

April 10, 1945.

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2,373,432

APPARATUS FOR RUSTPROOFING SHEET METAL

Filed Aug. 21, 1941

2 Sheets-Sheet 1

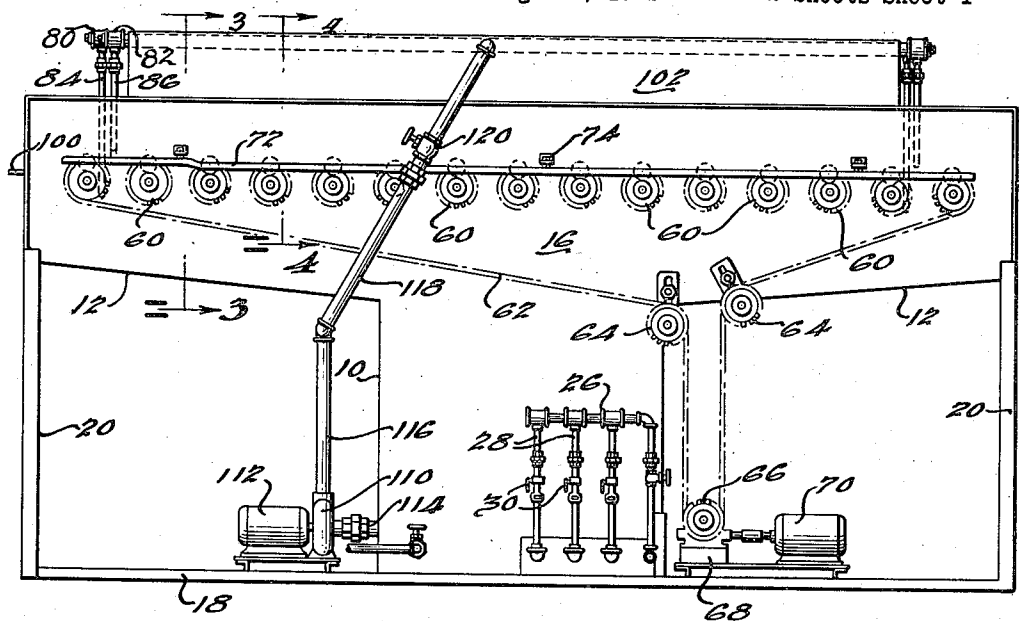


FIG. 1.

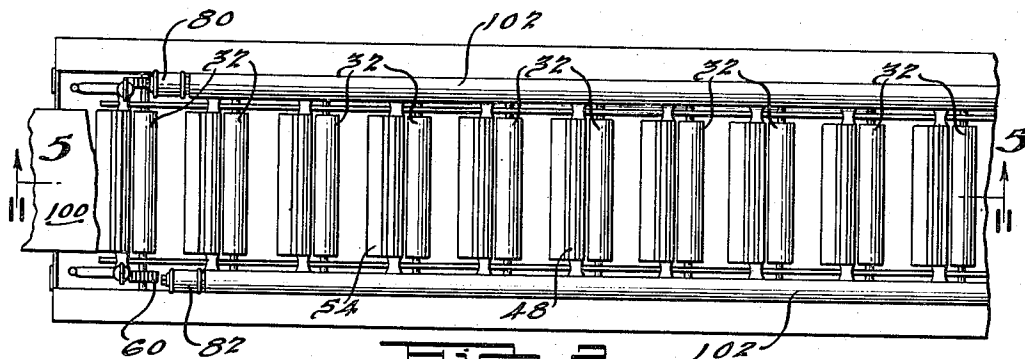
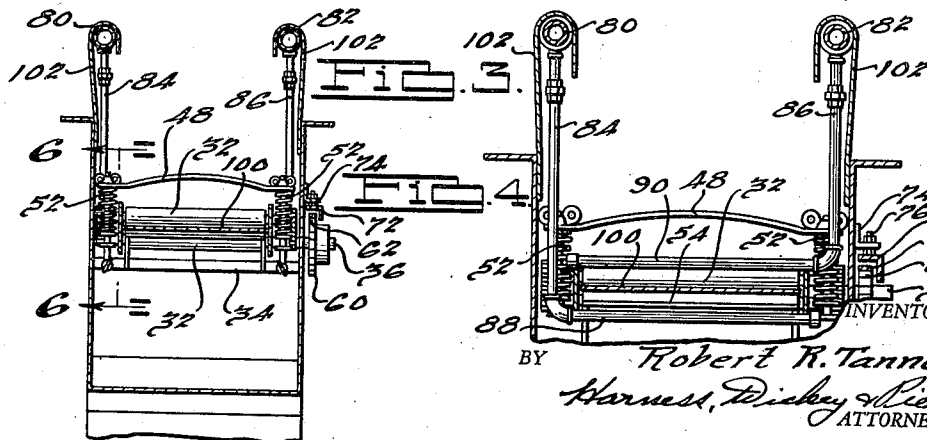


