

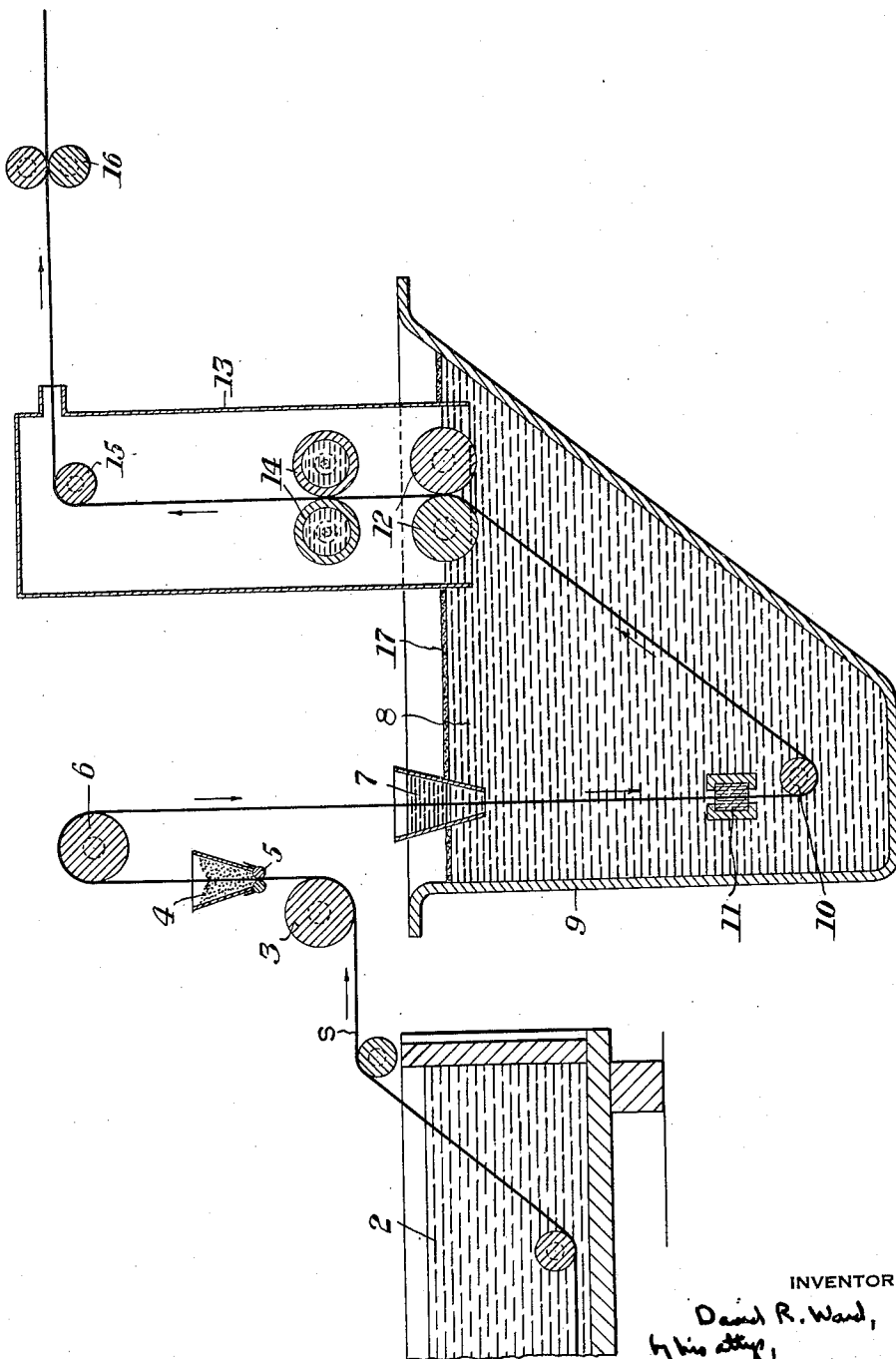
Oct. 31, 1933.

