United States Patent

Maxwell et al.

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[54] METHOD OF GALVANIZING

[72] Inventors: **Herris M. Maxwell; John E. Sowers,** both of Bethlehem; **John Neil Laidman,** Coopersburg, all of Pa.

[73] Assignee: **Bethlehem Steel Corporation**

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[52] U.S. Cl. ..... **117/51,** 117/52, 117/102, 117/114 A, 117/131, 118/57, 118/503

[51] Int. Cl. **B44d 1/092,** C23c 1/02

[58] Field of Search ..... 117/51, 101, 102 M, 131, 52, 117/114 A, 114; 118/503, 57

[56] **References Cited**

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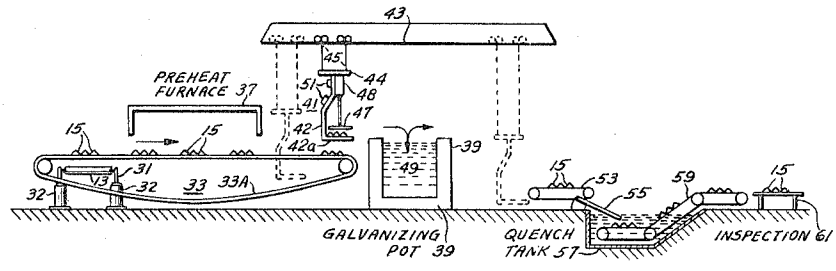
Second International Conference on Hot Dip Galvanizing, Oxford, Zinc Development Ass., 1953, p. 163 TS660I5, 1952.

Primary Examiner—Ralph S. Kendall
Assistant Examiner—Janyce A. Bell
Attorney—Joseph J. O'Keefe

[57] **ABSTRACT**

Elongated structural steel members are conveyed in a continuous operation longitudinally through a spray washer, a shot blast cabinet, an acid spray, an acid blowoff, a chloride flux spray and finally a flux blowoff to remove excess flux. The members are then passed through a preheat furnace to dry the flux and preheat the members and are then dipped into a molten zinc bath and removed therefrom supported upon C-hooks which are designed to be vibrated to remove excess molten zinc from the coated material. The structural materials are then passed to a reflow and quench device which rotates the structural members by dropping them off the end of a conveyor onto inclined skid means upon which the angles remain for a predetermined time as they slide down the skid means prior to immersion in a quench tank of water held at 160° F. to set the coating without shattering.