FIG. 2.



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2 Sheets-Sheet 2

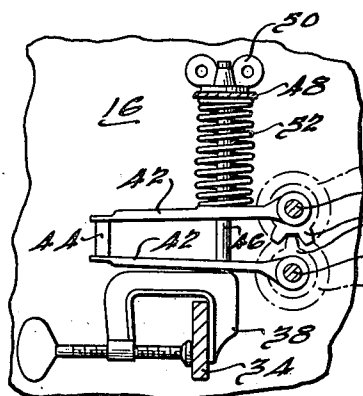
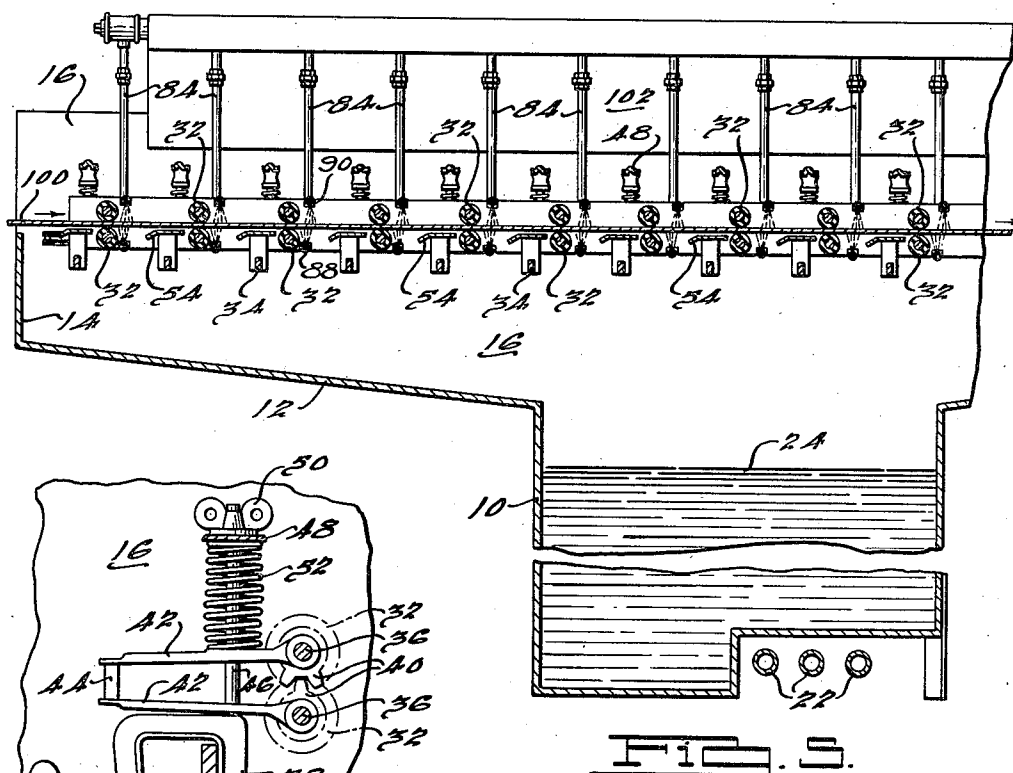


FIG. 6.

