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METHOD AND MEANS FOR TREATING METALLIC SURFACES BEARING PROTECTIVE COATINGS

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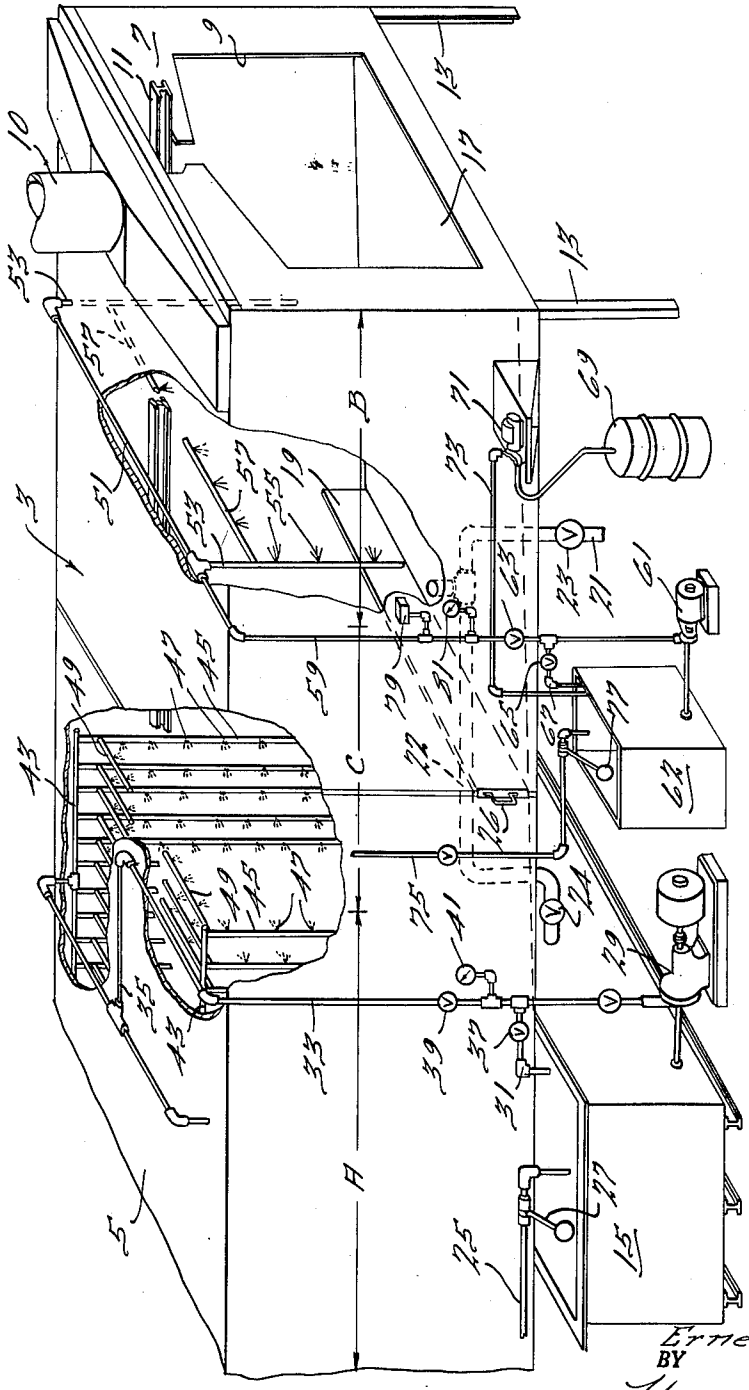


Fig. 1.

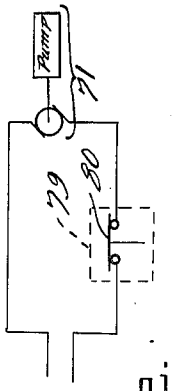


Fig. 2.

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METHOD AND MEANS FOR TREATING METALLIC SURFACES BEARING PROTECTIVE COATINGS

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This invention relates to a method and means for applying rinses in the protective coating art and more particularly to rinsing metallic surfaces bearing previously applied, chemically formed coatings.

