June 6, 1939. J. H. HILL ET AL 2,160,864

PRODUCING GALVANIZED METAL SHEETS OR ARTICLES

Filed May 3, 1937

Fig. 1.

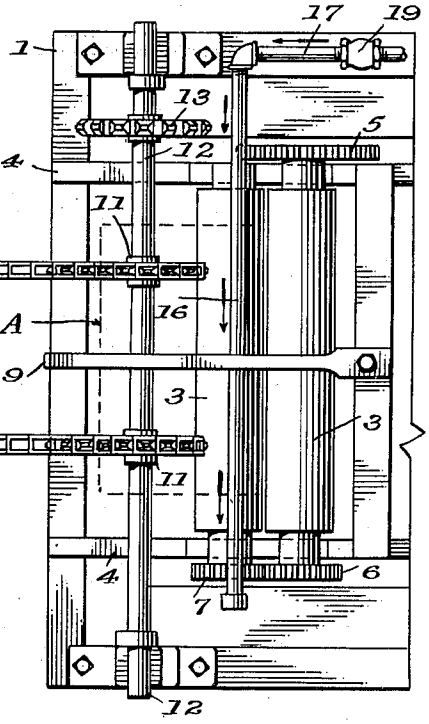


Fig. 3.

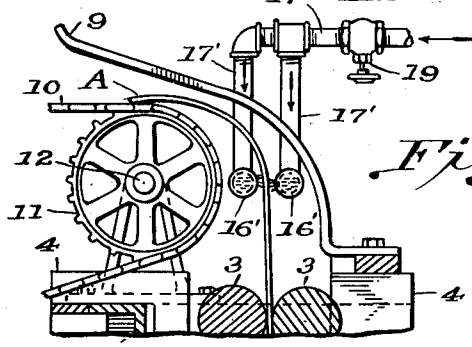


Fig. 2.

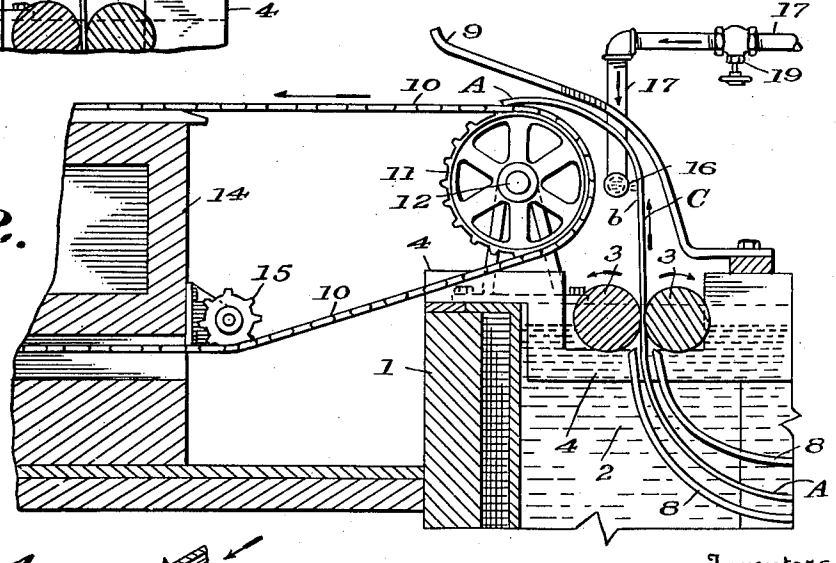
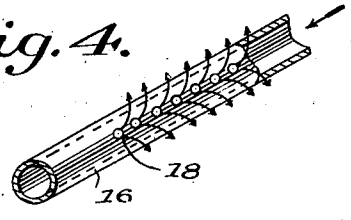


Fig. 4.