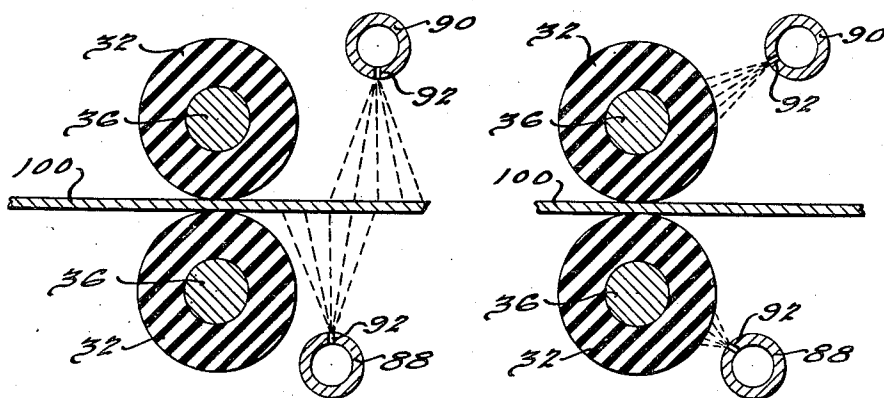


FIG. 7.

FIG. 8.

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2,373,432

APPARATUS FOR RUSTPROOFING SHEET
METAL

Robert R. Tanner, Birmingham, Mich., assignor
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a corporation of Michigan

Application August 21, 1941, Serial No. 407,775

3 Claims. (Cl. 91—29)

This invention relates to apparatus for chemically coating sheet or strip metal, the principal object being the provision of apparatus for this purpose by means of which the time required for a coating operation may be materially reduced, and a coating of even thickness may be produced.

Objects of the invention include the provision of apparatus of the type described comprising a plurality of closely associated pairs of resilient rolls between which strips or sheets of metal are adapted to be passed; the provision of a construction as above described in which the rolls are driven in unison; the provision of a construction as above described in which the pairs of rolls are positioned in or above a tank the bottom of which forms a reservoir for a chemical coating solution, the provision of pumping means for drawing the coating solution from the reservoir and delivering it to the sheet or strip between the pairs of rolls; the provision of a construction as above described in which the solution is sprayed above and below the path of the sheet or strip so that the surfaces to be coated are wet with the solution during their passage through the rolls; the provision of a construction as above described in which the rolls are positioned between the upper marginal portions of the ends of the tanks which are cut away to permit the passage of the strip or sheet being treated there-through; and the provision of a construction as above described that is simple in construction, efficient in operation and relatively economical to produce and operate.

The above being among the objects of the present invention the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the accompanying drawings which illustrate suitable embodiments of the present invention and in which like numerals refer to like parts throughout the several different views,

Fig. 1 is a side elevational view of my improved coating apparatus;

Fig. 2 is an enlarged fragmentary, plan view of the coating apparatus shown in Fig. 1;

Fig. 3 is an enlarged fragmentary, vertical sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a still further enlarged fragmentary, transverse sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is an enlarged fragmentary, vertical sectional view taken on the line 5—5 of Fig. 2;

Fig. 6 is a fragmentary, side elevational view

illustrating the means employed for resiliently urging the resilient rollers toward one another;

Fig. 7 is an enlarged, fragmentary, vertical sectional view taken longitudinally of the apparatus shown in the previous views illustrating the application of the solution to a sheet or strip passing through a pair of rolls; and,

Fig. 8 is a view similar to Fig. 7 but illustrating a modified arrangement for applying the solution to the sheets or strips.

