Dec. 6, 1949 C. M. HOFF 2,490,055

METAL STRIP ELECTROPLATING APPARATUS

Filed March 30, 1944 2 Sheets-Sheet 1

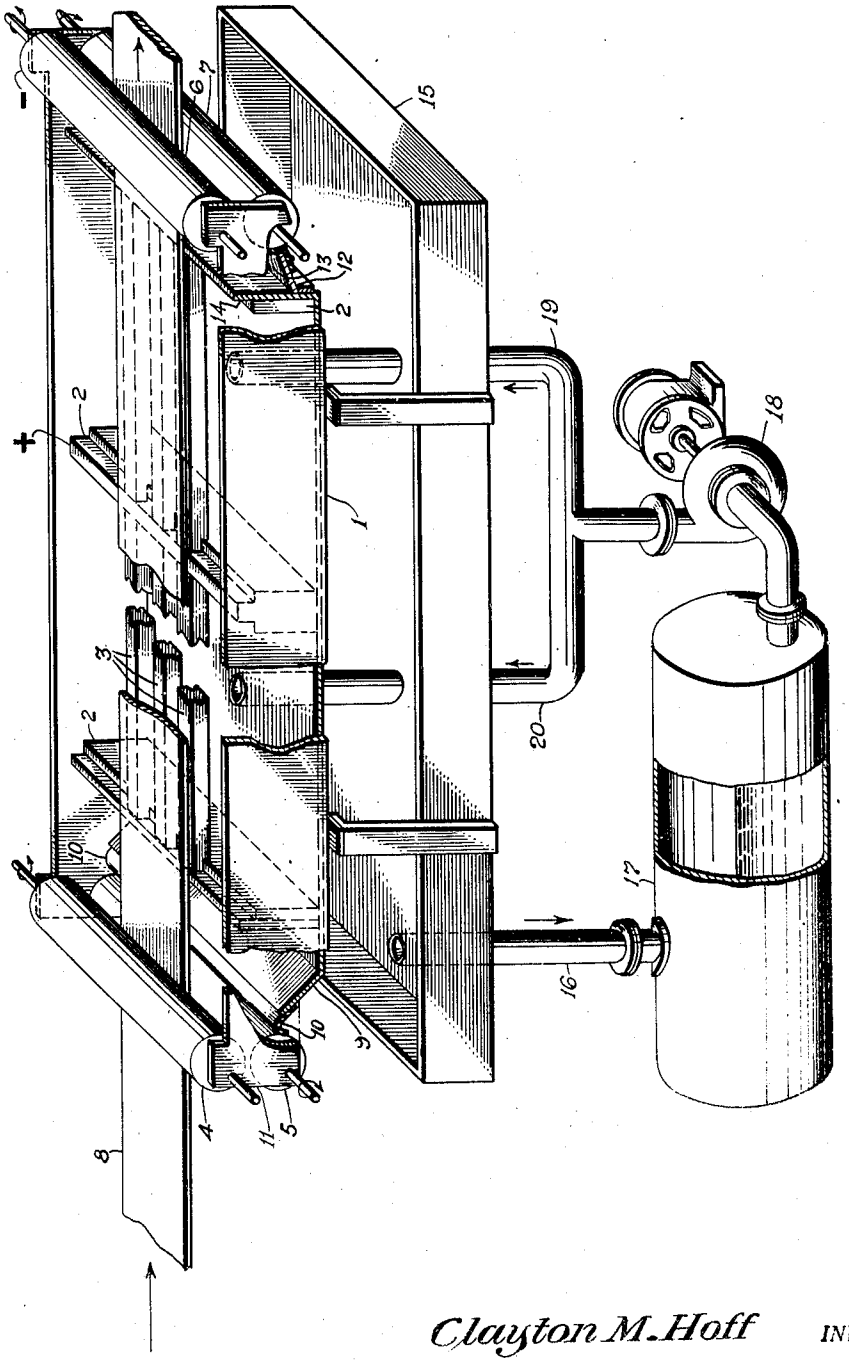

Fig. 1

Clayton M. Hoff INVENTOR.