5 Claims, 3 Drawing Figures



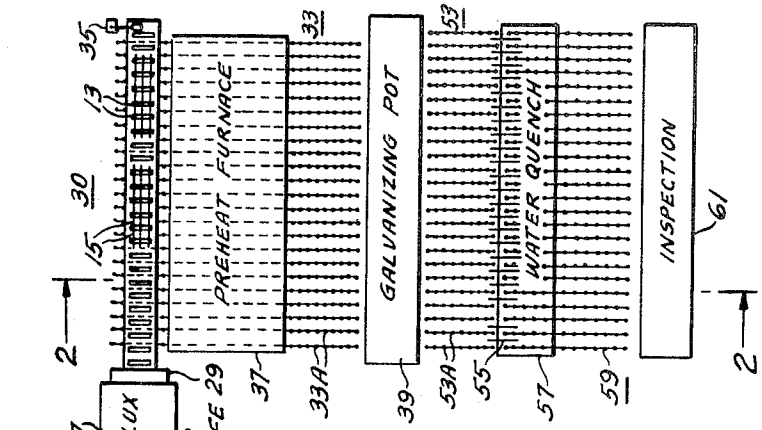


FIG. 1

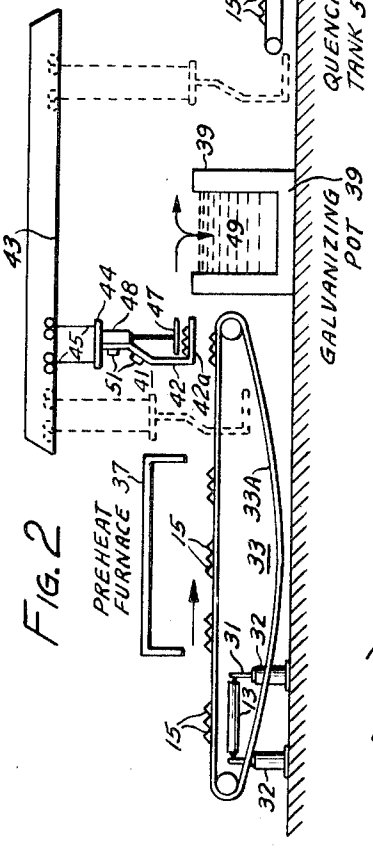


FIG. 2

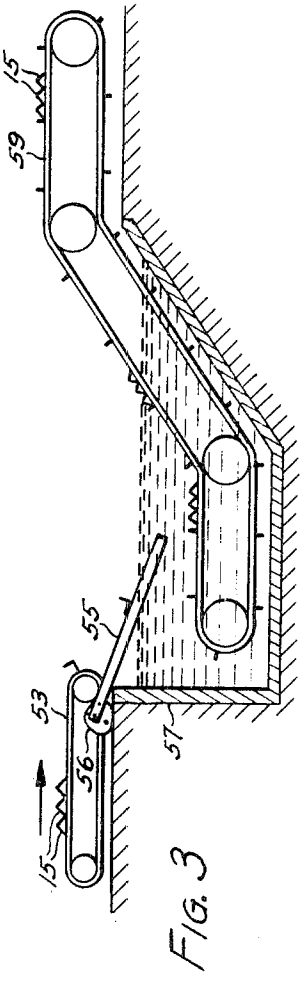


FIG. 3

INVENTORS
Herris M. Maxwell
John E. Sowers
John Neil Laidman

METHOD OF GALVANIZING

BACKGROUND OF THE INVENTION

This invention relates to the galvanizing of long structural parts in a continuous process.

It has been the general practice in galvanizing of elongated structural members to assemble the pieces manually into groups and pass them through the steps of cleaning and fluxing by manually handling batches of the products on cranes which dip the batches in successive vats of alkali; cleaning water, acid, cleaning water, flux and ultimately into the molten metal of a flux coated galvanizing pot after which the parts were manually removed from the galvanizing pot and quenched in a quench tank one at a time with manual manipulation. Not only was this former series of operations expensive and time consuming but the resultant product did not attain a uniform coated surface.

SUMMARY OF THE INVENTION

We have discovered that structural members can be efficiently and inexpensively coated with a superior galvanized coating having excellent uniformity by passing the members along powered roller conveyors through successive operations of washing, drying, shot blasting, acid spraying, immediate flux spraying without intermediate washing and then passing the members into a galvanizing pot without a flux cover, vibrating the members as or after they are removed from the galvanizing pot to remove excess coating and then after partial cooling rotating and holding the members a predetermined time prior to immersion in a quench tank of heated water to set the coating.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the layout of the apparatus of the present invention.

FIG. 2 is a diagrammatic elevational representation along the line 2—2 of FIG. 1.

FIG. 3 is an enlarged elevational view of the reflow and quench arrangement of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A roller conveyor 11 preferably with spaced powered rollers 13 and an initial loading section 14 conveys structural members such as channels, I-beams, or the like, and particularly angles 15 as illustrated, either consecutively or arranged side by side if the members are of small cross-sectional area, initially through an alkaline spray wash cabinet 17 in which jets of alkaline washing solution are impinged upon the angles 15 to degrease the angles. The angles 15 are then spray water rinsed at spray 18 and conveyed on the conveyor rollers 13 to a dryer cabinet 19 where they are dried and subsequently conveyed into a shot blast apparatus 21 in which scale and any other deleterious material is removed down to bright metal. An airblast 23 is preferably positioned subsequent to the shot blast cabinet to blow away any remaining powdered scale or metal particles. Alternatively wash water can be substituted for the airblast 23. The angles 15 are then conveyed in a continuous operation along rollers 13 to an acid cabinet 25 where a spray of hydrochloric acid is impinged upon all portions of the angles 15. Preferably excess acid is then blown from the surfaces of the angles while still in the spray cabinet and the angles are immediately passed without intermediate washing to a flux spray apparatus 27 where a coating of suitable flux for galvanizing such as a zinc ammonium chloride flux is sprayed onto the angles from all directions to thoroughly coat all portions of the angles. The angles 15 are then passed through an airblast or air knife apparatus 29 in one end of the flux spray 27 which blows off excess flux and smooths the remaining flux to provide a smooth uniform coating of flux upon the surface of the angles.

