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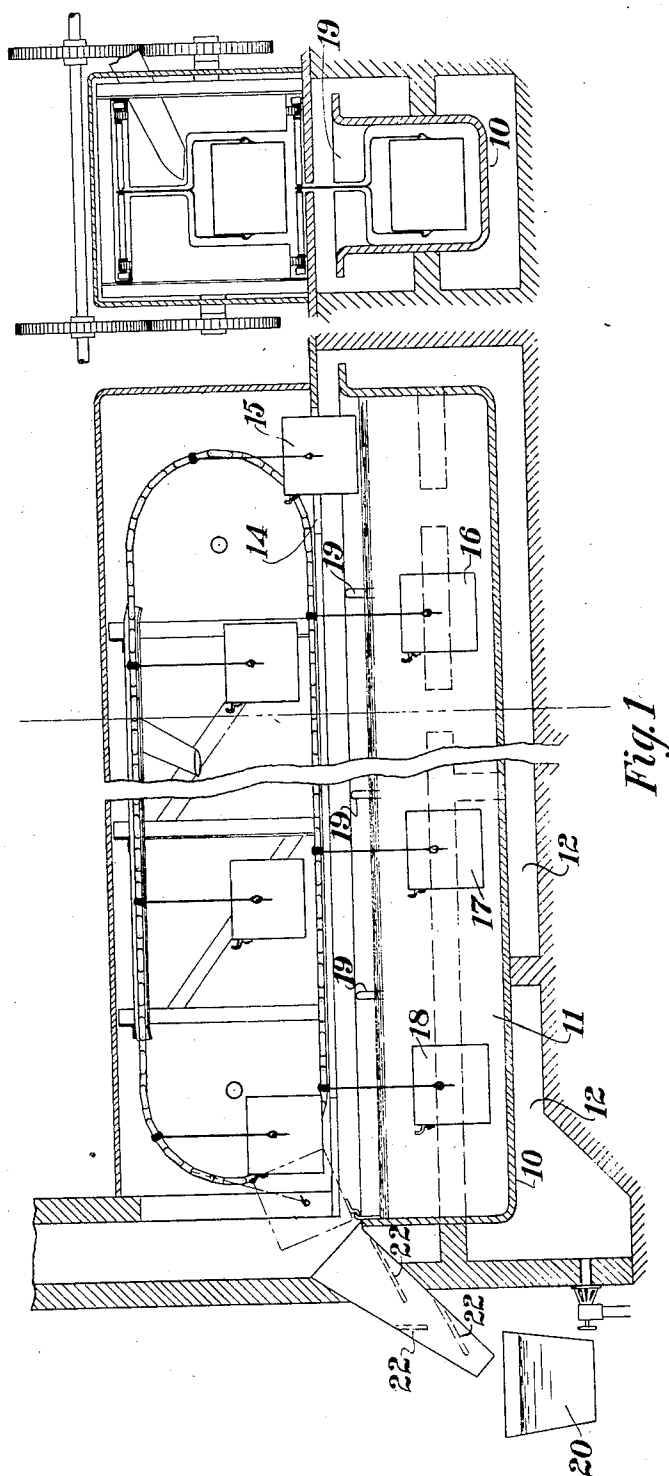
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COATING AND HEAT TREATING

