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GALVANIZING PROCESS

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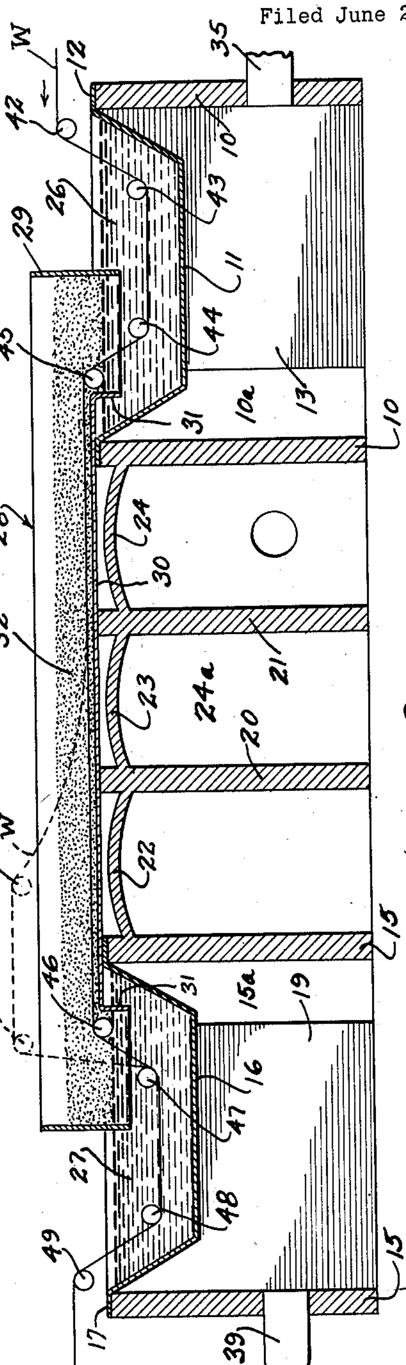

Fig. 1.

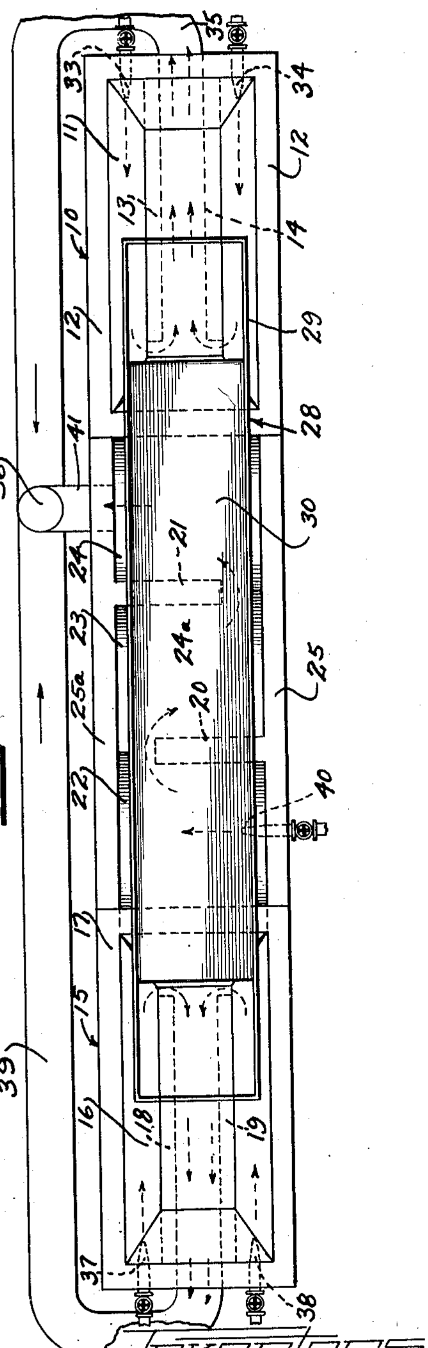

Fig. 2.

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GALVANIZING PROCESS

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6 Claims. (Cl. 91—70.2)

This invention relates to process and apparatus for galvanizing ferrous metal articles such as steel wire, strip metal and the like to provide a ferro-zinc alloy coating on the wire covered with a substantially pure zinc coating. More specifically the invention relates to the treatment of ferrous metal articles between zinc dips to increase the thickness of the ferro-zinc alloy coating on the wire.