D. R. WARD

1,933,401

COATED METAL ARTICLE AND MANUFACTURE THEREOF

Filed Oct. 1, 1929



INVENTOR

David R. Ward,
By his attys,
Byrne, Stetson, Pender & Stetson

UNITED STATES PATENT OFFICE

1,933,401

COATED METAL ARTICLE AND MANUFACTURE THEREOF

David R. Ward, Struthers, Ohio, assignor to
The Youngstown Sheet and Tube Company,
Youngstown, Ohio, a corporation of Ohio

Application October 1, 1929. Serial No. 396,444

16 Claims. (Cl. 91—70.2)

This invention relates to a coated metallic article and a method and apparatus for making the same, and is herein particularly described as applied to the lead coating of steel strips.

5 Any attempts to apply a lead coating direct to steel by processes heretofore known have resulted in coatings having pin holes therein and some of the fluxing agents have been retained on the metal. The pin holes and retained flux both induce corrosion effects. These pin holes are attributed to the combined action of escaping hydrogen absorbed by the base metal in the pickling operation, and to the surface tension of the lead. The surface tension of the lead is sufficiently high that it tends to produce globules on the surface of the base material during the process of solidification, because lead does not "wet" steel.

10 I provide for applying the metallic coating and substantially simultaneously cooling the same and acting on the surface, as by compression rollers, to prevent formation of pin holes or to close any pin holes which may be formed and produce substantial continuity of the coating material. Preferably the base is fed through a bath of the coating metal and is engaged almost immediately after it leaves the bath, as by a pair of rolls, which are maintained at such temperature as to "freeze" the adherent coating material, while at the same time, by compression, overcoming the surface tension effect, and tendency to form pin holes, or closing any pin holes which may be formed.

15 The material is preferably fluxed before entering the bath and is wiped or scrubbed so as to remove any escaping gases or flux adhering to the surface. Preferably the wiping is effected while the material is moving in a substantially vertical direction, whereby neither surface of the material lies above the gas bubbles which are wiped off. 20 If the wiped off bubbles in their natural upward travel through the bath were to be stopped in such travel by a surface of the base material, they would tend to adhere to the same and thus prevent continuous contact and alloying of the base with the coating material.

25 The base preferably passes through a dry flux on its way to the coating bath, and then through a flux box adjacent the surface of the coating material. This insures adequate fluxing of the material and aids in the production of a continuous uninterrupted coating.

30 The rolls employed for the fixation of the coating material on the base, that is to say, the rolls which compress and cool the coating, are preferably arranged in a chamber lying over the bath

and surrounded by a non-oxidizing or reducing atmosphere. This prevents oxidation of the coating material and removes the necessity of having a fluxing agent present to dissolve the oxides which would form in the presence of air. 60

If desired, the fixation rolls may be preceded by sizing rolls which determine the amount of coating material which is applied per unit of area of the base.

The use of my process and apparatus results in a new product substantially free from pin holes and having improved corrosion-resistant properties. 65

The accompanying figure of drawing illustrates in longitudinal vertical section a present preferred embodiment of the invention as applied to the lead coating of a continuous strip. 70

In the apparatus shown in the drawing, strip material S is fed continuously through a pickling tank 2 under a guide roll 3, and upwardly through a dry flux box 4. The flux box 4 is filled with a suitable flux such as zinc chloride, ammonium chloride, or both. The material is still wet from the pickling tank when it passes through the flux box 4. Hydrochloric acid is preferably employed for pickling. The flux box is closed off at the bottom by rolls 5 between which the wet strip is fed. The use of rolls 5 prevents choking of the box at the bottom and at the same time closes it off against leakage of the dry flux. 75

80 The material passes upwardly from the flux box 4 over a guide roll 6 and then downwardly through a flux box 7 containing a suitable molten flux such as those now in use. The material passes through the flux box 7 directly into a bath 8 of molten lead contained in a lead pot 9, which is maintained at proper temperature by any suitable means (not shown). The material travels downwardly and passes around a guide roll 10 submerged in the lead. 85

90 A wiper 11 is placed above the guide roll 10 so as to engage both surfaces of the strip in its vertical travel from the guide roll 6 to the guide roll 10. The rate of travel of the strip material is maintained such that the absorbed hydrogen produced during the pickling operation escapes before the wiper 11 is reached. The wiper may be made of any suitable material, such as woven asbestos reinforced with wire and carried in suitable rigid frame members, as shown. 105 The wiper is effective for mechanically removing gas bubbles adhering to the surface of the base material, and since the strip extends vertically upwardly from the wiper, the gases are 110

free to travel to the top of the lead bath and pass off to the atmosphere.