Inventors

James H. Hill

Harry W. Theiss

By La Porte & La Porte

Attorneys

Patented June 6, 1939 2,160,864

UNITED STATES PATENT OFFICE

2,160,864

PRODUCING GALVANIZED METAL SHEETS OR ARTICLES

James H. Hill and Harry W. Theiss, Louisville, Ohio, assignors to Continental Steel Corporation, Kokomo, Ind., a corporation of Indiana

Application May 3, 1937, Serial No. 140,434

6 Claims. (Cl. 91—70.2)

This invention relates to a new method of producing galvanized metal sheets or articles adapted to a variety of uses, but more especially intended for service conditions where a dull or matte-like finish is desirable on either one or both sides of the sheet or article.

In the use of galvanized sheets, and having particular reference to the common type of such sheets, the opposite faces of which have spangles of prominent or noticeable character, presenting a so-called frosty appearance or greasy-like smoothness, and where such faces are to be painted, enameled, or otherwise coated with a decorative application, it has been necessary that the face or faces of the sheet receive some additional or preliminary treatment, as etching, in order to insure proper adherence of the paint or the like to said greasy-like or smooth surface.

In overcoming the above-stated disadvantage, it has been found that any additional step of treatment is rendered unnecessary where the size of the spangles is minimized, bright, smooth areas eliminated, and the surface thereby given a uniform matte-like or so-called dull character and finish.

Different ways and means have been resorted to in efforts to produce the satisfactory dull finish, ready for painting without additional treatment, without at the same time impairing the homogeneous or adequately bonded coated sheet, such as subjecting the coated sheet before the same has become set or fixed, to flame treatment, to gradually cooling off under the influence of products of combustion, or through a leer or similar chambers of varying temperature, lengthwise of the same.

While measurable success has been attained in these former methods, the present invention, while simplifying such known methods, has been demonstrated to produce novel and improved results, characterized by the physical quality of the ultimate coated sheet, enabling subsequent formation or bending without cracking, loosening, or interfering with the closely bonded relationship of the coating and base metal, and by the substantially spangleless or matte-like or dull face or faces, as may be desired.

In previous methods where the aim has been to obtain a dull finish on the galvanized sheet, the possibility of obtaining relatively different finishes and appearances on the opposite faces of the coated sheet has not been sought, probably because of the difficulties of securing substantially varying setting treatment applied to the two faces of the like-coated sheet as it leaves the zinc bath. Customarily, the cooling of the coatings on the opposite faces of the sheet has been under equivalent conditions created by passing the coated sheet through treating chambers or zones of treatment, or past excessivey hot burner flames, under a temperature intended to have the same influence upon the entire coated sheet, including both faces alike, to correspondingly create uniform physical results and appearance throughout. So far as known, the prior art does not teach the possibility of variously finishing or setting coatings of identical material on the two faces of a sheet to give them readily distinguishable front and rear faces, so that the ready-to-paint face may be instantly seen and utilized, with the attending saving in the expense, apparatus, and care required to give equal finish to both faces where not needed. The practice of one phase of the method of the present invention will satisfactorily accomplish these results.

Although some other medium, such as air, heated to a degree within the prescribed limits, may be useful in carrying out the invention, the preferred embodiment of the invention involves the use of steam as a cooling element for the much more highly heated coated sheet as it leaves the zinc or similar coating bath.

For reasons that are difficult to explain, the employment of steam in the process, as a cooling agent, facilitates the obtaining of improved results in every aspect of the production of a galvanized sheet adapted to meet conditions attending any use to which a spangleless or in part spangleless sheet may be put; and, without treatment supplemental to the galvanizing process, itself, presents a ready-to-paint surface or surfaces meeting all requirements of a surface to which paint, enamel, or other facial decorations are to be applied.

Having in mind, as is well understood by those familiar with the art of galvanizing, that any sudden chilling or freezing of the coating, as the coated article leaves the coating bath, will result in objectionable spangle formation, as well as prevent complete bonding of the coating to the base metal, thereby correspondingly reducing the capability of the coated sheet to bend without impairment in later formation of the sheet into special shapes, and also remembering that any method of the general character under consideration must be as rapid as possible consistent with perfect results, the present invention may be said to embrace, as a step in the combined method or process, the subjection of the coated sheet, as it leaves the bath, to the influence of

steam of a temperature sufficiently below the temperature of the said coated sheet to cool the same, but without sudden chilling or freezing, and avoiding interference with the complete bonding or adherence of the coating with the base metal; in other words, the temperature of the steam must be such as to retard the cooling of the coated sheet as compared to suddenly or instantly chilling or cooling the same by older methods of exposing the coated sheet to the relatively low shop or atmospheric temperature, cold blasts of air, or submergence in cooling water, etc.