It is generally appreciated that American manufacturers engaged in mass production are constantly endeavoring to cut down the time required to perform certain operations in the manufacture of their product or products. The desire of the manufacturers in this direction has extended to all phases of operation and for that reason manufacturers requiring the production of coatings on metal surfaces by the action thereon of chemical solutions have desired to speed up the process of producing such coatings.

Typical of such coatings are phosphate coatings applied to iron, steel, zinc or the like to form a bond for paint. While my apparatus will be useful in applying other chemical coating solutions, it will be described in connection with the production of phosphate paint-bonding coatings, for which purpose it is especially suitable.

In the past it has been conventional practice to pass such sheets or strips through a bath of a suitable phosphate solution, or to pass it through a tank, housing or the like in which the solution may be flowed, sprayed, impinged or otherwise applied to the article. The processing time for treating steel in fast commercial production has been on the order of one minute. It had been thought that this was about the fastest coating time obtainable consistent with proper results. A shorter processing time has been obtained in treating zinc but even this can be reduced by operating in accordance with the present invention.

The trade, and particularly the steel making industry, now demands that the coating step be accomplished in a time of the order of ten seconds, and it has been found that by the use of the apparatus of the present invention the bonding coat can be produced in approximately this time, and even less in certain instances, particularly where the proper coating solution is employed. This is accomplished by passing the sheets or strips through a plurality of closely adjacent pairs of resilient rolls and applying the phosphate solution to both faces of the sheet as it passes through such rolls. It has been found

that by so treating the sheet or strip the small amount of oil usually found on such sheets or strips is quickly broken down and washed away and that the subsequent rolls mechanically force the phosphate solution into intimate contact with both surfaces of the sheet or strip in such a manner that the coating operation is speeded up to an unusual degree. The method by which this coating is provided, as distinguished from the apparatus employed in the method, forms no part of the present invention but comprises the subject matter of my application for Letters Patent of the United States on Method of expediting chemical coating on metal, filed October 13, 1944 and serially numbered 558,613.

Referring now to the accompanying drawings it will be noted that the apparatus of the present invention includes a centrally located tank or reservoir 10 integrally joined at its upper end with forward and rearward extensions 12 forming a housing and drain board portion, the lower walls of which slope downwardly toward the central tank 10. As indicated best in Fig. 5 the end walls 14 of the extensions 12 terminate short of the upper edges of the side walls 16, the side walls 16 of the tank structure along their lower margins are each provided with a longitudinally extending angle iron 18 the opposite ends of which terminate in substantial vertical alignment with the outer ends of the extension 12, and vertically directed supporting legs 20 of suitable construction such, for instance, as angle irons are extended between the ends of the angle irons 18 and the outer ends of the extensions 12. As indicated best in Fig. 5 the bottom wall of the central tank portion 10 is stepped as indicated and suitable steam pipes or other heating tubes 22 are positioned within the step so as to enable the phosphate solution 24 within the central tank portion 10 to be heated thereby. As indicated in Fig. 1 a suitable distributing manifold, indicated generally at 26 including branches 28 leading to the individual tubes 22 and each provided with a valve 30, is provided for supplying a heating media to the tubes 22 and for controlling the flow therethrough.

Extending between opposite side walls 16 of the tank structure over substantially the entire length thereof are pairs of resilient rollers 32. In the broad sense these rollers 32 may be supported in any suitable or conventional manner between the opposite side walls 16 and may be resiliently urged toward one another in any suitable or conventional manner. In the particular case shown by way of illustration and as best brought out in Fig. 6, a supporting bar 34 extends between the opposite side walls 16 of the tank structure and is rigidly secured thereto at the desired location of each pair of rolls or rollers 32. The rollers 32 as best illustrated in Figs. 7 and 8 comprise a body of resilient rubber or rubber composition mounted on a shaft 36 and in the particular construction shown are mounted in pairs upon a framework supporting the shafts 36 at opposite ends and including clamps indicated generally at 38 in Fig. 6 by means of which each pair of rollers is secured to the corresponding bar 34. Also as indicated in Fig. 6 at each end of each roller the corresponding shaft 36 has fixed thereto a long tooth gear 40, the corresponding pairs of gears intermeshing with one another so as to cause equal rotation thereof. An arm 42 encircles each shaft 36 outwardly of each of its gears 40 and the free ends of the arms 42 are spaced by means of a post 44 extending between them. A post or stud