The roller conveyor 11 conveys the angles 15 after they leave air knife apparatus 29 onto a conveyor transfer section 30 in which the rolls 13 of the conveyor are journaled in a vertically adjustable frame 31 mounted upon pneumatic cylinders 32 which serve to lower the rolls 13 on frame 31 down between the individual chains or belts 33A of a conveyor 33. When angles 15 reach the end of the adjustable frame 31 they trip a limit switch 35 which causes cylinders 32 to retract adjustable frame 31 so that the angles rest on the individual chains or belts 33A of conveyor 33 rather than the rollers 13 of roller conveyor 11 allowing the angles 15 to be removed laterally by conveyor 33. The conveyor 33 then conveys the angles 15 laterally through an air preheating furnace 37 where the angles are heated to a temperature of approximately 300° to 400° F., and preferably 350 to 440° F. prior to their immersion in a galvanizing pot 39. Furnace 37 both preheats the angles and thoroughly dries the flux layer applied by flux spray apparatus 27 prior to the entrance of the angles 15 into said galvanizing pot 39.

As conveyor 33 carries the angles 15 out of preheating furnace 37 an automatic C-hook arrangement 41 independently movable along crane tracks 43 and equipped with cable means 45 for raising and lowering the C-hooks is extended behind the collection of angles on the conveyor as shown in dotted outline in FIG. 2 and then raised by cable means 45 to lift the angles 15 from the conveyor 33 and deposit them in galvanizing pot 39. C-hook arrangement 41 may comprise a series of C-hooks 42 constructed of angle stock and mounted at about 20-inch intervals upon a frame 44 in such a position that the C-hooks 42 will extend between the individual chains 33A of conveyor 33 to lift angles 15 from the conveyor.

Prior to immersion of the angles into the pot 39 a holddown frame 47 is lowered onto the angles by the action of pneumatic cylinder 48 to clamp the angles against the lower jaws 42A of C-hooks 42 and counteract any tendency of the angles to float off the C-hooks in the high specific gravity molten zinc metal 49 in galvanizing pot 39. Alternatively magnetic means may be secured to the lower jaws 42A of the C-hooks 42 to hold the structural members on the hooks as they enter the molten bath 49.

As the C-hook system lowers the angles into the molten bath preferably one end of the C-hook frame 44 is lowered more quickly toward the molten metal so that the ends of the angles supported on the C-hooks 42 on this end of the C-hook frame 44 enter the molten zinc bath approximately twenty seconds before the opposite ends of the angles. The material to be coated thus enters the molten metal at an oblique angle to permit any entrapped air to escape. After angles 15 remain in the pot for a short immersion period of about 2 minutes at the oblique angle the C-hook frame 44 is automatically leveled and the holddown frame 47 is raised, after which cable means 45 is operated to raise the angles from the molten metal. If desired the C-hook system can be programmed so that the end of the C-hook frame which was lowered first is raised first in order that both ends of the angles will have the same dwell time of approximately 2 minutes in the molten zinc bath.

The molten zinc bath 49 is preferably held at a temperature between 820° and 860° F. and will have an aluminum content of approximately 0.005 to 0.01 percent by weight. The aluminum content favors the formation of a thin iron-zinc alloy layer under the zinc outer coating of the angles 15 and prevents oxidation of the zinc bath surface. Since all the necessary flux for proper coating is dried upon the angles themselves and the aluminum in the bath prevents oxidation of the bath surface, there does not need to be any flux blanket floating upon the surface of the molten metal. Undesirable fuming and air pollution from the flux on the bath is thus eliminated.

As the C-hooks are raised from the molten bath 49 air operated vibrators 51 attached to the C-hooks 42 or to frame 44 are automatically programmed to shake the C-hooks and the angles supported thereon to remove excess zinc from the angles. The C-hooks then move laterally along crane tracks 43 and cable means 45 lowers the angles upon a chain conveyor

53. AS seen in FIG. 1 the conveyors 33 and 53 both comprise a plurality of belts or chains 33A and 53A which move in unison and between which the C-hooks 42 are lowered to pick up or deposit the angles 15.