The foregoing characteristics of the invention may be availed of in similar fashion, and in keeping with the invention, where galvanizing sheets of metal of varying thickness, where the baths are of different temperatures, and where the speed of travel of the sheet through the bath are always in keeping with working requirements, determined by the size of the sheet, degree of coating desired, and other working conditions surrounding the treatment. This will readily be understood from an example of the practice of the method of the present invention hereinafter outlined. So, with this understanding, it will be clear that the method is not confined to the treatment of a particular sheet, but is comprehensive in character to the extent that the method may be varied or modified in such items as come under the expected workman's province or control, as to nature of coating bath, size of bath tank, size or gauge of sheet being galvanized, heat, time, and speed, so long as the basic principles of the treatment within the scope and for the purposes of the disclosed invention are preserved.

In view of the foregoing considerations, it may, therefore, be said that the invention comprises a method of galvanizing metal (as steel) sheets by immersing the same in a zinc or similar coating bath of the usual high temperature, and immediately on emergence of the coated sheet from the bath, that is before any substantial spangle formation can take place, subjecting one or both faces of the sheet (dependent upon whether one or both faces are to have the dull or matte-like appearance) to the action of steam contacting therewith, but without sufficient force to remove or displace any of the coating from the base metal, the steam being of a temperature substantially below the temperature of the coated sheet as it leaves the bath, to thereby cool the coating without suddenly chilling or freezing the same, and subsequently permitting the steam-treated face or faces to gradually cool.

While, as stated, the foregoing treatment may be applied to one or both faces of the coated sheet as it leaves the bath, and before the coating is set, it is to be observed that where one face only is being treated to produce the dull or matte-like formation and finish, the other side, as a step in the method of the present invention, will be subjected to influences to create spangles thereon, so that the ultimate sheet will possess one face spangled and the other face dull or matte-like.

In the last mentioned phase of the method, the employment of the steam and its relatively high temperature, as compared to ordinary processes of sudden chilling or freezing, affords a retarding cooling agent also to some extent with reference to that face of the sheet that is to be possessed of the spangle formations. This results from the radiation or transmission of the heat of the steam through the coatings and base metal, so that the coating that is intended to be spangled (preferably by exposure to the atmosphere) will, itself, not be so suddenly chilled as would happen if the radiated or transmitted heat were not present. Thus the spangles on the face just referred to are of somewhat reduced size, as compared to larger spangles or smooth surfaces resulting from the ordinary more sudden chilling or freezing treatment.

The feature of the invention just alluded to, that is the radiation or transmission of the heat of the steam applied to the intended dull or matte-like face of the sheet through the base metal sheet and to the intended spangle face of the sheet, will lend itself to a control of the size and character of the spangles, dependent upon the degree of heat of the steam and the correspondingly retarded or speeded cooling by the atmosphere of said spangle face of the sheet.

In practicing the invention thus disclosed, a galvanized steel sheet is produced, with no tendency to become distorted in any stage of the method, thereby eliminating warping or mis-shaping results attending so many of the excessively high heat treatments or excessively low cooling treatments, or burner or flame treatments with attending lack of clean products, of the old art. A clean, dull-coated sheet is furnished with either matte-like front, or rear, or both faces, on which paint, enamel, or the like, may be immediately received, as for example in the bill-board or road-sign displays. Where one side only is used for decorative purposes the other side will have a nicety in appearance, flowing from the spangle formations which, although not intended to be painted or decorated, will constitute a suitable background if and when exposed to view.

Many types of apparatuses may be resorted to in assisting the carrying of the invention into practical effect. One such type of apparatus will be disclosed herein, and the same will now be described, to the end that the method may be still better understood.

