

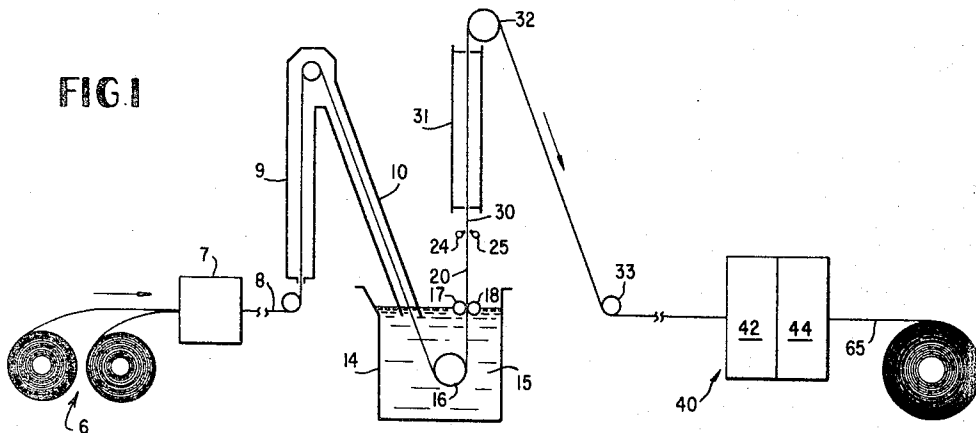
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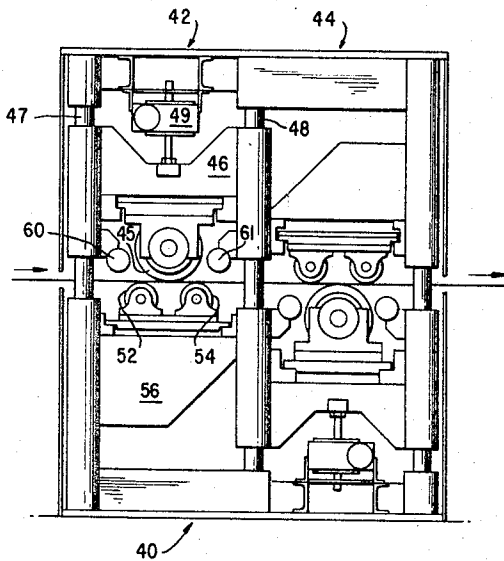
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GALVANIZED FLAT ROLLED PRODUCT AND ITS MANUFACTURE

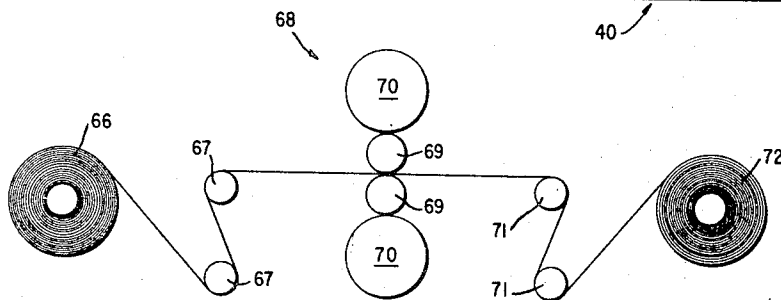
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**FIG. 2**



**FIG. 3**



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1

3,148,081

## GALVANIZED FLAT ROLLED PRODUCT AND ITS MANUFACTURE

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The invention is concerned with improvement of galvanized products and novel galvanized flat rolled products and their manufacture.

Galvanize coatings are widely used to prevent corrosion of metal products especially in the steel industry. These coatings ordinarily have a large crystalline structure presenting a frost-flower or spangled surface. There are many apt uses for galvanized product where the spangled surface is not desirable. The long association of the spangled surface with trash cans, and the like, make it unsuitable for decorative purposes. It is also difficult to coat with paint or plastics; neither will spread readily without pretreatment of the coating. And, in spite of a uniform coating thickness, large spangles present an uneven surface at the crystal boundaries which is highlighted by paint or plastic. One object of the invention is to provide galvanized flat-rolled metal free of the above disadvantages.

