

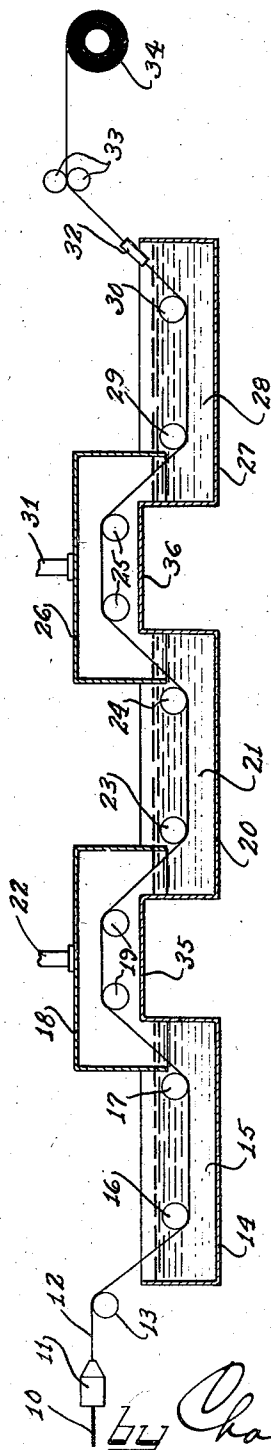
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GALVANIZING PROCESS

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GALVANIZING PROCESS

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This invention relates to a process for galvanizing ferrous metal articles such as strip metal, wire and the like. More specifically, this invention relates to a process for galvanizing hard drawn steel wires.

In the customary method of galvanizing wire, the wire is passed through a bath of molten zinc, or spelter. Owing to the alloying action of zinc toward the iron of the wire, this alloying takes place as the wire is passed through the spelter bath. An examination of a regular one dip wire will generally reveal a first thin layer of very fine grain structure close to the steel or iron body of the wire, consisting probably of FeZn_3 , a second, heavier layer of long needle-like crystals protruding more or less perpendicularly to the wire and consisting probably of FeZn_7 , and an outside layer or coating consisting mainly of zinc, with some iron in solution.

It has been found very difficult to put a heavy coating of spelter on a wire by using the hot dip process, as such a coating will peel and crack in bending the wire. It is our belief that the cracking of the coating is due to the long needle-like crystals in the intermediate layer of iron-zinc alloy. While this condition can be largely overcome by heating the coated wire, thereby probably changing the iron-zinc alloy to a compound of the formula FeZn_3 having a fine grain structure, the color of the coating thus obtained, however, is always dark gray and does not have a bright or shiny appearance.

We have now found that superior results may be obtained by passing the zinc coated ferrous article through a bath of molten lead maintained at temperatures above the temperatures of the molten zinc. As would be expected, such treatment removes or melts off a part of the coating which floats to the top of the bath. At the same time, however, the lead bath causes the zinc to react with the ferrous metal to form a fine grained ferro-zinc alloy having a higher proportion of iron than the natural solution of iron and zinc and iron-zinc alloy formed in the first zinc dip and thereby eliminates the long needle-like crystals protruding more or less perpendicularly to the wire, formed in the first coating and which makes the coating crack and peel.

The lead bath, furthermore, protects the zinc coated article against oxidation, such as would occur in a heat treating furnace, and in addition makes possible an immediate uniform heating of the coated article, which is not obtainable in a furnace. We have found that if the zinc coated ferrous metal article is exposed while in a heated

condition to the atmosphere either before or after the heat treating operation, it is impossible to form an adhering second coating of zinc on the article.

According to our process, the zinc coated article, upon leaving the lead bath, is again exposed to the action of molten zinc for receiving a bright zinc coating thereon of relatively pure zinc over the ferro-zinc alloy formed by the first galvanizing step. The article is carefully protected against contact with the atmosphere while passing from the lead bath to the second zinc bath.

The resulting zinc coating is not brittle, since the first coating is changed while it passes through the lead bath to an iron-zinc alloy high in iron which is malleable. Since it has a higher melting point than the zinc bath, the first alloy coating freezes on the wire as it comes in contact with zinc in the last bath. The intermediate brittle layer is thereby eliminated. The product of our process is, therefore, a double galvanized ferrous metal article having highly ductile zinc alloy and zinc coatings thereon.

