream of fresh wash water downwardly onto said one surface, changing the direction of strip travel and positioning the other surface uppermost and directing a stream of fresh wash water downwardly onto said other surface, and thereafter passing the strip between wringer rolls.

2. In the process of removing a solution of residual electroplating electrolyte from continuously moving metal strip electroplated with metal, the steps of passing the electroplated strip having such a solution thereon through a first bath, passing the strip from the bath and wringing the strip, arranging the wrung strip with one surface uppermost and directing fresh wash water onto the uppermost surface, arranging the strip with the other surface uppermost and directing fresh wash water onto this other uppermost surface, and wringing the strip to remove the excess liquid and leave a thin film of liquid on each surface of the strip.

3. In the process of removing a solution of residual electroplating electrolyte containing electrolytic salts from, continuously moving metal strip electroplated with metal, the steps of passing the electroplated strip having such a solution thereon through a first bath, passing the strip from the bath and wringing the strip, arranging the wrung strip with one surface uppermost and directing fresh wash water onto the uppermost surface, arranging the strip with the other surface uppermost and directing fresh wash water onto this other uppermost surface, and wringing the strip to remove the excess liquid and leave a thin film of liquid on each surface of the strip, the liquid of said film containing less than 25 parts per million of electrolytic salts in excess of that carried in the wash water.

4. In the process of progressively removing

residual electroplating electrolyte containing electrolytic salts from continuously moving metal strip electroplated with metal, the steps comprising passing the strip from an electroplating cell through a first rinse bath, passing the strip upwardly from the bath and spraying the strip with fresh wash water while the strip is so arranged that liquid on the strip flows into the first rinse bath, wringing the rinsed strip, passing the wrung strip forwardly beneath the lower one of a pair of horizontal, upper and lower wringer rolls with one surface uppermost, directing a fresh wash water spray downwardly against the uppermost surface before the strip passes beneath the lower roll, directing the strip about the lower roll and rearwardly between the wringer rolls with the other surface uppermost, and applying a spray of fresh wash water against the other surface while uppermost and before passing between the wringer rolls.

5. In the process of progressively removing electroplating solution from metal strip electroplated with metal continuously moving through three coplanar horizontal pairs of upper and lower, wringer rolls, the steps comprising directing the strip forwardly beneath the lower wringer roll of the first pair of a first surface of the strip uppermost, directing the strip rearwardly between the first pair of wringer rolls with the other second surface uppermost, directing the strip around the upper wringer roll of the first pair and then forwardly and downwardly beneath the lower roll of the second pair with the first surface uppermost, directing the strip about the lower roll and then rearwardly between the second pair of wringer rolls with the second surface uppermost, directing the strip upwardly about the upper roll of the second pair of rolls and then forwardly and downwardly beneath the lower roll of the third pair of rolls with the first surface uppermost, directing the strip upwardly about the lower roll and then rearwardly between the third pair of wringer rolls with the second surface uppermost, directing a spray of wash water downwardly against the first surface each time it is uppermost before it passes beneath a lower roll, and directing a stream of fresh wash water onto the second surface each time it is uppermost and prior to passing between each pair of wringer rolls.

6. The process of removing electroplating electrolyte containing electrolytic salts from moving metal strip electroplated with metal comprising the steps of supporting and moving the strip; alternately washing the strip from fresh water and removing excess liquid from the strip by passing it between wringer rolls at least three different times, each washing operation including positioning the moving strip with one surface uppermost and directing a stream of fresh water against said uppermost one surface, positioning the moving strip with the other surface uppermost and directing a stream of fresh water against said uppermost other surface, and then passing the strip between the wringer rolls; and collecting and removing the wash water away from the strip whereby the strip is not contaminated with removed electrolyte.

7. The process of removing electroplating electrolyte containing electrolytic salts from horizontal metal strip electroplated with metal moving along a path comprising the steps, of passing the strip from the plating cell through wringer rolls to remove some of the residual electroplating electrolyte; passing the strip through an aqueous

reclamation bath to wash the strip and remove some residual electrolyte; subjecting the strip to repeated washing and wringing operations, each operation including directing the strip along a path with first one surface uppermost and then the other surface uppermost, directing a water spray downwardly against each surface while in the uppermost position so that the water spray flows over the strip, and wringing the strip after both surfaces have been sprayed; and removing sprayed water from the vicinity of the strip and preventing recontamination of the strip.

SAMUEL S. JOHNSTON.
JOHN E. ELSWICK.

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