By the time the base reaches the guide roll 10 it is highly heated, and the lead in the bath becomes alloyed therewith as the strip travels from the guide roll 10 to a pair of rolls 12, similar to the so-called "wiping" rolls used in galvanizing practice. These rolls run partly in and partly out of the lead bath so that when the material leaves the same, it is above the bath. The spacing of the rolls is adjusted in any desired manner so as to determine the amount of lead which passes upwardly with the base.

The rolls 12 are enclosed in a chamber 13 in which a neutral or reducing atmosphere is maintained. This prevents oxidation of the hot lead after it leaves the bath.

As the coated material travels upwardly from the rolls 12, the surface tension of the lead tends to collect the coating into globules, thus causing a discontinuous coating. This condition, if not corrected, results in pin holes in the final product.

A pair of fixation rolls 14 is arranged in the chamber 13 a short distance above the sizing rolls 12. These rolls are hollow and are water-cooled. They are effective for mechanically acting on the still molten coating so as to squeeze down any globules, thus rendering the coating again continuous, and for freezing or setting the lead so that any tendency of the same to again collect into globules and produce a discontinuous coating is immediately eliminated. The material, therefore, when it leaves the fixation rolls 14, is a ferrous base having a coating of lead applied directly thereto, the coating being substantially free from pin holes. This material travels upwardly over a guide roll 15 and thence out of the apparatus. The force necessary to pull the strip through the apparatus may be supplied by a coiler or by pinch rolls 16, as desired. All rolls may or may not be driven as desired.

While the rolls 14 serve to chill the fluid lead under pressure, the solidified lead still has a high degree of plasticity and because there are no oxides present, it will be rolled into a uniform and continuous surface. As a matter of fact, the operations of rolling and chilling occur simultaneously and by proper regulation of the amount of cooling fluid supplied, the continuity of surface is probably obtained approximately when the solidification point of the lead is reached.

My process is of value not only in the coating of lead on steel, but also for the coating of other materials such as lead on brass or copper, or aluminum on iron, which do not readily alloy with the base. In this connection see "Protective Metallic Coatings" by Henry S. Rawdon of the U. S. Bureau of Standards, page 136, where pin holes in tin coatings are discussed.

It will be noted from the drawing that a coating 17 is provided over the bath to prevent oxidation of lead. This coating may be the flux material, powdered charcoal, or other suitable substance. It will be further noted that this protective coating is not applied to that portion of the bath lying within the chamber 13, and that the walls of the chamber are extended below the lead line so as to prevent any of the coating material from entering. There is no need to protect the surface of the lead from oxidation by a coating such as 17 in the chamber 13 because of the reducing or non-oxidizing atmos-

phere therein. Because of this provision the rolls 12 do not pick up dross, but maintain their shape and cleanness of surface indefinitely.

While the invention has been described as particularly applied to the coating of strips, it will be understood that it is not to be limited but may be also used for the coating of other articles such as wire, rods, sheets, or pipes. It will be understood, therefore, that while I have illustrated and described the preferred form of the invention as applied to the lead coating of strips, it is not to be limited to the form shown but may be otherwise embodied or practiced within the scope of the following claims.

I claim:—

1. In the method of applying a metallic coating to a metallic base, the steps consisting in feeding the base through a molten bath of the coating metal, engaging the issuing material while the coating is still at a high temperature, and substantially simultaneously mechanically confining, compressing and cooling the same in a non-oxidizing atmosphere.