BY Albert B. Greene ATTORNEY

Dec. 6, 1949 C. M. HOFF 2,490,055

METAL STRIP ELECTROPLATING APPARATUS

Filed March 30, 1944 2 Sheets-Sheet 2

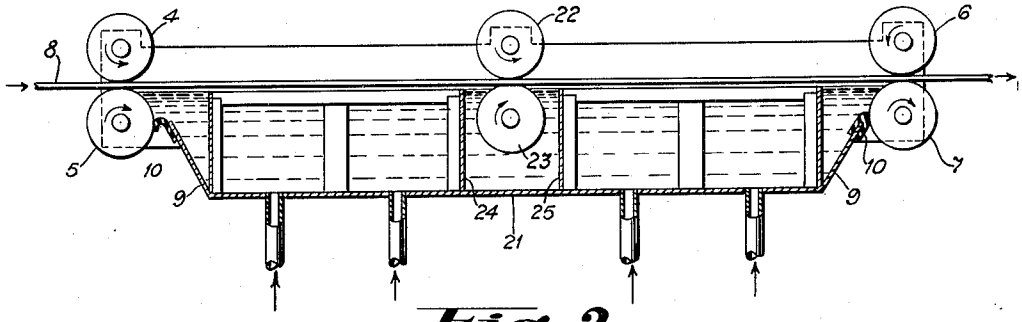

Fig. 2

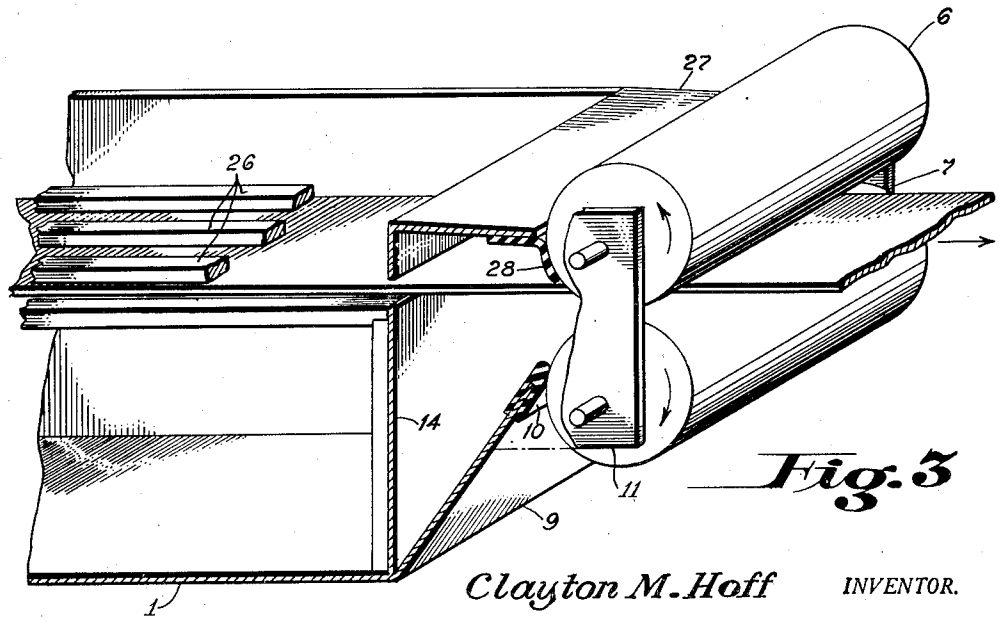

Fig. 3

Clayton M. Hoff INVENTOR.

BY Albert B. Griggs. ATTORNEY

Patented Dec. 6, 1949 2,490,055

UNITED STATES PATENT OFFICE

2,490,055

METAL STRIP ELECTROPLATING APPARATUS

Clayton M. Hoff, Wilmington, Del., assignor, by mesne assignments, to National Steel Corporation, a corporation of Delaware

Application March 30, 1944, Serial No. 528,673

3 Claims. (Cl. 204—206)

1

This invention relates to an apparatus for the application of electrodeposits to metal strips and is more particularly directed to electroplating apparatus for the high speed plating of strip metal using readily oxidized plating solutions wherein excessive aeration of solution is avoided.

It is an object of the present invention to provide apparatus well adapted for the handling of stannous tin plating solutions. It is a further object to provide apparatus for handling metal strip at high speed and effecting contact between a plating solution and the strip without excessive aeration of the solution. It is a still further object to provide apparatus which does not involve a radical departure from existing equipment so that such existing equipment can readily be altered to conform to the present invention. Still further objects will become apparent hereinafter.

The foregoing and other objects of the invention are attained by the use of an apparatus more particularly described hereinafter and illustrated in the accompanying drawings in which:

Figure 1 is a semi-diagrammatic showing of an assembly of a typical plating unit of the present invention,

Figure 2 is a cross section illustrating a modified apparatus of the invention, and

Figure 3 illustrates a still further modification of a roll assembly where the solution level is maintained above the strip being plated.