Important objects of the invention are to provide improved apparatus having a two-zone final rinse for treating previously applied, chemically formed coatings on metal surfaces whereby to improve their corrosion-resistance and paint-receptive properties; to provide means to mist spray a first rinse solution on previously coated work in combination with means to mist spray a fresh second rinse solution; to provide means to return the drain from the second rinse solution to the first solution make-up tank or to drain as may be desired.

Other objects of the invention are to provide a method of treating previously applied, chemically formed coatings on metal surfaces to enhance their chemical properties and to provide a method which comprises a two-stage treatment of mist spraying, wherein the second stage employs fresh second rinse solution and to provide a method which is particularly applicable to the rinsing of phosphate coatings to greatly increase their ability to withstand deterioration from corrosive conditions and to improve their receptivity to subsequently applied siccative coatings.

The above and other objects will become apparent during the course of the following description taken in conjunction with the accompanying drawing wherein a preferred embodiment of the invention is clearly shown.

In the drawing:

FIGURE 1 is a perspective view of a two-zone apparatus embodying the present invention. The figure shows only the final rinse apparatus of a continuous production line through which previously coated work passes near the end of its treatment cycle; and

FIG. 2 is a schematic diagram of the electrical means controlling the concentrate feed pump for the second zone.

It is known that acidic rinse solutions applied to chemically formed coatings on metal surfaces, particularly phosphate coated metal surfaces, improve corrosion resistance and receptivity for siccative coatings. In accordance with this invention it has been found that if the rinse is applied in a two-stage process, wherein the first stage is the conventional present day rinse and the second stage employs a fresh second rinse solution mist-sprayed onto the coated work, greater benefits inure to the coatings than has heretofore been possible with conventional techniques of immersion or single spray rinse stages. Generally the method of this invention is applicable to the treatment of any of the known chemically formed coatings such as phosphate, oxalate, sulphide, and oxide coatings and may satisfactorily employ conventional rinse solutions. It is important, however, that the second rinse solution be freshly prepared and that the surface be contacted finally only with such fresh and uncontaminated rinse solutions. The preferred procedure for applying the second rinse is to mist spray the rinse solution on the coated work surface separately from and subsequently to the contacting of the work with the first rinse solution. The second rinse solution need not be, and in the usual case is not, the same as the first rinse solution. For

example, as the first rinse solution, a dilute aqueous solution of phosphoric acid, chromic acid or oxalic acid or mixtures of these acids may be used while relatively pure tap or de-ionized water may be used for the second rinse solution. On the other hand, relatively pure tap or de-ionized water may be used in each stage of the process satisfactorily. Similarly, the dilute acidic solutions mentioned may be employed in each stage of the process providing that the second rinse, the acid solution, be one that has not previously contacted coated surfaces. Examples of typical rinse solutions that can be employed in the practice of this invention and their concentrations are set forth in U.S. Patents 2,067,214, 2,067,215 and 2,067,216 to Thompson et al.

Previously applied phosphate coatings treated with the above dilute acidic rinse solutions are especially benefited by the practice of the invention, and a feature thereof is the provision of a two-stage process of applying such acidic solutions to phosphate coated surfaces and wherein for the second rinse the acidic solution is constantly fresh and applied in a mist spray form. Another feature of the method of the invention is the application to previously applied phosphate coatings of the above acidic rinse solution in the first stage of the process, followed by treatment of the coated work with a freshly prepared de-ionized water rinse solution in mist spray form. While the greatest improvements have been observed from treatment of surfaces bearing phosphate coatings with a mist spray of dilute aqueous solution of the acids mentioned in the first stage of the process, followed by treatment of the surfaces with a second mist spray of the fresh solution of the same acids or de-ionized water, the invention is not so limited as has been indicated. In the practice of the invention no part of the drain solution from the first or the second rinse stage is allowed to admix with the fresh second rinse solution, while the drain solution collected from the first mist spray stage is preferably permitted to return to the source of the first rinse solution for recirculation. Likewise it is often desirable that the drain solution collected from the second mist spray be admixed with the first rinse solution but in other cases it is preferred to direct it separately to sump. The apparatus must be adapted to provide for these expediences and must be adapted to keep the second rinse constantly free of contamination from rinse solutions in previous contact with the coated surfaces.