Prior art attempts to improve the appearance and paintability of galvanized surfaces have been numerous but not highly satisfactory. Often the results are only temporary and no process is known of which will produce galvanized flat rolled product suitable for decorative uses as delivered from a galvanizing line without further treatment such as bonderizing and painting. The invention teaches methods for the production of novel galvanized products possessing permanent, smooth, spangle-free appearing finishes which are highly suitable for decorative purposes as delivered from the galvanizing line and have good paintability if paint, plastic or similar additional coating is desired.

The invention also eliminates entirely the need for skin rolling many flat-rolled galvanized products and eliminates many operational problems when skin rolling is practiced as a part of the invention or temper rolling is employed for other purposes. One of the operational problems eliminated is fouling of the skin rolls due to pickup of coating from the galvanized product. This fouling of the skin rolls causes uneven marking and marring of the galvanized product, resulting in wasted product and damage to the skin rolls.

In further description of the invention reference will be had to the accompanying drawings wherein:

FIGURE 1 is a schematic diagram of a continuous strip hot-dip galvanizing line embodying the invention;

FIGURE 2 is a detailed view of a portion of the apparatus shown schematically in FIGURE 1; and

FIGURE 3 is a schematic diagram of a temper mill.

Referring in particular to FIGURE 1, flat rolled steel product from supply 6 is fed through welder 7 to form continuous strip 8. After conventional cleaning strip 8 is heated in furnace 9 and led through atmosphere protective chute 10 into coating pot 14. The strip passes through molten galvanizing bath 15 around sinker roll 16 and exits through coating control rolls 17 and 18 located at the surface of bath 15. Without further treatment conventional galvanized hot-rolled product as described in "The Making, Shaping and Treating of Steel," seventh edition, 1957, pages 660-666, would be produced by the apparatus just described.

Conventional galvanized flat-rolled steel product has a relatively rough surface due both to the large crystalline structure of solidified galvanize coating and to surface imperfections in the steel itself caused by earlier hot and

2

cold rolling. The distinctiveness of the surface produced in accordance with the invention results from combining steps to eliminate surface roughness stemming from both the galvanized coating and the steel base metal.

Coated product 20 emerges from the galvanizing bath 15 with a coating which ordinarily remain molten for a considerable distance during its travel above the bath 15. While the coating is still substantially completely molten and before a crystallization pattern has started to appear, wet steam is blown onto the coated product 20 to cause rapid freezing of the coating which stops any alloying of the spelter coating with the base metal. The spangle formation is thus minimized without changing the chemical composition from the conventional galvanized. The distance traveled by product 20 between exit from the coating rolls and contact of wet steam from supply pipes 24 and 25 will vary dependent upon bath temperature, ambient temperature, strip thickness, and coating weight, among other things. Ordinarily, with most "Commercial Coating" product (about 0.8 to 1.25 ounces per square foot of galvanizing spelted having impurity level percentages of lead, iron and cadmium, aluminum additions, and the balance zinc. See "The Making, Shaping and Treating of Steel," supra), steam pipes 24 and 25 should be supported to permit adjustment at approximately eight feet above the galvanizing bath 15. Steam pipes 24 and 25 are provided with jets which extend, in close proximity to each other, along the entire longitudinal length of the steam pipes 24 and 25 to insure surface contact across the entire width of coated product 20. Steam is provided at the proper temperature, pressure, and "wetness" from a suitably controlled supply (not shown).

Rapid freezing of the galvanize coating on coated product 20 produces a minimized spangle product 30 having a dull, non-crystalline appearance rather than the conventional bright-crystal, large spangled appearance of conventional galvanized product. Other methods for minimizing spangle formation are known in the art and it is understood that the invention is not to be limited to blowing wet steam. Minimizing spangle formation plays an important role in developing the smooth finish produced in accordance with the invention, first by eliminating part of the roughness inherent in conventional galvanized coating and second by lending permanence to the finish. The latter is believed to be traceable to a minimizing spangle operation which penetrates the coating and is not limited to outer surface action only.