This machine is identical with that disclosed in the earlier application of applicants, Serial No. 55,820, filed December 23, 1935; and in so far as the subjects-matter of the present case is common to the subjects-matter of said earlier application, the present application is to be regarded as a continuation thereof.

In the drawing, forming part hereof,

Figure 1 is a fragmentary plan view of the machine for matte-treating one face only of the coated sheet;

Figure 2 is a longitudinal sectional view of the machine illustrated in Figure 1;

Figure 3 is a fragmentary longitudinal view showing the machine of Figures 1 and 2 modified to matte-treat both faces of the coated sheet; and

Figure 4 is an enlarged perspective view of a section of the steam piping employed in the alternative embodiments of Figures 2 and 3.

Referring more specifically to the drawing, wherein like reference numerals refer to the same parts in the several views, 1 designates the exit end portion of a sheet-galvanizing pot or bath, of suitable size and construction, wherein is contained in a molten state in the usual manner, a galvanizing bath or coating material 2, such as zinc. Finishing or exit rolls 3—3 are preferably partly immersed in the galvanizing bath material 2 and supported therein by the framing 4. One of said finishing rolls 3 is provided with a driving sprocket 5 adapted to be rotated by a chain, not shown, driven by a suitable power means, not

shown. The opposite end of said roll 3 is preferably provided with a gear 6 meshed with a like gear 7, by which the associated finishing or exit rolls 3—3 may be rotated in the direction of the arrows, whereby to withdraw a sheet A from the galvanizing pot 1 in the manner illustrated in Figure 2. The usual sheet exit guides 8 are shown disposed in the pot 1, leading to the underneath portions of the rolls 3—3 whereby to guide the moving sheets in the pot 1 into gripping contact with the rotating rolls 3, to be discharged therefrom. Suitably disposed in association with the finishing rolls 3—3 is a sheet deflecting device or member 9 adapted to deflect or guide a discharged sheet A from the pot 1 onto a sheet conveyor 10 which is actuated by a driving mechanism, such as the spaced sprocket wheels 11 mounted on a drive shaft 12 suitably supported for rotation on said pot 1. A driving sprocket 13 for rotating said shaft 12 is provided near one end thereof and is adapted to be rotated by a chain, not shown, driven by a suitable power means, not shown.

The sheet conveyor 10, comprising spaced chains, is adapted to travel in the direction of the arrow (see Figure 2) and carry with it the sheets A, deposited thereon, into association with a conveyor table, to constitute a cooling rack 14, whereby the finished and treated coated sheets may continue to cool, and permit their inspection and handling by the operator or operators in attendance thereon,—such cooling being conveniently accomplished under mill or plant atmospheric conditions. The chains 10 are preferably endless chains and in their rotative movement are guided by idler sprockets 15, one of which is shown in Figure 2.

A non-spangling applicator mechanism is shown comprising a length of pipe 16 disposed transversely of the pot 1 and overlying the length of the finishing rolls 3—3 (see Figures 1 and 2), and is preferably positioned by the supporting piping 17 therefor in such a manner that the discharge openings 18 (see Figure 4) provided in the length of said pipe 16 will discharge the contents (as steam) emitted therefrom upon the entire width of one surface of a coated sheet A as it is discharged from the finishing rolls 3—3 of the galvanizing pot 1. The path of travel of a sheet A from the finishing rolls 3—3 is substantially a vertical one until deflected at substantially a right angle thereto by means of the deflector or bull-tail 9 and thence upon the conveyor mechanism 10. It is preferred that the applicator pipe 16 be positioned at a point which shall enable a discharge upon the entire width of one surface of said sheet A during its travel in said substantially vertical plane and before its deflection into another plane of travel by said deflecting device 9.

The pipe 17, shown broken away from its source of supply, is preferably provided with a controlling valve 19, through which is conducted a spangle-preventing medium, preferably steam, which is illustrated as being discharged from the openings 18 in the pipe 16 by the arrows (see Figure 4).