When a ferrous metal article such as wire or the like is dipped in molten zinc baths at galvanizing temperatures between 850° to 900° F., the zinc will alloy with the ferrous metal to form a ferro-zinc alloy coating on the article. This alloy coating contains iron and zinc in varying proportions such as FeZn; $FeZn_3$; and $FeZn_7$. The iron content in the alloy decreases with the increase in distance from the wire. Thus the inner zone of the coating adjacent the article may be FeZn; the middle zone may be $FeZn_3$ and the outer zone $FeZn_7$ to pure Zn.

It is only possible to build up a ferro-zinc alloy coating of limited thickness on the wire in a single zinc dip because alloy in excess of this limited thickness is dissolved off by the solvent action of zinc on the alloy.

It has heretofore been proposed to put a heavy coating of zinc and ferro-zinc alloy on wire by treating the coated wire after the first zinc dip in a molten lead bath for the purpose of increasing the iron content in the alloy coating thereon. The thus treated coated wire is then dipped in a second zinc bath to receive a coating of substantially pure zinc thereon. The first coating is not appreciably dissolved off of the wire by the second zinc bath because the increased iron content of the alloy raises the melting point of the coating.

We have found, however, that molten lead has a solvent influence on the coating obtained in the first dip and tends to dissolve off appreciable amounts of the coating.

Further, the lead will alloy with the ferro-zinc alloy formed on the wire to produce a modified coating which might be unsatisfactory for some purposes.

According to this invention, ferrous metal articles are passed between molten zinc dips through a heat controlled medium which does not dissolve appreciable amounts of zinc or zinc alloy from the coated article and which assists the formation of ferro-zinc alloy on the article. The preferred medium to effect the formation of a desired ferro-zinc alloy coating on the ferrous metal article is a molten salt bath maintained at temperatures not lower than the temperatures of the zinc bath.

Examples of suitable salt baths are as follows:

Example 1

	Percent
Zinc chloride	50
Sodium chloride	50

(The above salt bath has a melting point of around 900° F.)

Example 2

	Parts
Zinc chloride	3
Sodium chloride	2
Potassium chloride	1

(The above salt bath has a melting point around 600° F.)

Since the usual galvanizing temperatures for hot dip galvanizing processes are between 850° F. to 900° F. (specifically 860° F.) the salt baths are maintained at the temperatures of the zinc bath or above. Suitable temperatures for the salt bath are from 850° to 1200° F.

It is then an object of this invention to increase the ferro-zinc alloy layer on galvanized metal articles.

It is a further object of this invention to treat ferrous metal articles between zinc dips in a galvanizing process in a heat controlled medium for assisting the formation of ferro-zinc alloy on the coated wire without dissolving off substantial amounts of zinc from the wire.

A further object of this invention is to utilize a molten salt bath between zinc dips in a galvanizing process for raising the iron content of ferro-zinc alloy coatings on the article.

Another object of this invention is to permit successive coatings on a metallic base without intervening oxidation of the coatings.

A further object of this invention is to provide apparatus for carrying out the process of the invention.

Another object of the invention is to provide a bridge between zinc pans in a galvanizing apparatus for housing a salt bath through which ferrous metal articles such as wires can pass between zinc dips.

Other and further objects of this invention will become apparent to those skilled in the art from the following detailed description of the annexed sheet of drawings which discloses a preferred embodiment of apparatus according to this invention utilized in carrying out the process of the invention.

On the drawing:

Figure 1 is a vertical cross-sectional view with parts illustrated somewhat diagrammatically, taken longitudinally through the apparatus of this invention.

Figure 2 is a top plan view of the apparatus shown in Figure 1.

As shown on the drawing:

In Figures 1 and 2, the reference numeral 10 designates walls of ceramic material, brick, refractory material or the like defining a rectangular open topped heating chamber 10*a*.

A pan 11 having flanges 12 around the peripheral edges thereof is mounted in the heating chamber 10*a* with the edges 12 of the pan resting on top of the walls 10.

Vertical walls 13 and 14 are mounted in the heating chamber 10*a* in spaced parallel relation for supporting the bottom of the pan 11. The walls 13 and 14 also provide baffles for a purpose to be hereinafter described.

Additional walls 15 of brick, ceramic material, or refractory material define an open topped rectangular heating chamber 15*a* in spaced longitudinal relation from the heating chamber 10*a*. A second pan 16 having flanges 17 around the periphery thereof is mounted in the heating chamber 15*a* with the flanges 17 resting on top of the walls 15.