Filed May 25, 1925

2 Sheets-Sheet 1



INVENTOR
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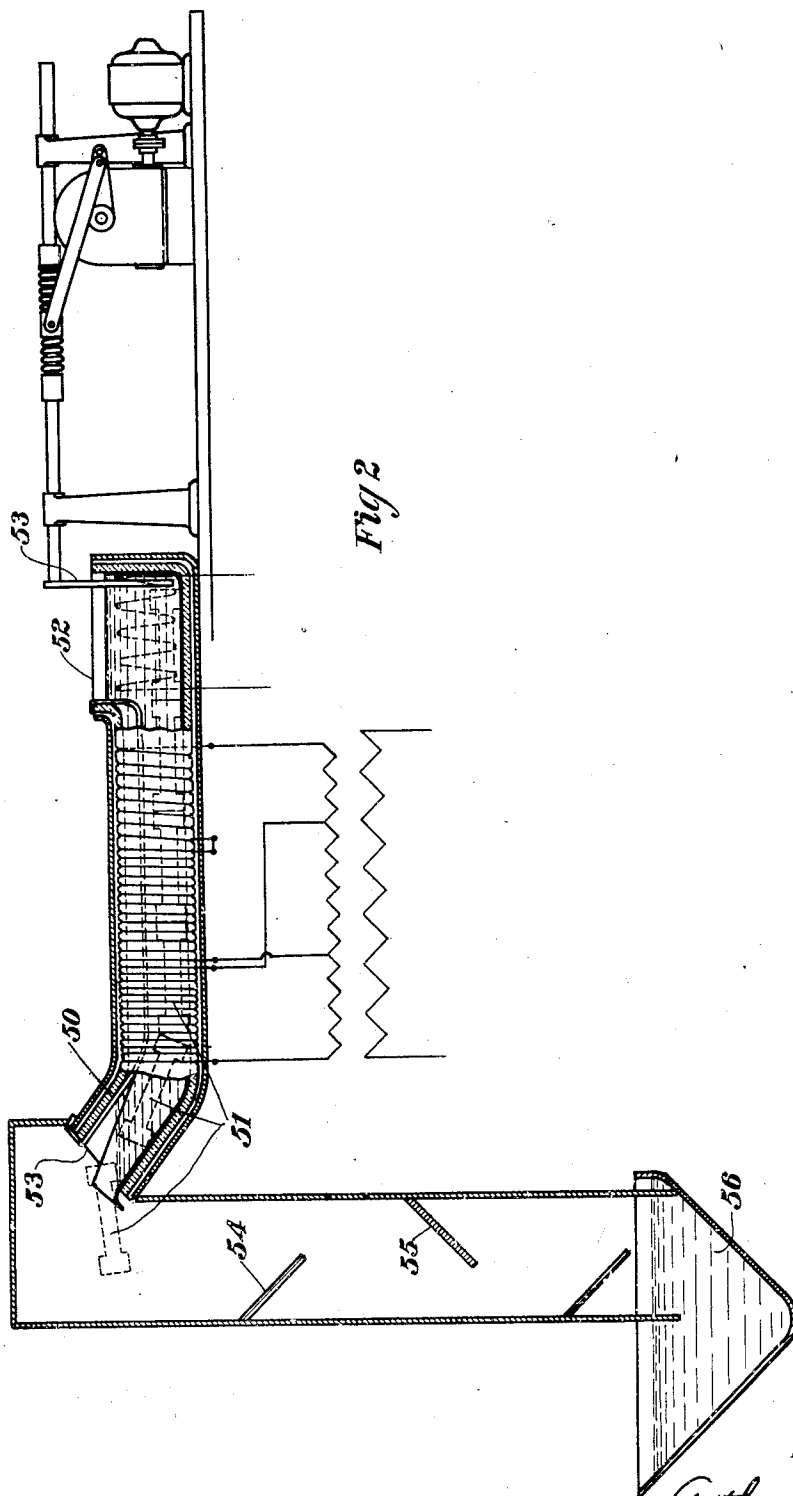
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COATING AND HEAT TREATING

Application filed May 25, 1925. Serial No. 32,709.

This invention relates to a method and apparatus for coating and heat treating metal articles and has for its object the provision of a method and apparatus in which a uniform coating may be economically applied to the articles and in which difficulties that heretofore have been experienced are largely avoided.

The invention also, includes heat treatment of articles simultaneously with the coating operation. In the accompanying drawings there is illustrated, apparatus by means of which the present invention may be performed. This apparatus together with the process comprised in the invention is described in the following specification, the invention being more particularly pointed out in the appended claims.

In the drawings—

Fig. 1 is a vertical section view showing one form of apparatus for practicing the present invention.

Fig. 2 is a view similar to Fig. 1 showing a different form of apparatus.

This invention deals with new and improved methods of galvanizing and heat treating articles. In galvanizing, tinning or coating articles with lead or other material, it is generally desirable to form a uniform coat which amalgamates with the material covered and acts as a water protection.

While the invention applies particularly to galvanizing or the process of coating steel, grey iron and malleable castings with zinc, it applies to coating with some other metals such as tin. In the process of galvanizing it is customary to clean the article by sand or shot blast or by pickling in acid. In the pickling operation, a coating may exist which acts as a flux so that when the article to be galvanized or tinned is placed in the bath, an amalgamation takes place. Where articles are simply clean and bright, it is generally necessary to dip the articles in a flux such as zinc chloride or sprinkle the articles with

ammonium chloride commonly known as sal-ammoniac. If the galvanizing or tinning bath is not very hot, an amalgamation usually takes place without much difficulty, providing the usual pains are taken. Where the amount of material galvanized is large, however, the bath is cooled. This makes it necessary to keep the articles to be galvanized or tinned in the bath long enough so that they can all become heated up, otherwise, if they are taken out of the bath they will have too thick a coat and there may be no amalgamation owing to the chilling of the coating material in contact with the pieces.