The apparatus embodying the invention comprises an extended horizontal treating chamber, generally designated 3 divided into a first and second treating zone, the extent of each of which is shown generally by letters A and B respectively. Intermediate the first and second zones is a drain zone, the extent of which is designated generally by the letter C. In the embodiment shown the entering end 5 of the treating chamber 3 has an enlarged opening and is a continuation of prior apparatus (not shown) for coating of the metal surfaces before they enter the entering end 5. The exit end 7 of the treating chamber 3 is formed with an enlarged opening, as at 9, to allow passage of various size workpieces. An exhaust 10 is provided in the roof of the treating chamber for venting any gases from the process particularly when heated rinse solutions are employed. The rinsed work exiting from zone B can be transferred directly to a drying oven (not shown) or can be air-dried if desired. Conventional automatic handling equipment may be employed for transferring the work through the treating chamber only part of which is shown, viz., an overhead track 11 in the form of an I-beam. The track 11 is designed to slidably carry work hangers upon which the work is supported either in baskets or independently, depending upon the size of the work to be processed. The treating chamber 3 is conveniently supported off the floor

as by legs 13 to afford space for the relatively large make-up tanks required for supplying the two stages of the process, the first make-up tank 15 being shown as directly beneath the first zone A of the treating chamber. The floor, generally designated 17, of the treating chamber is sloped from the exit end 7 toward the entering end 5 so as to drain through an opening (not shown) disposed above the first make-up tank 15. Drainage of the run-off from the second stage of the process to the make-up tank 15 which would normally occur due to the slope of the floor 17 can be controlled and entirely prevented if desired by a baffle 19, disposed substantially centrally of the length of the treating chamber. The baffle 19 is constructed and arranged with respect to the floor and side walls of the treating chamber to form a liquid seal to prevent passage of rinse solution from zone B to zone A. A drain line 21 is provided in the floor of zone B and is suitably valved as at 23. A branch line 22 connected between the drain line 21 and the make-up tank 15 permits direct transfer of the drain solution from zone B to the first rinse solution when the valve 24 which controls the flow therethrough is open and the valve 23 is closed. The drain line 21 with the valve 23 open and valve 24 closed permits direction of the drain solution from zone B to sump when desired. The baffle 19 is adapted to be extended laterally from one side of the treating chamber and completely removed by handle 26 when desired and its opening plugged, in which case the valves 23 and 24 would be closed and the run-off from the zone B would be permitted to mix with the run-off from zone A and flow along the sloped bottom 17 to the first make-up tank 15. The first rinse solution to be used in the first stage of the process is supplied to the make-up tank 15 by way of the inlet line 25, which is controlled by a constant level float valve of well-known construction, generally designated 27. A pump and motor unit, generally designated 29, is suitably piped to the make-up tank 15. The first rinse solution exiting from the pump and motor unit 29 can be recirculated back to the make-up tank through the branch line 31 or can be directed to the main line 33 which leads to the overhead piping 35 above zone A of the treating chamber. The positions of the valves 37 and 39 determined the extent of the recirculation and the amount of flow to the main line 33 and their relative openings are in turn indicated by a pressure gauge 41. The overhead piping 35 leads to a pair of horizontal headers 43 from each of which depend a series of spaced vertical pipes 45. Each series of vertical pipes is disposed close to one of the opposite side walls of the treating chamber 3 and a plurality of spray nozzles 47 is fitted in each individual vertical pipe. By the position of each vertical pipe 45, the spray nozzles 47 are directed toward the work which passes through the treating chamber. A horizontal pipe 49 is connected to each vertical pipe 45 and extends transversely of the treating chamber 3 slightly less than half the width thereof so as to provide space for the overhead rail 11. A number of spray nozzles fitted in each horizontal pipe 49 are adapted to eject rinse solution onto the work from above. Work carried by the rail 11 into the entering end 5 is subjected to thorough spraying by the arrangement described as it passes through the first zone A. The run-off from zone A is carried by the sloped bottom 17 back to the make-up tank 15 and such run-off is then recirculated through the first zone by the pump and motor unit 29.