46 secured to the lower arm 42 projects upwardly through the upper arm 42 and the studs 46 for each pair of rollers 32 receive the opposite ends of a bar 48 followed by a wing nut 50. A coil spring 52 surrounds each stud 46 and is maintained under compression between the bar 48 and the upper surface of the upper arm 42. The compressive force of the spring 52 may be varied by threading the wing nuts 50 outwardly or inwardly on their corresponding posts or studs 46, and of course, act to resiliently urge the rollers 32 of each pair of rollers resiliently into contact with respect to each other. The frame for each pair of rollers 32 also includes a guide board 54, best shown in Fig. 5 in advance of its corresponding rollers and with its upper surface substantially flush with the upper surface of the lower roller 32 of such pair, thus to guide any article properly between each pair of rollers. The lines of contact between the rolls of all the pairs of rollers preferably lie in the same horizontal plane which is located immediately above the upper edges of the end walls of the tank extensions 12.

The various pairs of rollers 32 are preferably positioned in as close a relationship to one another longitudinally of the apparatus as is conveniently feasible. In the particular construction shown by way of illustration and with the particular type of roller supports employed in the construction shown, the rollers may be positioned from one foot to sixteen inches apart.

As perhaps best illustrated in Figs. 3 and 4 the shaft 36 for the lower roller of each pair of rollers 32 projects out through one side 16 of the tank structure and outwardly of such side wall has a sprocket 60 fixed thereto. A drive chain 62 overlies all of the sprockets 60 in meshing relationship with respect thereto, turning around the end sprockets 60 and then passing over adjustable idler sprockets 64 and then looping around a drive sprocket 66 mounted on a gear reduction mechanism 68 driven by a suitable electric motor or the like 70. The adjustable sprockets 64 are capable of taking up any slack in the chain 62 caused by wear or from other reasons as will be appreciated. It will also be appreciated that rotation of the motor 70 acting through the gear reduction 68 will drive the drive sprocket 66, and therefore, the chain 62 which being in mesh with the sprockets 60 on the lower shaft of each pair of rollers 32 will drive the lower rollers of each of said pairs and, acting through the gears 40 of each pair, will drive the upper rollers of each pair. Consequently a sheet or strip of material such as 100 which is introduced between the leading pair of rollers 32 will be consecutively fed between each pair of rollers 32 in turn until it is finally discharged from that pair of rollers 32 at the discharge end of the apparatus.

A guard is preferably provided over the upper run of the chain 62. As best illustrated in Figs. 3 and 4 this guard comprises an angle iron 72 arranged in protecting relation to the upper run of the chain 62 and upper edges of the sprockets 60. The angle iron 72 is carried from an angle iron 74, fixed to the corresponding side 16 of the tank structure, by means of adjustable bolts or studs 76.

In order to apply phosphate solutions to the sheet or strips passing through the pairs of rollers 32 in the particular construction shown, a pair of headers 80 and 82 respectively are arranged above the opposite sides 16 of the tank structure and extend substantially the full length thereof. At intervals along the headers 80 and 82 equal to