One method of correcting this difficulty is to run the molten bath at a higher temperature. This greatly speeds up the operation but in many cases it is open to serious difficulties. Where a bath of high temperature is used, there is a tendency to oxidize the surface of the article to be galvanized or tinned if amalgamation does not take place in a very short time such as may happen if there is a small amount of air or gas entrapped. This makes it exceedingly difficult to use a high temperature bath on many classes of ware which are galvanized or tinned. If the hot bath comes in contact on one side of the metal to be coated and an air or gas pocket exists on the opposite sides of a thin section, the surface may become oxidized or the flux driven off so that amalgamation will not take place readily unless more flux is applied or considerable length of time is allowed. Where the surface becomes oxidized or the flux is driven off before amalgamation takes place, a bare spot or pinhole in the galvanizing or tinning usually results.

One object of the present invention is to get away from this difficulty. This is accomplished by placing the article to be coated in a molten bath which has a relatively low temperature. Where the bath is at low temperature, the tendency to drive off the flux before amalgamation takes place is not so

great and the tendency to oxidize the surface is also reduced so that amalgamation takes place with a minimum amount of fluxing and without the formation of bare spots or pinholes. After amalgamation takes place, the surface of the article to be galvanized or tinned will not be affected by an increase in temperature and oxidization or the driving off of flux will not matter. The next step is to transfer the articles galvanized to a bath which is much hotter. This is frequently quite important when a thin uniform coat is desired or where large production is desirable. In order to insure uniformity, steps may be taken so that temperature is finally raised to the desired value. This can be readily done in one of several ways, depending upon the conditions.

Fig. 1 shows one form of the invention which is suitable for carrying on work where large production is involved. A suitable metal tank 10 containing a molten bath 11 and heated by hot gases in a flue 12 is provided for melting the spelter or tin. In this arrangement, it is desirable to have a tank which is rather long compared to the cross-section so that a material different in temperature in the bath may be obtained at the two ends of the tank. In operation, an ordinary galvanizing basket or container 13 is dropped down through a trap 14 to the position 15. Suitable means is provided for moving the basket containing the material to be galvanized to positions 16, 17 and 18. This may be done gradually or in steps. Since the fire enters through the flue or fire box 12 adjacent to the discharge end, this end of the bath will be considerably hotter as the heating gases are hotter at this point and cool down as they travel along the tank. Another factor which tends to cause a difference in temperature between the entering and discharge end of the tank is that the material to be galvanized requires considerable heat upon entering which tends to cool off the bath at this end. This makes it comparatively easy to maintain a considerable difference in temperature between the two ends of the bath.

Where the galvanizing tank is relatively long compared to the cross-section, it is not necessary to have the baskets or containers of such size that they will prevent convection currents in the molten bath which will tend to cause a uniform temperature throughout nor is it necessary to provide means to prevent convection currents which, of course, is necessary where the cross-section of the tank is rather large compared to the length. Where the baskets travel at some distance below the surface, there is a tendency for the molten bath to travel with the baskets to some extent. This causes a flow in the opposite direction near the top. By properly proportioning the parts, this flow may be

controlled so that the flux and accumulation of dirt on the top of the bath may be kept at the entering side. In this case, the baffles 19 are partially or entirely removed. Where the motion of the baskets through the galvanizing bath is not too rapid, most of the flux will rise to the surface at the entering end where it will remain due to being held back by the baffles 19 or the flow of the molten bath at the surface, as previously described. When the basket reaches the end position 18 it is lifted either by hand or automatically and the contents emptied into the quenching tank 20 which is filled with water, oil or other suitable material. It is generally advisable to allow the material being emptied to strike baffles 22 before it enters the quenching tank. This tends to separate the pieces so that when they are quenched, there will be no difficulty in the pieces being stuck together by the galvanize or tin. Where the latter takes place, a bare or rough spot usually results. By using the baffles 22 or other retarding device, the articles are separated as they enter the quenching bath so that they do not freeze together.