The work that leaves zone A passes into zone C where a drain period is provided in the cycle before passing over the baffle 19 to allow the first rinse solution to more or less completely drain from the work. After passing through the zone C the work enters into the final mist spray zone B.

A piping arrangement similar to that in zone A is provided in zone B to establish a second mist spray stage in the process. In the instance shown an overhead pipe 51 leads to a pair of vertical pipes 53, each of which is provided with a plurality of nozzles 55 as described. To each vertical pipe 53 is connected a transversely disposed horizontal pipe 57 as previously described. While only a single pair of vertical pipes is shown and is usually sufficient to obtain the desired results, it will be apparent that a plurality of vertical and horizontal pipes can be employed if desired. The main line 59 for the spray equipment in zone B is connected to a pump and motor unit generally designated 61, which, in turn, is connected to the bottom of the second make-up tank 62 and the flow therethrough is controlled by the valve 63. When the valve 63 is closed, recirculation may be had by opening the valve 65 in the branch line 67 which leads back to the second make-up tank 62. Fresh rinse solution is always supplied to the second zone B, the source for which in the instance shown, is the drum 69. The concentrated rinse solution in the drum 69 is transferred to the second make-up tank 62 through piping 73 by a concentrate feed pump and motor unit generally designated 71, which is suitably mounted on the side of the treating chamber. Fresh water is also supplied to the make-up tank 62 for the zone B by the line 75. The flow of fresh water through the line 75 to the make-up tank 62 is controlled by the constant level float control valve 77. To prevent the pump and motor unit 71 from operating and thus transferring the concentrated rinse solution from the drum 69 into the make-up tank 62 when the supply pump and motor unit 61 is not operating, a pressure flow switch 79 is provided in the main line 59. The pressure switch 79 is electrically connected in series with the pump and motor unit 71 as shown in FIG. 2 so as to actuate a normally closed disconnect contact as at 80 when the pressure in the main line 59 falls below a predetermined minimum. A pressure gauge 81 is also provided in the main line 59 to indicate the amount of rinse solution being supplied to the spray nozzles 55. Preferably the spray nozzles 55 should be supplied with the fresh second rinse solution at a rate sufficient to establish a satisfactory mist spray in zone B. With typical operating conditions, approximately half-a-gallon per minute of rinse solution is supplied to the spray nozzle at 20 lb./sq. in. Work that passes through zone B is thoroughly soaked by the mist spray developed by the arrangement described. If desired, a second drain period can be established in the cycle of the travel of the work through the treating chamber 3 just before the same leaves the exit end 7 thereof to allow for drainage of the excess of the second fresh rinse solution before the work enters the drying ovens or the air-dry line. The run-off from the mist spray in zone B, including that drained from the work, can be directed to drain or to the first make-up tank 15 either by way of the sloped bottom 17 or by way of branch line 22 as deemed expedient in the particular application. It will be apparent that each of the make-up tanks 15 and 62 can be jacketed or otherwise provided with means for heating the first and second rinse solutions so that the rinsing in each stage of the process can be carried out at elevated temperatures if desired.

Preferably the first rinse solution comprises a dilute aqueous solution of chromic acid, phosphoric acid or oxalic acid or mixtures thereof and for this purpose any soluble compound which yields one of the acids can be dissolved in water. For example, a dilute chromic acid rinse can be formed from chromic acid itself, soluble salts of chromium acid or other soluble compounds containing chemically combined hexavalent chromium such as zinc dichromate. An entirely satisfactory acidic rinse solution can be prepared from a concentrate consisting of ⅓ chromic acid, ⅓ phosphoric acid and balance water. The optimum concentration of the first stage acidic rinse solution is determined by the type of phosphate coating being treated and can be easily selected from a few test runs. Satisfactory results generally have been observed from treatment with acidic first rinse solutions having a con-

centration of acid in the range between about two to twenty grams per gallon of water based on chromic acid.