Additional vertical walls, of brick, refractory material, or other ceramic material such as the walls 18 and 19, are disposed within the heating chamber 15*a* and support the bottom of the pan 16. The walls 18 and 19 also provide baffles for a purpose to be hereinafter described.

Between the heating chambers 10*a* and 15*a* additional vertical walls 20 and 21 are provided for defining with the end walls 10 and 15 supports for arches 22, 23 and 24 to provide an oven chamber 24*a*. The sides of the oven chamber are closed by brick or ceramic material walls 25 and 25*a*.

As best shown in Figure 2, the wall 20 is in spaced relation from the back side wall 25*a* while the wall 21 is in spaced relation from the front side wall 25 of the oven construction. The oven chamber 24*a* thus provided is between the heating chambers 10*a* and 15*a*.

As shown in Figure 1, the pan 11 receives zinc or zinc spelter 26 therein to supply the zinc for the first coating on the ferrous metal article being galvanized. The second pan 16 likewise contains zinc or zinc spelter 27 therein. The zinc 27 is usually substantially pure zinc.

A bridge member 28 operatively connects the two pans 11 and 16. The bridge member 28 has a rectangular outer wall 29 and a bottom portion 30 connected to the side portions of the walls 29 but spaced from the end portions of the wall. The bottom 30 rests on the walls 20 and 21 of the oven construction 25 and also on the flanges 12 and 17 of the pans 11 and 16.

The ends of the bottom 30 are turned down as at 31 to extend respectively into the zinc baths 26 and 27 in the pans 11 and 16. Likewise, the end portions of the outer walls 29 of the bridge member extend into these zinc baths.

A salt or a mixture of salts 32 is disposed in the bridge member 28 and floats on top of the zinc baths 26 and 27 as best shown in Figure 1.

The heating chamber 10*a* is heated by means of a fluid fuel injected through nozzles 33 and 34. The nozzle 33 communicates with the chamber 10*a* between a side wall of the chamber and the baffle wall 13. The nozzle 34 communicates with the chamber between a side wall of the chamber and the baffle 14. As shown in Figure 2 the baffles 13 and 14 do not extend to the end of the chamber 10*a* so that the burning fuel circulates around the ends of the baffles 13 and 14 into the space between the baffles where it is completely burned. The burned products of combustion are drawn off through a duct 35 into a stack 36 from which they are discharged to the atmosphere.

The heating chamber 15*a* is similarly heated by fluid fuel injected through nozzles 37 and 38 and the burning gases pass around the ends of the baffles 18 and 19 to have a tortuous path in the heating chamber. The burned products of combustion are discharged through a duct 39 into the stack 36.

The pans 11 and 16 are thus heated to maintain the zinc baths 26 and 27 within galvanizing temperatures between 850° and 900° F.

The salt 32 in the bridge member 28 is heated by radiation from the oven 24*a*. The oven 24*a* is heated by fuel injected into the oven through a nozzle 40 or a plurality of nozzles and the burning gases pass around the walls 20 and 21 as best shown in Figure 2 for heating the arches 22 to 24 which arches in turn heat the bottom of the bridge member 28 for maintaining the salt 32 in a molten condition. The salt bath 32 is preferably maintained at temperatures not lower than the temperatures of the zinc bath. Temperatures from 900° to 1200° F. are preferred for the salt bath.

The burned products of combustion from the oven 24*a* are discharged through a duct 41 into the stack 36.

When the apparatus of this invention is utilized for galvanizing steel wires, a wire W, or a plurality of such wires in spaced parallel relation, is fed over a roll 42 and under rolls 43 and 44 submerged in the zinc bath 26 so that the wire passes through the zinc bath to receive a coating of zinc thereon.

The wire W is then directed around a roll 45 in the salt bath 32 and the wire passes directly from the zinc bath into the salt bath in the bridge member 28 without contacting the atmosphere since the salt floats on top of the molten zinc.

During the passage of the wire through the molten salt bath 32 the zinc coating on the wire is maintained at a temperature near or above its melting point which causes it to unite rapidly with the iron of the wire and raises the iron content of the ferro-zinc alloy layer.

After passing through the salt bath 32, the wire W passes directly to the second zinc bath over a roller 46 at the end of the bridge member 28 and under submerged rollers 47 and 48 in the second zinc bath 27 for passage through this bath to receive a second coating of zinc thereon around the ferro-zinc alloy coating thereon. The wire does not contact the atmosphere between zinc dips and is introduced into the second zinc bath in a heated condition at an optimum temperature desired for receiving the second coating thereon. The wire W is guided out of the zinc bath 27 around a roller 49.