Conveyor 53 moves the angles laterally until they tumble from the end of the conveyor onto skid means 55 disposed at an angle below the end of conveyor 53 and extending below the water surface in a quench tank 57. The vertical distance from the end of the conveyor to the surface of skid means 55 immediately below the conveyor is arranged to be just sufficient so that each angle rotates approximately one half turn as it falls from the end of the conveyor onto the skid means 55 and the angle of the skid means is arranged together with the height of the water in the quench tank 57 so that just sufficient time will be consumed by the angles in sliding down skid means 55 so that the still partially molten zinc on the surface flows back under the influence of gravity to exactly counteract the effect of gravity upon the molten coated surface of the angles after they have been removed from the molten zinc bath. The still molten or excess molten zinc is thus reflowed back onto the surfaces of the galvanized angles instead of collecting in beads or sharp serrated edge deposits along the extreme edge of the angles. The angle of the skid means 55 is such that when the reflow of the coating is complete, that is to say when the prior effect of gravity is completely counteracted by reflowing the coating under the influence of gravity in the opposite direction with respect to the angle, the angle will enter the quench bath where the coating is immediately hardened and set. It will be understood that the rate of travel of the angles along the inclined skids 55 is determined according to the normal laws of physics by the inclination and coefficient of friction of the upper supporting surfaces of the skids and the weight and surface condition of the angles sliding therealong. A movable cam arrangement 56 may be provided to adjust the angle of skid means 55 to the most desirable inclination for any particular product. The slope of the skid means 55 also prevents a so-called shattered coating from forming. This is a coating with a frosty or porous appearance. It will be noted in FIG. 3 that no matter in what position the angles 15 lie on skid means 55 no surface of the angles will enter the quench bath parallel to the surface of the bath. In other words, no substantially flat surface of angles 15 will forcibly strike the surface of the quench bath and cause a shattered coating. We have discovered in addition to this that if the temperature of the quench water is maintained at approximately 140° to 200° F. and preferably approximately 160° F. the incidence of shatter type coatings can be decreased to substantially zero and very smooth uniform coatings attained. It will be noted from a consideration of the angle of skid means 55 in FIG. 3 that not only angles but channels and beams, and in fact any structural member of generally rectangular cross section, will enter the surface of the quench bath with all the said member's external surfaces at an oblique angle with respect to the surface of the quench liquid. To obtain a minimum incidence of shatter type coatings the angle of the skid means 55 should be reduced to the minimum consistent with the attainment of correct reflowing of the coating in order to slow down the rate of entry of the structural members into the quench bath. In order to maintain this slow speed of entrance into the quench the skid means 55 should extend under the surface of the quench liquid. It has also been found beneficial to add a water softener to the quench water.

Shattered-type coating surfaces have a much rougher surface than normal and show in profilometer tests about twice as many peaks per inch as are found in a comparable smooth coating. There is also a tendency in shattered coatings for voids and cracks to extend through the outside coating into the iron-zinc alloy layer. There is a tendency therefor for shattered coatings to show earlier staining and first rusting than smooth coatings although because the coating weight of the sacrificial zinc coatings is the same in both cases the actual corrosion life of both types of coating is the same. The earlier staining and rough surface of the shattered coatings are aesthetically objectionable in many application, however. In order to obtain minimum shattered coatings it is essential according to our invention to enter the coated members into a quench bath held at approximately 140° to 200° F., and preferably at 160° F., with all coated surfaces at an oblique angle to the surface of the bath.

After the angles 15 enter the quench tank 57 they fall to the bottom of the tank and are picked up by a conveyor 59 which carries them out of the quench tank and deposits them on an inspection table 61 for inspection prior to collection for packaging and shipping.

The coating process of the present invention provides a superior adhesive, smooth, uniform coating on structural members. The coating process is both faster and provides more reproducible results that were available in prior structural member coating operations.