While it is not completely understood why it is imperative that the second rinse solution be fresh, i.e., never have been in contact with coated surfaces, in order to obtain the characteristic increase in the quality of the previously applied phosphate coating, evidence indicates that in contacting the coated work, the first rinse solution removes the contaminants adhering to the surface of the work including some of the coating solution through which the work was previously processed and initiates the salutary reaction of the ingredients of the rinse solutions with the coating. In any event, it is known from comparative tests which have been performed that the beneficial effects imparted to the phosphate coating is far different and vastly superior if the second stage treatment is carried out with a fresh rinse applied in mist spray form in contrast to conventional techniques. In certain applications, it is desirable to use freshly prepared deionized water as the second rinse solution, as has been indicated, and the effectiveness of a final de-ionized water mist-spray treatment has been particularly observed in areas where the source of water for make-up of the coating solution is generally hard water or where the water contains high levels of contaminants such as chloride and sulphate. It is a feature of the process when employing deionized water as the second mist spray rinse to also employ deionized water as the make-up water for the acidic rinse solution used in the first stage of the process. In other applications it is desirable to use as the second rinse solution a fresh acidic rinse solution, the concentration of which generally can be within the range indicated for the first rinse solution and usually is a more dilute solution. Again the optimum of concentration must be selected for a given application by simple operating tests which take into account different factors such as the type of phosphate coating being treated, the time of passage through the second stage and the temperature of the rinse solution, etc.

Surfaces of work previously coated with zinc, manganese, iron, ammonium and alkali metal phosphate coating solutions were treated by the two-stage process described employing as the source for the second mist spray treatment either deionized water freshly prepared or the acidic solutions described. As the source for the first mist spray treatment the acidic solutions were also employed but admixed with the drain solution resulting from the first and second stages. On a comparative basis with identically coated surfaces treated according to conventional rinse processes, improvements were observed in the coatings on samples treated according to the present invention. Such samples withstood continual impingement from salt sprays for a greater length of time than samples processed specifically in a single stage mist spray employing the same acidic rinse solution as that employed in the first stage of the present invention. Paints, varnishes, enamels, lacquers and other siccative coatings applied over phosphate coatings that have been processed by the present invention showed less tendency for blistering after extended treatment in cabinets maintained at 100% relative humidity at 100° F. and after extended immersion in water maintained at 100° F.

It will thus be seen that there has been provided by the invention a method and apparatus in which the various objects hereinabove set forth, together with many thoroughly practical advantages, are successfully achieved. While preferred embodiments of the invention have been clearly shown, it should be understood that the same is susceptible to modification and variation without departing from the spirit thereof or the scope of the appended claims.

What is claimed is:

1. Rinse apparatus for treating coated surfaces comprising a horizontal treating chamber having side walls, a roof, a bottom, and entering and exit end walls, said bottom being sloped from the exit end wall to the entering end wall, openings in each of said end walls arranged to allow said surfaces to pass therethrough, a first and second zone in said chamber, first mist spray piping within said first zone, nozzles fitted into portions of said piping and arranged to direct mist spray at said surfaces passing through said first zone, a first make-up tank disposed below said chamber, a first inlet line connecting said first make-up tank and said first mist spray piping, transfer means in said first inlet line adapted to transfer first rinse solution from said first make-up tank to the nozzles in said first spray piping under pressure, a second mist spray piping in said second zone, nozzles fitted into portions of said second mist spray piping arranged to direct mist spray at said surfaces passing through said second zone, a second make-up tank disposed below said chamber, a second inlet line connecting said second make-up tank to said second mist spraying piping, transfer means in said second inlet line adapted to transfer second rinse solution from said second make-up tank to the nozzles in said second mist spray piping, a branch line connected to said second inlet line at a point on the outlet side of said transfer means and to said second make-up tank for recirculating said second rinse solution, a baffle disposed between said first and second zones and arranged to prevent flow of drain solution from said second zone to said first zone along said sloped bottom, said baffle being constructed and arranged to be withdrawn laterally from the interior of said chamber to permit flow of drain solution from said second zone to said first zone along said sloped bottom, and means to remove the drain solution from said second zone separately to sump and to said first make-up tank when said baffle is in position to prevent the flow of drain solution from said second zone to said first zone.