The process of this invention thereby provides for the coating of a ferrous metal article such as a wire with zinc; the heat-treatment of the zinc coating on the wire in a molten salt bath to convert the coating into a ferro-zinc alloy of enhanced characteristics without dissolving off appreciable amounts of zinc from the wire. The zinc coated wire is passed directly into the salt bath from the first zinc bath without contacting the atmosphere. The heat treated wire is then immersed in a second zinc bath for covering the ferro-zinc alloy coating on the wire with a substantially pure zinc coating.

In some instances it may be desirable to cool the wire before passing the same into the second zinc bath. For this purpose the wire W can be directed around guide rolls **50** and **51** disposed above the salt bath **32** so that the wire is removed from the salt bath into the atmosphere before it is submerged in the second zinc bath. No deleterious effects of the coating on the wire result since the salt will solidify on the coating to protect the same against contacting the atmosphere. The wire may be removed from the salt bath for any desired length of travel to obtain a desired cooling effect and the cooled wire is then re-immersed in the salt bath for melting off of the crystallized salt thereon before immersing the wire in the second zinc bath and for heating the wire to an optimum temperature.

If it is desired to keep the wire submerged in the salt bath without contacting the air, it is possible to vary the temperature in various parts of the salt bath so that the heat is high at the entrance and considerably below the melting point of zinc in the latter part of the bath.

From the above description it should be understood that the molten salt bath or flux increases the iron content in ferro-zinc alloy coatings obtained in a hot dip galvanizing process to provide coatings that are malleable. Prior to this invention it was impossible to build up a non-brittle ferro-zinc alloy coating of appreciable thickness on a ferrous metal article which could be subsequently coated with another layer of coating, such as of pure zinc, because the heating media heretofore used dissolved off appreciable amounts of the coating or resulted in an oxidation of the coating. The salt flux used in this invention has much less affinity for zinc than iron or steel has, and so it favors the formation of the ferro-zinc alloy and still at the same time protects the alloy against oxidation. The salt bath or flux is maintained at temperatures not lower than the galvanizing temperatures used for the zinc bath but temperatures as high as 1200° F. may be used for the salt bath.

We are aware that many changes may be made and numerous details of the process and apparatus 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 hot galvanizing a ferrous metal article which comprises passing the article through a molten zinc bath maintained at temperatures between 850° to 900° F. to form a zinc coating on the article and heat treating the coated article in a molten salt bath heated to temperatures not lower than the temperature of the zinc bath to increase the ferro-zinc alloy content of the coating.

2. The process of increasing the thickness of ferro-zinc alloy coatings on zinc coated ferrous metal articles which comprises heating the coated article to temperatures not lower than the coating temperature and between 850° to 1200° F. in a non-oxidizing molten salt bath having substantially no solvent action on the zinc alloy.

3. In a multi-dip hot galvanizing process, the step which comprises passing a ferrous metal article between zinc dips through a directly heated molten salt bath which does not dissolve substantial amounts of zinc from the article to heat the article for assisting the formation of ferro-zinc alloy on the article and to adjust the temperature of the article as it enters the next zinc bath.

4. The process of hot galvanizing ferrous metal wires which comprises passing a wire through a zinc bath maintained at temperatures between 850° to 900° F. to form a zinc coating on the wire, passing the coated wire directly from the zinc bath into a salt bath without contacting the wire with the atmosphere, heating the salt bath to temperatures between 850° to 1200° F. for converting the zinc coating on the wire into a ferro-zinc alloy of increased iron content and passing the wire from the salt bath through a second zinc bath to receive a coating of substantially pure zinc thereon.

5. In a double dip hot galvanizing process, the step which comprises passing a ferrous metal article between zinc dips through a salt bath comprising molten zinc chloride and sodium chloride at temperatures between 850° to 1200° F. to assist the formation of ferro-zinc alloy on the article.

6. The process of hot galvanizing a ferrous metal article which comprises passing the article through a molten zinc bath maintained at temperatures between 850° to 900° F. to form a zinc coating on the article, and treating the coated article in a non-metallic, non-oxidizing salt bath having little or no solvent action on the zinc coating and maintained at temperatures not lower than the temperature of the zinc bath and between 850° to 1200° F. to convert the coating into a non-brittle ferro-zinc alloy of increased iron content.

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