It is emphasized that further treatment is necessary because minimized spangle, though more smooth than conventional galvanized, is relatively rough when compared to other metal coatings. Also most of the hot and cold rolling surface imperfections of the steel itself show through minimized spangle. An additional step which smooths the minimized spangle surface and acts to eliminate or cover the surface imperfections of the steel is practiced in combination with minimizing spangle formation. As shown in FIGURE 1, the minimized spangle product 30 travels upwardly through cooling tower 31, returns around guide rolls 32 and 33, and is introduced to planishing mill 40 before coiling.

Referring in particular to FIGURE 2, planishing mill 40 includes independent units 42 and 44 for treating the top and bottom surfaces, respectively, of the minimized spangle product 30. Unit 42, for example, includes planishing roll 45 mounted on movable support 46. Support 46 is mounted for vertical movement on guides 47 and 48. Movement of support 46 is activated by motor 49 and the contact pressure of roll 45 is, in part, determined by such movement.

Backup for planishing roll 45 is provided by rolls 52 and 54 located to bracket the brush 45. Backup roll support 56 is mounted for vertical movement on guide

57. With light gage strip, a single backup roll with its axis in the same vertical plane as the axis of planishing roll 45 may be used in place of backup rolls 52 and 54.

Vacuum lines 60 and 61 are provided for removal of grit and/or galvanized particles from the surface of the product being planished. Unit 44 has apparatus identical to that of unit 42 but positioned to operate on the opposite side of the product from unit 42. The number of units such as 42 and 44 utilized on each side of the strip may be varied to suit the product and operating conditions.

Planishing mill 40 cleans and polishes the surface of product 30. The planishing rolls 45 are ordinarily made of metallic bristles which are completely embedded in hard plastic which prevents "give" of the bristles during contact with the product. The coarseness of metallic bristles and pressure applied through support 46 and backup rolls 52, 54 determine the type of surface resulting from the planishing action. Either or both surfaces of the strip may be planished. The dull, relatively uneven surface of the minimized spangle product 30 is converted to a smooth, permanently spangle-free, silver-tone finish on product 65. The surface imperfections of the steel base metal can be removed entirely or they can be partially removed or smoothed over and further improved product produced by combination with an additional step to be described later. However, it is emphasized that, by minimizing spangle formation and planishing, finished product can be produced without significant loss of coating weight. It has been found that any loss of weight incurred in planishing is not measurable by the standard instruments used in the industry for determining coating weight of commercial galvanized flat rolled product.

Spangle free-product 65 possesses a polished surface suitable for most decorative purposes and suitable for painting as delivered from the planishing mill. Thus, in accordance with the invention smooth surface galvanized product possessing excellent paintability may be produced without skin rolling, bonderizing, or other similar treatment in a single continuous strip operation, without loss of line productivity and without the cost of the additional handling usually required.

While it is a primary objective of the invention to eliminate skin rolling as a necessary step to improve the appearance or paintability of galvanized product, in accordance with the invention, a temper mill can be used in combination with the previously described apparatus. A single stand temper mill is shown schematically in FIGURE 3. Galvanized strip from coil 66 passes around entry tension rolls 67 and is fed into stand 68 which includes work rolls 69 and backup rolls 70. The strip is rolled under tension and delivered via delivery tension rolls 71 to recoiler 72. A two stand temper mill could also suitably be employed.

Temper mills product a temper effect and a skin effect simultaneously although both are not necessarily desirable. The tempering effect inhibits deep drawing, bending, and seaming defects known as stretcher strains, kinking, fluting, etc. The slight amount of elongation or cold reduction taking place in the strip imparts an additional stiffness or "temper" to the material which is usually accompanied with an increase in the hardness and a decrease in the ductility of the strip.