In the carrying out of said process, the sheets to be galvanized are prepared therefor in the usual manner and then suitably fed into the galvanizing pot 1, wherein is contained the molten galvanizing bath or coating material, such as zinc, of a suitable temperature, and thence are guided by the sheet-exit guides 8 upwardly between the rotating finishing rolls 3—3 which advance the coated sheets upwardly and outwardly from the pot 1 and towards the deflecting device 9. The nature and extent of the zinc coating which adheres to said sheets upon being withdrawn from the pot 1 (while being the same on both faces of the sheet because of simultaneous immersion and coating treatment of said faces in the same bath) depends, of course, upon the spaced adjustment of the finishing rolls 3—3, the size of said rolls, height of the metal in the pinch of the rolls, speed at which the sheet is caused to travel through the bath, the temperature of the zinc in the pot 1, and the gauge of the sheet, all of which is determined by the particular requirements being met for production purposes.

Upon a coated sheet A advancing toward the deflecting device 9 (see Figures 1 and 2), one surface thereof (*b*) is caused to intercept and be subjected throughout the width thereof to the discharge of a spangle-preventing medium, preferably steam, jetted from the discharge openings 18 of the pipe 16, as controlled by the adjustment of the valve 19 in the pipe 17, whereby one entire surface of said coated sheet, as it passes said pipe 16, is treated by said spangle-preventing medium; whereupon, during the continued travel thereof, said treated sheet is deflected upon the conveyor mechanism 10 and carried toward and in association with the cooling rack 14.

The opposite or untreated coated surface (*c*) of said sheet, as it leaves the finishing rolls 3—3, is caused to crystallize in the form of spangles; whereas, the opposite treated surface (*b*) of said coated sheet, because of the application of a non-spangling medium thereon, preferably steam, prevents the formation of spangles upon said treated surface (*b*) of the sheet. As herein previously stated, it is contemplated that in lieu of the use of steam as a spangle-preventing medium, correspondingly temperatured air may in instances be used in similar manner.

It is simply necessary to regulate the supply of the steam through the valve feed 19 so that the influence of the steam on the zinc-coated surface will prevent quenching or sudden cooling of the coating on the surface being treated, by the retarding action of the steam (its temperature, of course, being less than the customary temperature of the coating), whereby the cooling of the sheet first by steam in connection with later subjection of the sheet to the atmosphere will be correspondingly gradual in character.

We have found steam to be the best medium for the purposes stated; and while we are not prepared to advance a theory as to why that is the case, the use of steam does operate in the substantial prevention or minimizing of spangling effects, so that the resultant surface is of a dull or matte-like character beneficially capable of receiving paint, enamel, or other decoration, without special preparation or treatment supplemental to the galvanizing method or process.

Reference being had to Figure 3, a modified form of non-spangling applicator mechanism is shown, whereby the opposite faces, that is both faces of the coated sheet A, are simultaneously subjected to the discharge of a spangle-preventing medium, preferably steam, thereby preventing the formation of spangles on either face of said sheet. Said mechanism is shown as comprising a pair of oppositely disposed pipes 16' supported by the piping 17' connected to the main supply pipe 17 in which is provided the controlling valve 19. The pipes 16' are each provided with a like series of discharge openings

similar to the openings 18 in the pipe 16 (see Figure 4), whereby to discharge the spangle-preventing medium on both sides or surfaces of the sheets A, when passed therebetween in the manner shown in Figure 3.

It will be noted that the steam from the pipe 16 (Figure 2), although emitted towards and to the surface of the treated sheet, also disperses upwardly and downwardly with reference to the supply pipe 16 (see Figure 4); and it will be further noted that the arching or bending of the coated sheet A above the supply pipe 16 will effectively form a hooded, somewhat confined steam treating zone. Thus the steam will be permitted to spread throughout said zone and the gradual cooling effect to which reference has been made will thereby be aided.

The coating on the base metal, as the coated sheet leaves the bath, is not disturbed in any way by the engagement of the steam with the coating. In both the single-face coating produced by the assistance of the apparatus shown in Figure 2 and/or the double-face coating of the apparatus shown in Figure 3, while it is intended that the steam shall be jetted to and against the coated sheet, the force of impact is kept to a point below that which would tend to remove, strip, or disarrange the freshly applied molten coating material on the sheet. The influence of the steam on the surface of the sheet is to merely control the cooling, prevent spangling, and form the desired dull, matte-like surface; also to regulate the spangle formations on the spangled face when desired.