the spacing of the pairs of rollers 32 the header 80 is provided with downwardly extending branches 84 and the header 82 with downwardly extending branches 86. The branches 84, as best shown in Fig. 4, extend downwardly below the line of contact between the corresponding pair of rollers 32 and then turns and extends across the tank structure as at 88. Each branch 86 as also best illustrated in Fig. 4 extends downwardly to a point above the line of contact between the corresponding pair of rollers 32 and then extends across the tank as at 90. Over their length the portions 88 and 90 are provided with a plurality of transversely aligned openings 92 therein so that the solution delivered to the headers 80 and 82 and the various branches 84 and 86 and their extensions 88 and 90 respectively, will be discharged through the openings 92 to the sheet or strip 100 passing through the various pairs of rollers 32. The solution discharging from the branch portions 90 will, of course, be delivered to the upper surface of the sheet or strip 100 while the solution delivered from the lower branch portions 88 will be delivered to the underside of the sheet or strip 100. These branch portions 88 and 90 may be arranged as indicated in Fig. 7 to deliver the solution directly to the surface of the sheet or strip 100 or as illustrated in Fig. 8 may be arranged to deliver the solution to the surface of the corresponding rolls 32 the rotation of which will carry the solution into contact with the corresponding surfaces of the sheet or strip 100. In the last mentioned arrangement the solution has perhaps a better opportunity to spread out into a film or layer substantially of uniform thickness before being carried into contact with the surfaces of the sheet or strip 100 than in the first described construction and may be preferable, under some circumstances at least, for that reason.

Preferably side plates 102, forming upward extensions of the tank sides 16, are provided between the sides of the tank structure and the headers 80 and 82. These plates 102 not only serve as splash guards for the solution applied to the sheet 100 but when extended over the headers as shown serve as shields for the headers when carrying hot solutions.

As illustrated in Fig. 1, a pump 110 driven by a motor 112 is positioned adjacent the bottom end of the central tank portion 10 and its intake side is connected by means of a pipe 114 with the bottom portion of the tank portion 10. The discharge side of the pump 110 is connected to a pipe 116 which branches below the lefthand tank extension 12 into two branches 118 one of which connects with the distributing pipe or manifold 80 and the other of which connects with the distributing pipe or manifold 82. Preferably a valve 120 is disposed in each branch 118 so as to permit adjustment of the volume of flow of solution to the headers 80 and 82. The solution which is thus delivered to the upper and lower surfaces of the sheet or strip 100 passing between the pairs of rollers 32 drains from such sheet or strip by gravity and back into the bottom of the central tank portion 10 where it is again picked up by the pump 110 and re-circulated.

In the operation a suitable volume of phosphate solution 24 is prepared and placed in the central tank portion 10. Such solution may be of any type or composition suitable for rapid production of a phosphate bonding coat. Steam or other heating media is admitted to the tubes 22 and the solution 24 brought to a desired temperature

where necessary or desirable. The motor 70 is then energized to effect rotation of the various rolls 32 and the motor 112 is energized to circulate the solution 24 in the manner above described and then the strip, sheet or other article to be treated is introduced between the first pair of rolls 32 and is connected through each subsequent set of rolls 32 in turn, being wet and preferably substantially flooded with chemical solution 24 between each pair of rolls. The sheet, strip or other object as it passes between each roll is, of course, squeezed between the resilient rolls and the chemical solution on its surface is squeezed into intimate chemically reactive contact with the surface of the sheet, strip or other article.

It will be appreciated that most sheets, strips or the like as they are received from the mill usually have a light coating of oil thereon which may persist to a greater or lesser extent even though the sheet or strip is passed through a cleaning solution before passing into the coating apparatus here shown. It has been found that the action of the first few sets of rolls 32, in combination with the chemical solution, serves to quickly remove this oil coating so that the chemical solution may thereafter more quickly and positively attack the surface of the sheet, strip or other article being treated.

It should be understood however, that this apparatus should not be depended upon as a cleaning apparatus. The metal should come to this apparatus as clean as is reasonably practicable and the action of the rollers then aids somewhat in minimizing the bad effects of the foreign matter inevitably remaining on the metal surface. The main function of the apparatus is to force the chemical solution promptly into chemically reactive contact with all portions of the surface to be coated.