It is therefore an important object of this invention to provide a method of galvanizing in which the intermediate layer of iron-zinc alloy having the long needle-like crystal has been eliminated and substituted by an iron-zinc alloy of similar type to the first layer, having a very fine crystalline structure and containing a high percentage of iron, and the outer coating is of comparatively pure zinc, the coating being flexible and malleable and having the same degree of brightness and luster as regular "one dip" galvanized wire.

It is a further important object of this invention to provide a method of galvanizing wherein a pure zinc coating is applied to a wire having an iron-zinc alloy coating and both coatings are applied in a continuous process.

A further object of this invention is to provide a double dipped galvanized metal article having ductile zinc coatings thereon.

A further object of this invention is to form and heat treat ferro-zinc alloy coatings on ferrous metal articles to render said coatings ductile, without exposing the same to the atmosphere.

A specific object of this invention is to provide a galvanizing process including a plurality of zinc dips with an intermediate treatment in a lead bath to render the zinc coatings ductile.

Other and further objects of this invention will become apparent from the following detailed description of the annexed sheet of drawings,

which discloses a preferred form of apparatus for effecting the process.

On the drawing:

The figure is a diagrammatic elevational view of an apparatus for carrying out the process of this invention, as specifically applied to the galvanizing of ferrous metal wires, showing the dipping tanks in vertical cross section.

As shown on the drawing:

10 Ferrous metal 10 is drawn through a die 11 to produce a wire 12 of proper size. The wire 12 without previous annealing is trained over a guide roll 13 and directed into a tank or vat 14 containing molten zinc 15, preferably maintained at temperatures around 850 to 950° F. The wire 12 passes under guide rollers 16 and 17 in the tank 14 and receives thereon a coating of zinc. The coated wire is then directed upwardly from the tank 14 under a hood 18 and around a pair of 20 guide rollers 19 rotatably mounted in the hood 18.

After passing over the last guide roller 19, the wire 12 is directed downwardly into a tank 20 containing molten lead 21, maintained at temperatures between 900 to 1600° F., preferably between 1100 and 1400° F. In the lead bath the zinc coating on the wire is reacted with the ferrous metal of the wire to form a ferro-zinc alloy having a relatively high proportion of iron. This alloy most probably has the formula FeZn_3 as compared with the heretofore obtained alloy of the formula FeZn_7 produced by dipping iron or steel wires in zinc spelter. The FeZn_3 alloy has a fine crystalline grain structure whereas the 35 FeZn_7 alloy has a brittle needle-like structure.

The hood 18 has the sides thereof extending into the molten zinc 15 in the tank 14 and the molten lead 21 in the tank 20, so that the wire upon leaving the tank 14 and upon entering the tank 20 is not exposed to the atmosphere. If 40 desired, the space under the hood 18 may be evacuated or filled with an inert gas through a pipe 22 connected to the top of the hood and communicating with the space thereunder.

The wire 12 in the lead bath 21 is directed under guide rolls 23 and 24, respectively, and then upwardly over a pair of guide rolls 25 rotatably mounted under a hood 26 similar to the hood 18.

After passing over the last guide roll 25, the wire is directed into a tank 27 containing molten zinc 28 maintained at temperatures of about 850 to 950° F. The wire in the tank 27 passes under guide rollers 29 and 30 rotatably mounted in the tank under the top level of the zinc bath 28 therein.

The hood 26 has the sides thereof extending into the molten lead bath 21 and the molten zinc bath 28, so that the wire is not exposed to the atmosphere as it passes from the tank 20 to the tank 27. The hood 26 can be evacuated or filled with an inert gas through a pipe 31 secured on the top thereof and communicating with the space thereunder.

After passing through the second zinc bath 28, the coated wire is directed through a wiping device 32 to remove excess zinc therefrom and is then passed between a pair of driving rolls 33 which can operate to pull the wire 12 through the hereinabove described tanks and hoods.

The zinc coated wire is then reeled into a coil 34.