The skin effect produces a change in appearance of the coated strip and a change in the surface characteristics of the strip. These changes are dependent, to a large extent, on the surface characteristics of the work rolls. Somewhat coarse "50 grit" workrolls will impart a rough-matte finish to a galvanize surface; less coarse "90 grit" work rolls will impart a matte-satin finish; polished work rolls will impart a near-glossy smooth finish. In addition to affecting the appearance of the coated strip, the work rolls affect the hardness of the surface of the strip. A coarse finish workroll can cause an increase in the Rockwell hardness number of the surface of two to three points per percent reduction while a smooth

workroll will cause an increase of only 1 to 1½ points in the Rockwell hardness number.

In temper mill rolling of conventional galvanized strip the operator will ordinarily attempt to strike a serviceable medium between desired tempering effect and desired skin effect. Galvanized strip is ordinarily never elongated more than one percent. With rough surfaced galvanized it is often impossible to impart the desired skin effect without changing the physical properties of the steel to such an extent that the strip is no longer suitable for the intended commercial application. By utilizing the teachings of the invention, rough surface galvanized can be prepared so that, with the additional skin effect from temper mill rolling, an acceptable surface can be obtained without destroying the desired physical properties of the steel. Also in many instances temper mill rolling can be carried out with less coarse work rolls which, in combination with the effects of minimizing spangle formation and planishing produce an acceptable surface with a minimum increase in the Rockwell hardness or change in other physical properties of the steel. Taking full advantage of minimizing spangle formation, planishing, and skin rolling with polished rolls, a high-luster, mirror-like finish can be imparted having the appearance of light-tone polished silver.

Many variations, modifications, and combinations of the steps and apparatus described will be possible in the light of this disclosure therefore it is to be understood that the invention can be practiced otherwise than as specifically described while remaining within the scope of the appended claims.

What is claimed is:

1. Continuous-strip process for improving conventional galvanize coated steel strip to produce a smooth-finish, spangle-free appearance as delivered from a single continuous-strip coating and treatment line comprising the steps of

passing steel strip through a molten hot-dip galvanizing bath,

controlling coating weight of molten galvanize coating on the steel strip upon exit of the steel strip from the galvanizing bath, then

minimizing spangle formation in the galvanize coating without changing the chemical composition of the coating by suddenly freezing the molten galvanize coating,

cooling the minimized-spangle galvanized steel strip, and then

planishing the minimized-spangle galvanized surface by contacting the minimized-spangle galvanized steel strip with driven planishing roll means to smooth surface imperfections and produce a permanent smooth-finish, spangle-free appearance.

2. Continuous-strip process for improving conventional galvanize coated steel strip to produce a smooth-finish, spangle-free appearance as delivered from a single continuous-strip coating and treatment line comprising the steps of

passing steel strip through a molten hot-dip galvanizing bath,

controlling coating weight of molten galvanize coating on the steel strip upon exit of the steel strip from the galvanizing bath, then

minimizing spangle formation in the galvanize coating without changing the chemical composition of the coating by blowing wet steam onto the molten galvanize coating before a crystallization pattern has started to appear to rapidly solidify the molten galvanize coating, and then

planishing the minimized-spangle galvanized iron-free surface by contacting the minimized-spangle galvanized steel strip with driven planishing roll means to smooth surface imperfections and produce a permanent, smooth-finish, spangle-free appearance.

3. Method for improving conventional galvanize coat-

5

ing steel strip to produce a smooth-finish, spangle-free appearance comprising the steps of

passing flat rolled steel product through a molten hot-dip galvanizing bath,

controlling coating weight of molten galvanize coating on the product upon exit from the galvanizing bath, then

minimizing spangle formation in the galvanize coating without changing the chemical composition of the coating by suddenly freezing the coating, then

planishing the minimized-spangle galvanized strip by contacting the minimized-spangle, iron-free, galvanized surface with driven planishing means to smooth surface imperfections and produce a permanent,

5

10

6

smooth-finish, spangle-free appearance, and skin rolling the product after planishing to develop desired temper in the flat rolled steel product and further smooth the galvanize coating finish.

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