2. A method of continuously treating metallic surfaces bearing a chemically formed coating selected from the group consisting of phosphate, oxalate, sulfide and oxide which comprises the steps of subjecting a first group of said surfaces to a first mist spray of a first rinse solution consisting essentially of a dilute aqueous solution of at least one acid selected from the group consisting of chromic acid, phosphoric acid and oxalic acid, thereafter separately subjecting said first group of said surfaces to a mist spray of a fresh second rinse solution, admixing the drain solution from the said first mist spray treatment with said first rinse solution, and subsequently subjecting a second group of said surfaces to a first mist spray of the admixed first rinse solution and the drain solution resulting from the first mist spray treatment, and thereafter separately subjecting said second group of said surfaces to a second mist spray of a fresh second rinse solution, and collecting and discarding the drain solution resulting from said second mist spray treatment, said second rinse solution being selected from the group consisting of deionized water and a dilute solution in deionized water of at least one acid selected from the group consisting of chromic acid, phosphoric acid and oxalic acid.

3. A method in accordance with claim 2 wherein said fresh second rinse solution consists essentially of deionized water.

4. A method in accordance with claim 2 wherein said first rinse solution consists essentially of a dilute solution in deionized water of at least one acid selected from the group consisting of chromic acid, phosphoric acid and oxalic acid, and said second rinse solution consists essentially of deionized water.

5. Rinse apparatus for treating metallic surfaces bearing a chemically formed coating selected from the group consisting of phosphates, oxalates, sulfides and oxides which comprises a horizontal treating chamber having side walls, a bottom, and entering and exit end walls, said bottom being sloped downwardly from the exit end wall to the entering end wall, opening in each of said end walls

to allow said coated surfaces to pass therethrough, a first zone and a second zone in said chamber, first mist spray piping within said first zone, nozzles fitted into portions of said piping and arranged to direct mist spray at said coated surfaces passing through said first zone, a first makeup tank associated with said first zone, a first inlet line connecting said first makeup tank and said first mist spray piping, transfer means in said first inlet line adapted to transfer first rinse solution from said first makeup tank to the nozzles in said first spray piping under pressure, means connecting said sloping bottom and said first makeup tank adapted to return the drain solution from said first zone to said first makeup tank, second mist spray piping in said second zone, nozzles fitted into portions of said second mist spray piping arranged to direct mist spray at said surfaces passing through said second zone, a second makeup tank associated with said second zone, a second inlet line connecting said second makeup tank to said second mist spray piping, transfer means in said second inlet line adapted to transfer second rinse solution from said second makeup tank to the nozzles in said second mist spray piping, supply means for retaining concentrate for said second rinse solution and means to circulate said concentrate from said supply means to said second makeup tank comprising a transfer pump in said piping and motor means for driving the same, pressure switch means located in said second inlet line adapted to deactuate said motor means when the pressure in said second inlet line falls below a predetermined minimum pressure, a source

of fresh water and means to transfer said water from said source to said second makeup tank, said water transfer means being controlled by a constant level float control valve positioned in said second makeup tank.

6. An apparatus in accordance with claim 5 including a baffle disposed between said first and second zones and arranged to prevent flow of drain solution from said second zone to said first zone along said sloped bottom, said baffle being constructed and arranged to be withdrawn laterally from the interior of said chamber to permit flow of drain solution from said second zone to said first zone along said sloped bottom, and means to remove the drain solution from said second zone separately to sump and to said first makeup tank when said baffle is in position to prevent the flow of drain solution from said second zone to said first zone.

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