Apparatus such as shown has been employed successfully to produce a phosphate paint-bonding coat on steel stock, such as is usually employed for making tin cans, in a coating time of as little as 10 seconds by use of a coating solution of approximately the following composition.

Free acidity	1.3
Total acidity	15.
ClO ₃	per cent. 2.0
Zn	do. 0.4
NO ₃	do. 0.4
PO ₄	do. 0.5
Cu	do. 0.0007
pH	2.6

The values for free and total acidity refer to the number of cc. of N/10 sodium hydroxide required to titrate a 10 cc. sample of the solution when methyl orange and phenolphthalein are used, respectively, as indicators.

It will be understood that, after the coating has been produced, provision may be made for first removing the coating solution and then acid-rinsing or otherwise treating the chemical coating in known or desired ways. It will be understood further that while the use of the apparatus with a particular phosphate coating solution has been described, any other suitable phosphate coating solution may be employed, and that the apparatus is useful for applying to the surface of sheet metal any chemical coating solution which needs to be brought into intimate, chemically reactive contact with the metal surface in order to produce the desired coating promptly and evenly.

Where a coating is produced in as short a time as a few seconds, any delay in the starting of the chemical reaction on any portion of the surface results in a thinner coating on that portion, and the delay may easily extend to all or such a large part of the few seconds that no appreciable coating is formed on such portions. Accordingly, the action of the rolls in bringing the solution promptly into chemically reactive contact with the entire surface to be coated not only reduces the time within which a coating of the desired thickness can be formed, but also increases the uniformity of the coating and greatly reduces the likelihood of there being any bare spots remaining on the surface after treatment.

What I claim is:

1. Chemical coating apparatus comprising, in combination, a tank structure, a multiplicity of pairs of rolls arranged in closely associated relationship with respect to each other over the major portion the length of said tank and with the rolls of each pair extending transversely of said tank structure and adapted to pass a sheet or strip of metal therebetween, each of said rolls having a smooth unbroken surface of readily yieldable character, means for rotating said rolls, header means extending along the sides of said tank adjacent the upper edge thereof, branches extending from said header means to above and below the path of movement of said sheets or strips between said rolls and having means for discharging a solution therethrough, and pumping means having the suction side thereof connected with the bottom of said tank structure and the discharge side thereof connected with said headers.

2. Chemical coating apparatus comprising, in combination, a tank structure, a multiplicity of pairs of rolls arranged in closely associated relationship with respect to each other over the major portion of the length of said tank and with the rolls of each pair extending transversely of said tank structure and adapted to pass a sheet

or strip of metal therebetween, each of said rolls having a smooth unbroken surface of readily yieldable character, means for rotating said rolls, header means extending along the sides of said tank adjacent the upper edge thereof, branches extending from said header means to above and below the path of movement of said sheets or strips between said rolls and having means for discharging a solution therethrough, pumping means having the suction side thereof connected with the bottom of said tank structure and the discharge side thereof connected with said headers, and means in the connection between said pump and header for varying the proportional flow to said headers.

3. Phosphate coating apparatus comprising, in combination, a tank structure having a central portion forming a reservoir and oppositely extending end portions, a multiplicity of pairs of resilient rolls arranged in closely adjacent relationship with the rolls of each pair extending transversely with respect to the length of said tank structure and the rolls of each pair resiliently urged toward one another, means for driving said rolls, a header arranged above each side of said tank structure, branches extending downwardly from one of said headers and then transversely of said tank structure between each adjacent pair of rolls and below the line of contact between the rolls of said adjacent pairs of rolls, downwardly extending branches from the other of said headers extending downwardly and then transversely of said tank between each adjacent pair of rolls and above the line of contact of the rolls of said adjacent pairs of rolls, said horizontally extending portions of said branches being provided with openings therein on that side thereof closest to a plane including the lines of contact between the rolls of adjacent pairs of rolls, a pump connected to said headers, and means connecting the inlet side of said pump with the bottom of said reservoir.

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