Assuming that the bath or coating material (as zinc) for the steel sheet or sheet of high melting point is around the temperature commonly employed, say, for example, 810° F., and that it is desired to prevent the formation of spangles on a face of the sheet, or stated in the reverse, to form a dull, matte-like finish ready without further treatment for the reception of paint and the like, the steam treatment is applied in a simple operation immediately following the emergence of the coated sheet from the zinc bath or coating material, under a pressure sufficient to extend over and cover the face of the sheet being treated, without removing or displacing the coating material on said face, and under a temperature, dependent on the sheet being treated and associated conditions, within a range running from a low point (substantially the minimum temperature of steam) up to a high point anywhere below the temperature of the coated sheet leaving the bath; the degree of the cooling of said coated sheet, as will be apparent, being in keeping with the difference of the temperature of the steam and the temperature of the coated sheet. In this way, and substantially throughout the range of temperature stated, the face of the coated sheet that is to be given the dull or matte-like appearance will in no instance suddenly chill or become frozen. Thus, the many objections to a sudden chilling or freezing operation are absolutely overcome. Furthermore, the temperature of the steam is such that, in the zone of operation,—as the coated sheet moves on,—there will be gradually reducing temperature adjacent the face of the sheet, eventually running down to plant atmospheric temperature as the coated face is exposed thereto. All of this works against the tendency of the coating to spangle and brings about the dull, matte-like effect sought by the practice of the process or method of the present invention.

Moreover, the temperature of the steam applied to the coated face, or faces, while operating to facilitate the cooling and setting of the coating, in one aspect of the operation actually retards the cooling, as compared to the sudden cooling or freezing practiced in the prior art; so that although the coated sheet is reduced in temperature in the zone of steam application, the cooling is being carried out while the still intense heat of the coated sheet, as it leaves the bath, remains for a while to some extent effective in enabling or insuring permanent adhesion or bonding of the coating to the base metal. Thus, when the coated sheet is gradually and eventually cooled, the same will possess those highly desirable qualities of a uniform homogeneous structure capable of bending or formation into miscellaneous shapes or configurations, without cracking, chipping, or other impairment, such as so frequently arises where spangles of substantial size remain on the ultimate product and crack or break away from the base metal under bending or distorting manipulations.

Still further, while the steam treatment of the one coated face of the sheet is being carried out, the opposite face (where spangling may be permissible or desired), upon emergence of the coated sheet from the bath, is subjected to influences that will cause or effect spangling of that face, as by immediate exposure to prevailing atmospheric conditions in adjacence to the steam zone, and then to relatively cooler atmospheric conditions beyond the steam zone and towards and upon or over the cooling rack. However, owing to the radiation or transmission of the heat of the steam applied to the coating of the face of the sheet which is to have the dull or matte-like finish, and therefrom through the base metal to the opposite coating which is to have the spangle finish, the formation of the spangles is also slightly retarded, as distinguished from an instance where there is immediate cooling or freezing. In this way, the size and degree of the spangle formations are reduced, as compared to the larger spangles or areas of greasy smoothness resulting from sudden chilling or freezing operations. This distribution or utilization of temperatures, as just defined, affords a convenient and efficient means for controlling or determining the kind of spangles created, or varying the same with regard to the relatively larger, or relatively smaller, size thereof, as best suited to particular uses for which the galvanized sheet is intended and facially designed.