In the general assembly of Figure 1 there will be seen a plating receptacle, 1, which is constructed of a suitable material or is suitably lined to resist corrosion by the plating solution employed. For a stannous chloride-sodium fluoride bath of a pH about 3 there would be used, for instance, a tank lined or coated with rubber, polychloroprene or polyvinyl chloride.

The plating tank, 1, is provided with supports, 2, for holding anodes, 3, in a suitable spaced relation to the strip to be plated. The anode supports, 2, are made of a suitable conductor, such as carbon, while the anodes are preferably made of the metal to be plated, for instance, tin.

At the entrance end of the plating tank there are provided rolls, 4 and 5. At the exit end there are provided rolls, 6 and 7. The pairs of rolls, 4—5 and 6—7, engage the strip of metal, 8, to be

2

plated and serve as guide rolls in the passage of strip across the top of the plating tank. Driving rolls, not shown, engage the strip and pull it thru the plating equipment. The rolls, 4—5 and 6—7, are driven, by means not shown, so that they turn in synchronism with the driving rolls, but the drive is not positive so that rolls 4—5 and 6—7 may slip to stay at the same speed as the moving strip. In this way the rolls shown are driven so that they do not depend upon friction with the strip to turn them, but they are not so positively driven that they will go at a different speed from the strip and scratch it. The upper rolls 4 and 6 are metal and some or all of these upper rolls may serve as electrical contacts. The lower rolls 5 and 7 are back-up rolls and are preferably made of a nonconducting material such as rubber.

The sides of the tank, 1, are preferably somewhat raised to minimize overflow of solution. At each end of the tank there is provided means for retaining solution. As shown at the entrance end of the tank, there is a sealing means or wall, 9, extending from the bottom of the tank towards the lower roll, 5. The upper end of the member 9 terminates in a resilient wiper, 10. The wiper, 10, may suitably be made of rubber. It will be seen that the solution will be prevented from flowing out of the tank by the wall, 9, the wiper, 10, the roll, 5, and, of course, by the extension, 11, of the sides of the tank, 1.

An identical construction may be used at the exit end of the tank, but for purposes of illustration, there is shown a very similar construction which has proven successful in plant practice. A retaining member, 12, extends from the end of the tank, 14, and is provided with a rubber wiper, 13. It will be observed that the wall, 14, serves to restrain the unimpeded flow of solution and it also serves as an electrical shield to minimize plating on the roll. This structure and the wall, 14, are very important when the strip is moving at high speed. Without means for retaining the solution it would be carried out of the tank so fast that plating would be impossible.

Solution which passes through the rolls or which splashes over the sides of the plating receptacle is caught in the tray, 15. Solution from the tray is withdrawn from the tray through a pipe, 16, to a tank, 17, from which it is returned

by a pump, 18, to the plating tank, 1, by the pipes, 19 and 20.

In the operation of the apparatus illustrated in Figure 1, any suitable solution such as a stannous chloride-sodium fluoride tin plating bath is put in the tank, 1. A metal strip, such as strip steel, is run across the top of the receptacle, the solution level being such that at least the lower surface of the steel is in contact with the electrolyte. Suitable anodes, such as tin are slipped into place and electrodeposition is effected in the customary way by the application of current.

The strip steel is guided as it moves rapidly across the top of the cell by the rolls, 4—5 and 6—7. Any solution which overflows will be caught and returned to the tank. It will be seen that only a relatively small amount of the solution will overflow, and thus aeration will be held at a minimum. It will also be understood that the assembly of Figure 1 represents only a single plating unit and a number of such units will ordinarily be required to obtain a sufficiently heavy metal deposit at relatively high speeds.

In Figure 2 there is illustrated a modification in which two units like that of Figure 1 are juxtaposed. The plating tank, 1, is provided with a retaining member, 9, and a wiper, 10, at the inlet and at the exit end. The construction in effect provides two tanks, like that in Figure 1, which are joined by a member, 21, which extends around the bottom and sides of the tank to form one long plating tank. Rolls 22 and 23 are provided intermediate the length of the long tank to provide driving power, to hold the sheet in position, and to provide an electrical contact. Walls, 24 and 25, serve to minimize plating on the roll 22 and to slow down the motion of plating solution.

It will be seen that the modification of Figure 2 is applicable to installations using a still larger number of tanks. Thus, according to the invention, one may either use a plurality of elements like that shown in Figure 1 or may use a plurality of elements joined by rolls, such as 22—23, the tanks in the latter event being interconnected.