2. In the method of applying a metallic coating to a metallic base, the steps consisting in feeding the base through a molten bath of the coating metal, engaging the issuing material while the coating is still at a high temperature, and substantially simultaneously mechanically confining, compressing and cooling the same in a reducing atmosphere.

3. In the method of applying a metallic coating to a metallic base, the steps consisting in feeding the base through a molten bath of the coating metal, passing the material direct from the bath into a non-oxidizing atmosphere, and before the coating has set there substantially simultaneously mechanically confining, compressing and cooling the same.

4. In the method of applying a metallic coating to a metallic base, the steps consisting in passing a base through a molten bath, wiping the surface of the base while the same is submerged and is in such position as to insure uniform release of gases from both sides thereof, and continuously moving the base away from the wiping point while it is maintained in the same relative position to permit uniform release of gases from both sides thereof.

5. In the method of applying a metallic coating to a metallic base, the steps consisting in supplying a wet pickled base, applying a flux thereto while still wet, heating the fluxed base, wiping the same while the portion being wiped is vertically disposed within a coating bath, and applying a coating.

6. In the method of applying a metallic coating to a metallic base, the steps consisting in heating a base, wiping the same and applying a coating, and thereafter compacting the coating before it has set so as to close pin holes and simultaneously solidify the coating.

7. In the method of applying a metallic coating to a metallic base, the steps consisting in heating a base, wiping the same and applying a coating, and thereafter compacting the coating material in a non-oxidizing atmosphere and before it has set so as to close pin holes and simultaneously solidify the coating.

8. In the method of applying a metallic coating to a metallic base, the steps consisting in fluxing a base and heating the same, wiping the heated base, applying a coating material thereto, and thereafter compacting the coating material before it has set so as to close any pin

holes therein and simultaneously solidify the same.

9. Apparatus for applying a metallic coating to a metallic base, comprising means whereby a coating material is applied to the base, and means effective on the coating before it has set for chilling the applied coating under rolling pressure in a non-oxidizing atmosphere.

10. Apparatus for applying a metallic coating to a metallic base, comprising a container for a bath of molten coating material, means whereby the base is guided through the container, means for engaging the issuing material before the coating has set and substantially simultaneously mechanically confining, compressing and cooling the same, and means for maintaining the issuing material in a non-oxidizing condition until the last-mentioned means has acted thereon.

11. Apparatus for applying a metallic coating to a metallic base, comprising a container for a bath of coating material, a chamber extending upwardly from the bath, means for guiding base material through the bath and the chamber, the chamber being adapted for maintaining a non-oxidizing atmosphere around the base as it travels therethrough, and means in the chamber for cooling the coated base under pressure.

12. Apparatus for applying a metallic coating to a metallic base, comprising a container for a bath of molten coating material, means for guiding the base therethrough, means whereby the base is heated, means for wiping the base while at elevated temperature, sizing means for

determining the amount of coating material on the base as it leaves the bath, and means for setting and cooling the coated base under pressure.

13. Apparatus for applying a metallic coating to a metallic base, comprising a container for a bath of molten coating material, guide means whereby the base is directed upwardly and then downwardly into the bath, and means for applying a flux during its upward travel.

14. Apparatus for applying a metallic coating to a metallic base, comprising a pickler, means for applying a dry fluxing material to the wet base as it leaves the pickler, and a container for a bath of molten coating material adapted to coat the fluxed base.

15. In the method of applying a metallic coating to a metallic base, the steps consisting in feeding the base through a molten bath of the coating metal, withdrawing the coated base, applying pressure to the coated base before the coating has set, and chilling the base and coating at the point of pressure application while maintaining said point under a reducing atmosphere.

16. In the method of applying a metallic coating to a metallic base, the steps consisting in feeding the base through a molten bath of the coating metal, withdrawing the coated base, applying pressure to the coated base before the coating has set, and chilling the base and coating at the point of pressure application while maintaining said point under a non-oxidizing atmosphere.

DAVID R. WARD.

35

40

45

50

55

60

65

70

75

80

85

90

95

100

105

110

115

120

125

130

135

140

145

150