With the improved method, smaller batches may be sent through at a time. In addition to the improved condition for ordinary galvanizing and tinning operations, the improved method has a further advantage of great importance. With the method as shown, it is possible to use much higher temperatures in the bath without serious consequences. This forms an opportunity to heat treat articles during the galvanizing or tinning operation. By raising the temperature high enough, it is possible to materially improve the qualities of malleable iron which may otherwise be embrittled by the galvanizing operation. It is also possible to change the structure of steel pieces in order to increase their toughness and control the elastic limit, resiliency or temper of the piece. This may be controlled in the usual way of the temperature of the piece and the nature of the quenching bath. Conditions are greatly facilitated in some cases by carrying out the operations, particularly at high temperatures, in a neutral or practically non-oxidizing atmosphere. This may be readily accomplished by causing the flue gases to fill the space above the tank and around the basket and articles before they enter the quenching tank. Not only does the neutral reducing air of the flue gases protect the bath from oxidation, but the articles are kept hot until they enter the quenching bath. This is important in small articles where a uniform coating is desired or where a closely controlled temperature for the quenching is desired.

This improved method has several other advantages. It is particularly applicable to the galvanizing of threaded parts where the

high temperature of the molten bath permits a control of the thickness of the coating.

The method is particularly applicable for galvanizing or tinning baths which are electrically heated as the amount of material required is exceedingly small.

One form of apparatus for accomplishing the desired results is shown in Fig. 2. In this case a tube 50 is filled with a molten bath and the articles 51 are put in at the charging end 52 and discharged at the end 53. The tubular member 50 containing the molten material may be of metal or a suitable refractory. The heating may be accomplished by any suitable fuel or by electrical energy as shown. Since the incoming material enters the end 52, it will tend to lower the temperature of the bath at this point. As the material traverses toward the end 53 it will be heated up. This movement may be provided by magnetic apparatus in the case that a refractory or non-magnetic tube is used or by a mechanical feeder 53 which periodically shoves the pieces 51 forward. If the heating turns are concentrated at the discharge end a higher temperature will be provided at that end which with the cooling action at the entering end will tend to maintain a temperature difference with its advantages as previously explained. With this system an enclosed tube may be used which will prevent the bath from coming into contact with the air or gases except at the entering and discharging ends, so that there will be little oxidation.

Where the refractory tube is used, the amount of dross will be reduced to a minimum and under favorable conditions no dross will be formed. This is a very material advantage in that one of the principal objections to high temperature is the amount of dross formed. As the piece is discharged from the end 53 it may be allowed to fall a considerable distance and strike several baffles 54 and 55 before falling into the quench tank 56. Striking several baffles tends to knock off any superfluous material and if time sufficient is allowed before striking the cooling bath, the surface tension will tend to form a very uniform coat. Instead of striking baffles it is possible to allow the article to fall thru a passage into which air is forced at a considerable velocity. This tends to blow off any superfluous material and the direction of the air may be used to retard the fall giving ample time to remove the superfluous material. With the methods shown, it is possible to raise the material to the desired temperature so that the article may be tinned or galvanized and at the same time given a heat treatment to increase the mechanical strength, hardness or reliability. This method is applicable to the heating of articles for heat treatment as well as for the galvanizing or tinning operation.

I claim—

1. The method of imparting a protective coating to articles, comprising the steps of subjecting the articles to melted coating material, the temperature of the melted coating material to which the articles are initially subjected, being only slightly above the melting point of said coating material, and subsequently subjecting the articles to a bath of the same coating material at a temperature much higher than the temperature of the melted coating material to which the article are initially subjected.

2. The method of imparting a protective coating to articles, comprising the steps of immersing the articles in a bath of melted coating material, the temperature of the melted coating material to which the articles are initially subjected, being slightly above the melting point of said coating material, and thereafter moving the articles to a bath of said material at a temperature much higher than the melting point of said coating material and much higher than the temperature of the coating material to which said articles were initially subjected.

3. The method of coating metal articles, comprising the steps of maintaining a bath of coating material at different temperatures in different portions of said bath, subjecting the articles first to a portion of the bath at a lower temperature, and thereafter moving the articles to a portion of the bath composed of like material as said first portion but at a temperature much higher than the temperature of that portion of the bath to which the article was first subjected and sufficiently above the melting point of said material that only a thin coating of said material will adhere to said article.

4. The method of coating metal articles, comprising the steps of providing a bath of coating material having one portion thereof at a lower temperature than another portion the material of the bath being the same throughout, subjecting the articles first to the portion at a lower temperature, then to the portion at a higher temperature, and then removing the articles from the high temperature portion and agitating them to remove excess material, the portion of the bath from which the articles are removed being maintained at a temperature well above the melting point to permit all of the coating metal but a thin layer thereof to be removed by said agitation, the temperature of said last named portion being so high as to interfere with the application of an initial coating if the articles were submerged therein prior to receiving an initial coating.