We have found that the molten zinc 15 in the tank 14 reacts better with a hard drawn ferrous wire than with an annealed wire, and we, there-

fore, prefer to draw the wire, as indicated at 11. This drawing operation can conveniently be performed immediately prior to passing the wire through the molten zinc bath 15.

The treatment in the lead bath 21 causes the first applied zinc coating on the wire to react with the iron of the wire, thereby forming a ferro-zinc alloy of fine crystalline structure, probably having the formula FeZn_3 . At the same time, the ferrous wire itself is also annealed to render the same ductile. The lead bath immediately raises the temperature of the wire to the temperature of the bath, and the amount of annealing that takes place in this bath is, of course, determined by the temperature of the bath and the length of immersion in the bath.

The zinc bath 28 in the tank 27 is preferably a high grade zinc, whereas the zinc bath 15 in the tank 14 can be a lower grade zinc spelter. The annealed coated wire from the lead bath receives a bright outside coating of zinc in the bath 28. This coating affords added protection for the ferrous wire and, at the same time, gives the wire a brighter appearance than was heretofore obtained.

It should be understood that a plurality of wires may be fed simultaneously in parallel spaced relationship through the apparatus described above. Only one wire has been described for purposes of convenience.

As shown in the drawing, the tanks 14, 20, and 27 are connected by plates 35 and 36, which plates form the bottoms for the space under the hoods 18 and 26. Alternatively, the tanks 14, 20, and 27 may be arranged against each other, thereby dispensing with the necessity of bottom plates for the hoods. Further, the hoods can be replaced with charcoal baths resting on the baths in the tanks and piled over adjoining edges of the tanks. The wires can pass through these charcoal baths and thereby be protected from the air.

We are aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and we, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

We claim as our invention:

1. The process of galvanizing ferrous wires which comprises drawing said wires through a molten zinc bath maintained at temperatures between about 850° to 950° F. to form a zinc coating on the wires, passing the coated wires through a molten lead bath maintained at temperatures between about 1100° F. to 1400° F. to render the coating on the wire ductile and subsequently passing the coated wire through a molten bath of relatively pure zinc to form a bright coating over the previously applied and heat treated zinc coating.

2. The process of galvanizing and annealing hard drawn steel wires which comprises passing said wires through a bath of molten zinc maintained at temperatures of about 850° to 950° F., removing the wires from the zinc bath without contacting the wires with the atmosphere and introducing the removed wires into a molten lead bath maintained at temperatures of about 1100° to 1400° F., removing the wires from the lead bath without exposing the same to the atmosphere and passing the wires through a molten bath of relatively pure zinc to form a bright outer coating thereon.

3. The process of galvanizing ferrous metal

articles which comprises exposing said articles to the action of a molten zinc bath maintained at temperatures between 850° to 950° F. to form a zinc coating thereon and immediately thereafter subjecting the coated articles before they are exposed to the atmosphere in a lead bath maintained at a temperature of between 1100 and 1400° F. to react the ferrous metal with the zinc coating thereon and form a ductile ferro-zinc alloy therefrom having a high proportion of ferrous metal therein.

4. The process of galvanizing ferrous metal articles which comprises exposing said articles to the action of a molten zinc bath maintained at a temperature of between 850° to 950° F. to form a zinc coating thereon, immediately thereafter heat treating the coated articles before they are exposed to the atmosphere in a lead bath maintained at a temperature of between 1100 and 1400° F. to react the ferrous metal with the zinc

coating thereon and form a ductile ferro-zinc alloy therefrom having a high proportion of ferrous metal therein, and exposing the so formed ferro-zinc alloy to the action of relatively pure molten zinc at a temperature of between 850 and 950° F. to cover the alloy with a bright coat of zinc. 5

5. The process of galvanizing a hard drawn steel wire to provide a ductile coating thereon which comprises passing said wire through a molten zinc bath maintained at temperatures between about 850° to 950° F., to form a zinc coating thereon, removing the wire from the zinc bath and passing the coated wire through a molten lead bath maintained at temperatures between about 1100° to 1400° F., to render the coating on the wire ductile. 10 15

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