Figure 3 illustrates a still further modification and shows the exit end of a modified structure. The tank, 1, is provided with a wall, 9, and a wiper, 10. There is also provided a wall, 14, which serves like that of Figure 1.

The apparatus of Figure 3 is characterized by the fact that the sides of the tank are considerably higher than those of Figure 1 so that the solution level may be raised to a point well above the moving strip and the strip accordingly may be plated on both sides at the same time. Anodes, 26, may be provided for this purpose. It is to be noted that the anodes, 26, may be omitted and this structure used if it is considered important to maintain a somewhat higher solution level than that readily obtainable in a structure of Figure 1.

A suitable solution retaining member, 27, is provided and this carries at its end a wiper, 28. It will be seen that this structure minimizes the loss of solution at the exit end of the plating receptacle as shown.

While I have shown certain illustrative embodiments of the invention, it will be understood that one skilled in the art may without departing from the spirit of the invention readily devise numerous similar apparatus for the plating of strip metals with a minimum of solution aeration.

I claim:

1. A strip plating apparatus comprising a tank for holding a plating solution, having side, end, and bottom walls, means for passing a strip across the top of said tank in a plane substantially coincident with the plane of solution level, said last-mentioned means comprising a lower roll at the exit end and located with its upper surface substantially tangential to the plane of the solution level, and a cathode contact roll above said roll, said rolls being adapted to receive the strip therebetween, the end wall of said tank at the exit end extending upward almost to the plane of the solution level and being positioned so that the rolls are beyond the said end wall in the direction of motion of said strip, an anode located in said tank below the solution level, electrode connections for the said anode and for said contact roll, extensions on the side walls of the tank and a sealing means extending from the said exit end wall to said lower roll which together with the extensions on the side walls of the tank form a container for holding the plating solution and for restraining its flow from the tank.

2. A strip plating apparatus comprising a tank for holding a plating solution, having side, end, and bottom walls, means for passing a strip across the top of said tank from end to end in a plane substantially coincident with the plane of solution level, said last-mentioned means comprising a lower roll located at the exit end with its upper surface substantially tangential to the plane of the solution level, and a cathode contact roll above said lower roll, said rolls being adapted to receive the strip therebetween, the end wall of said tank at the exit end extending upwardly almost to the plane of the strip and being positioned so that the rolls are beyond the said end wall in the direction of motion of said strip, an anode located in said tank below the solution level, electrode connection for the said anode and for said contact roll, side wall extensions extending from the side walls to the rolls and above the plane of the strip, and a sealing means extending from the said exit end wall to said lower roll, said sealing means and said rolls together with the extensions of the tank side walls forming a container for holding the plating solution and for restraining its flow from the exit end of the tank.

3. A strip plating apparatus comprising a tank for holding a plating solution, having side, end, and bottom walls, the side walls extending above the solution level, means for passing a strip across the top of said tank from end to end in a plane substantially coincident with the plane of solution level, said last-mentioned means comprising a lower roll located at the exit end with its upper surface substantially tangential to the plane of the solution level, and a cathode contact roll above said lower roll, said rolls being adapted to receive the strip therebetween, the end wall of said tank at the exit end extending upwardly almost to the plane of the strip and being positioned so that the rolls are beyond the said end wall in the direction of motion of said strip, an anode located in said tank below the solution level, electrode connection for the said anode and for said contact roll, side wall extensions extending from the side walls to the rolls and above the plane of the strip, and a sealing means extending from the said exit end wall to said lower roll, said sealing means and said rolls together with the extensions of the tank side walls forming a con-

tainer for holding the plating solution and for restraining its flow from the exit end of the tank.

CLAYTON M. HOFF.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
347,959	Rau	Aug. 24, 1886
929,312	King	July 27, 1909
1,191,386	Battle	July 18, 1916
1,813,297	Klein	July 7, 1931
2,061,554	Billiter	Nov. 24, 1936
2,223,860	Schellenberg	Dec. 3, 1940
2,240,265	Nachtman	Apr. 29, 1941
2,244,423	Hall	June 3, 1941
2,324,652	Stoker	July 20, 1943
2,377,550	Hall	June 5, 1945
2,384,660	Ward	Sept. 11, 1945

FOREIGN PATENTS

Number	Country	Date
467,019	Great Britain	June 9, 1937

OTHER REFERENCES

"Metal Finishing," February 1944, pages 77 to 79, article entitled "Electrotinning Steel Strip at Weirton Steel."