5. The method of coating metal articles, comprising the steps of providing a bath of coating metal having a relatively hot portion and a cooler portion, initially subjecting the articles to the cooler portion in the presence of a flux to provide intimate union of the

coating metal with the surface of the articles, then moving the articles to a hotter portion of the bath to impart uniformity of the coating and facilitating removal of excess coating material, then removing the articles from the hot portion of the bath and agitating them while still hot to remove excess material, the temperature of the hot portion of the bath being much higher than the melting point of the coating material.

6. The method of coating metal articles, comprising the steps of providing a bath of coating metal having a relatively hot portion and a cooler portion, the temperature of the hot portion being sufficiently above the melting point of the coating metal to interfere with the application of an initial coat of said metal to articles to be coated, subjecting the articles to the cooler portion first and thereafter to the hot portion, and then removing the articles from the bath at the hot portion thereof into a substantially nonoxidizing atmosphere.

7. The method of coating metal articles, comprising the steps of providing a bath of coating metal having one portion at a higher temperature than another, maintaining a covering of inert gas over the surface of the bath, subjecting the articles first to the cooler portion of the bath in the presence of a flux to impart a coating to the articles and effect intimate union between said coating and the surface of the articles, then transferring the articles to a hotter portion of the bath at a temperature sufficiently above the melting point of said coating material to insure uniformity of the coating and facilitate removal of excess coating material but which would interfere with the application of an initial coating of said material to said articles, then removing the articles from the bath into the inert gas, then agitating the articles while still hot to remove excess material, and then quenching the articles.

8. The method of treating articles, comprising the steps of subjecting the articles to a bath of coating metal at a temperature but slightly above the melting point of said coating metal and suitable for applying an initial coat of said metal to said articles without serious oxidation or interference with the action of the flux used, then to a bath of the same metal at a temperature much higher than that of the coating metal to which the article is initially subjected and sufficient to modify the physical characteristics of the metal of which the bodies of said articles are composed, and then removing the articles from the bath and quenching the articles.

9. The method of treating articles, comprising the steps of maintaining different portions of a bath of coating material at different temperatures in an atmosphere of substantially non-oxidizing gas, subjecting the articles to the cooler portion of the bath in

the presence of a flux to impart a coating to the articles, then subjecting the articles to a portion of the bath having a temperature sufficiently above the melting point of said coating material to heat treat the articles and modify the characteristics of the metal of the articles but also hot enough to render it unsuitable for the application of an initial coating of said material, then removing the articles from the bath into said atmosphere, then agitating the articles while still hot to remove excess coating material, and then quenching the articles in a cooling medium.

10. The method of treating metal articles, comprising the steps of maintaining one portion of a bath of coating metal at a temperature sufficiently high to affect permanently the physical characteristics of the metal of the articles and to interfere with the application of an initial coating to said articles and another portion of said bath at a lower temperature but slightly above the melting point of said coating material, subjecting the articles first to the portion of the bath at the lower temperature to impart a coating thereto, and then transferring the articles to the hotter portion of the bath for heat treating the articles.

11. The method of treating metal articles, comprising the steps of causing products of combustion to travel along a receptacle to impart different degrees of heat to different portions of the receptacle, permitting the products of combustion to cover the surface of a bath of coating metal in said receptacle, introducing articles to be treated into the cooler portion of said bath in the presence of a flux to impart a coating to said articles and effect an intimate union of said coating with the surfaces of said articles, then transferring the articles to the hottest portion of said bath to heat treat the articles and insure uniformity of said coating and facilitate removal of excess material therefrom, then removing the articles into said products of combustion, agitating said articles while still heated and while surrounded by said combustion products, and then quenching said articles in a cooling medium.

12. The method of treating metal articles, comprising the steps of subjecting the articles to a bath of coating material having a relatively low temperature where the articles are introduced into the bath and a higher temperature where the articles are removed therefrom, and permitting the articles to fall upon baffles and into a quenching bath as they are discharged from said bath.

13. The method of coating articles comprising the steps of subjecting the articles to a bath of coating metal at a temperature but slightly above the melting point of said coating metal and suitable for applying an initial coat of said metal to said articles without serious oxidation or interference with the action of the flux used, then subjecting the

articles to a bath of the same metal at a temperature much higher than that of the coating metal to which the articles were initially subjected and so high as to interfere with the coating operation if the articles were
5 subjected thereto prior to receiving an initial coating and then removing the articles from the bath at the hotter portion thereof.

In testimony whereof I have signed my name to this specification on this 19th day
10 of May A. D. 1925.

ARTHUR O. AUSTIN.

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