As a guide to the practice of the invention, under a given set of conditions, the following information is advanced:

A special instance in which the invention is successfully carried into effect is where a sheet of 22-gauge, after immersion in the bath as previously pointed out, and emerging with a weight of coating equivalent to 1.20 oz. per sq. ft. of sheet surface, traveling at a speed of approximately 35 ft. per minute, is subjected to the action of steam of approximately 365° F., the same issuing from nozzles in a pipe ¾ in. in diameter, the diameter of said nozzles being ⅛ in., the temperature of the bath in this instance being approximately 810° F. The travel of the coated sheet and passage of the same through the steam zone at the suggested rate of speed will produce the desirable results. In other instances, where the conditions are (in keeping with the customary practices in the art) relatively changed, the subjection of the sheet face or faces to the influence of the steam will

be regulated correspondingly,—governed at all times by the principle of preventing sudden chilling or quenching of the coated sheet on its emergence from the bath, and insuring a gradual cooling of the treated face.

Herein, we are not claiming the ultimate novel product, namely, the galvanized steel sheet produced by the method herein disclosed and claimed, either in that embodiment possessing one face of dull or matte-like appearance and the other face spangled, or in the other embodiment possessing like opposite faces of dull or matte-like finish, such subjects-matter more properly constituting the basis of a companion or divisional application, Serial No. 140,435, filed May 3, 1937, in compliance with the requirement of the Patent Office in our application Serial No. 55,820, filed December 23, 1935, wherein it was held that the article could not be claimed in the same case with the method.

We claim:

1. The method of treating a metal sheet, comprising immersing the sheet in the customary zinc coating bath, and on the emergence of the sheet from the bath and before any substantial spangling takes place on one face thereof, subjecting said face to the influence of a cooling medium of a temperature not less than that of minimum steam temperature and substantially less than the temperature of the coating on the sheet as it leaves the bath, whereby the coating contacted by said medium will be cooled but not chilled, and spangling thereby prevented, and exposing the opposite face of said sheet to cooling means of a character to facilitate the formation of spangles thereon.

2. The method of treating a metal sheet, comprising immersing the sheet in the customary zinc coating bath, and on the emergence of the sheet from the bath and before any substantial spangling takes place on one face thereof, subjecting said face to the influence of steam of a temperature substantially less than the temperature of the coating on the sheet as it leaves the bath, whereby the coating contacted by said steam will be cooled but not chilled, and spangling thereby prevented, and exposing the opposite face of said sheet to cooling means of a character to facilitate the formation of spangles thereon.

3. The method of forming a galvanized metal sheet having one face dull and matte-like and the opposite face spangled, comprising subjecting the base metal to a bath of hot coating material, and on emergence of the coated base metal from the bath, treating one coated face to the action of a cooling medium of substantial temperature upwards of approximately 212° F. but less than the temperature of the emerging sheet, while subjecting the other face to the action of a chilling medium facilitating spangling.

4. The method of forming a galvanized metal sheet, having one face dull and matte-like and the opposite face spangled, comprising subjecting the base metal to a bath of hot coating material, and on emergence of the coated base metal from the bath, treating one coated face to the action of a steam cooling medium of a temperature less than that of the emerging sheet, while subjecting the other face to the action of a chilling medium facilitating spangling.

5. The method of forming a galvanized metal sheet having one face dull and matte-like and the opposite face spangled, comprising subjecting the base metal to a bath of hot coating material, and on emergence of the coated base metal from the bath, treating one coated face to the action of a cooling medium of substantial temperature upwards of approximately 212° F. but less than the temperature of the emerging sheet, while subjecting the other face to the action of a chilling medium facilitating spangling, and regulating the temperature of the cooling medium to correspondingly affect the formation and appearance of the spangled face, whereby the radiation or transmission of its heat through the base metal and to the said other face correspondingly retards or augments the forming of the spangles.

6. The method of forming a galvanized metal sheet having one face dull and matte-like and the opposite face spangled, comprising subjecting the base metal to a bath of hot coating material, and on emergence of the coated base metal sheet from the bath, treating one coated face thereof to the action of a steam cooling medium of a temperature upwards of approximately 212° F. but less than the temperature of the emerging sheet, while subjecting the other face to the action of a chilling medium facilitating spangling, and regulating the temperature of the cooling medium to correspondingly affect the formation and appearance of the spangled face, whereby the radiation or transmission of its heat through the base metal and to the said other face correspondingly retards or augments the forming of the spangles.

JAMES H. HILL.
HARRY W. THEISS.