We claim:

1. A method of galvanizing elongated structural sections having angular transverse cross sectional configurations comprising:
   a. degreasing said sections by passing them longitudinally through an alkaline spray,
   b. shot blasting said sections,
   c. spraying acid over said sections by passing them longitudinally through acid sprays,
   d. spraying a chloride flux solution on said sections by passing them longitudinally through flux sprays,
   e. preheating said sections to between 300° to 400° F.,
   f. clamping said sections in a support means,
   g. submerging said support means and said sections in a molten zinc bath held at 820° to 860° F.,
   h. withdrawing said support means and sections from said molten bath while vibrating said support means to remove excess molten zinc,
   i. reflowing the molten zinc on said sections before said coating solidifies by partial rotation of said sections relative to the prevailing gravitational field by:
      1. conveying said sections transversely at least a short distance along a first substantially horizontally disposed support means, and longitudinal
      2. causing said angular elongated sections to topple transversely from said first support means onto a second lower supporting means positioned below said first support means a distance sufficient to allow approximately one half of a full rotation of said sections about their longitudingal axes as they move under the influence of said prevailing gravitational field from said first support means to said second support means to initiate reflow of said zinc coating, and
   j. supporting said sections in their substantially half rotated position until the still at least partially molten zinc on the surface of said sections reflows under the influence of the prevailing gravitational field back to substantially its original evenly distributed condition and then immediately quenching said sections in a water bath held at 140° to 200° F.

2. A method of galvanizing elongated sections according to claim 1 wherein step (i) is effected by dropping said sections from the end of a conveyor constituting said first support means of step (i) substep (1) onto an upper portion of inclined skid means having upper supporting surfaces constituting said second lower supporting means of step (i) substep (2) and wherein step (k) is effected by causing said sections to move downwardly on said skid means to the surface of the quench bath at a rate of travel calculated to provide sufficient time prior to quenching of said sections by entrance into said water bath to allow the still at least partially molten zinc on the surface of said sections to reflow under the influence of the prevailing gravitational field back to substantially its original evenly distributed condition, said rate of travel of said sections being determined by the inclination and coefficient of friction of the upper supporting surfaces of said skid means with relation to the weight and surface condition of said sections and

said time being determined by the length of said skid means between the contact point of said sections with said skid means and the surface of the quench bath and the said rate of travel of said sections.

3. A method of galvanizing elongated structural sections according to claim 2 wherein said sections are continuously conveyed through said coating line up to said galvanizing pot on conveyor means.

4. A method of reflowing and quenching molten metal coated elongated structural sections having angular transverse cross sections comprising:

a. conveying said sections from a molten metal coating bath to a point adjacent to a water quench bath maintained at 14° to 200° F. While the coating is still molten,

b. rotating said sections about their longitudinal axes relative to the prevailing gravitational field approximately a half rotation by toppling said sections over the edge of a support means onto skid means having an upper supporting surface positioned a predetermined distance below said support means which distance will allow approximately a half rotation of said sections while in a freefall condition between said support means and said upper supporting surface of said skid means, said upper supporting surface of said skid means having an inclination such that no substantial surfaces of the angular sections resting upon said upper supporting surface of said skid means are parallel to the surface of said quench bath, and a length such that the still at least partially molten zinc coating on the surface of sections sliding therealong at a rate of travel determined by the inclination and coefficient of friction of the upper supporting surfaces of said skid means with relation to the weight and surface condition of said sections will be substantially completely but not more than completely reflowed under the influence of the prevailing gravitational field back to substantially its original evenly distributed condition as the sections reach the portion of the skid means immediately adjacent the surface of the quench bath, and

c. allowing the said angular sections to enter the said quench bath upon attainment of said still at least partially molten coating of its said substantially original evenly distributed condition upon the surface of said angular sections.

5. A method of reflowing and quenching molten metal coated articles according to claim 4 wherein said sections are initially deposited upon a conveyor and are dropped from the end of the conveyor to the inclined skid.

* * * * *

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(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,639,142 Dated February 1, 1972

Inventor(s) Harris M. Maxwell, John E. Sowers and John Neil Laidmar

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 13, "440° F." should read --400° F.--

Column 3, line 1, "AS" should be --As-- (Capital "A" and small "s")

Column 3, line 74, "earlier" should read --early--

Column 4, line 16, "that" should read --than--

Column 4, claim 1, subparagraph (i)1, line 3, delete "longitudinal"

Column 5, claim 4, line 6, "14°" should read --140°--.

Signed and sealed this 31st day of October 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents