UNITED STATES PATENT OFFICE.

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METHOD OF APPLYING PROTECTIVE COATINGS TO METALLIC ARTICLES.

1,155,317. Specification of Letters Patent. Patented Sept. 28, 1915.

No Drawing. Application filed May 28, 1914. Serial No. 841,484.

To all whom it may concern:

Be it known that we, CLARENCE MARK, residing at Evanston, in the county of Cook and State of Illinois, and CLAYTON MARK, Jr., residing at Lake Forest, in the county of Lake and State of Illinois, citizens of the United States, have jointly invented a new and Improved Method of Applying Protective Coatings to Metallic Articles, of which the following is a specification.

Our invention relates to methods of applying protective coatings to metallic articles, and consists in introducing the articles to be coated into a bath containing lead and zinc, or lead, tin and zinc in such proportions that when they are alloyed they are electro-positive to iron in an electrolyte, such as tap water, salt solutions or common conducting solutions other than nitrates, and in maintaining a suitable protective flux upon the bath.

Our invention also consists in maintaining the bath at a temperature lower than the melting point of zinc and in the periodic addition of zinc which will be taken up by the bath so as to maintain constant the proportion of zinc in the alloy.

A typical example of carrying out our process is as follows:

We take the article to be coated, such as an articles of iron or steel, and cleanse it in a suitable bath, preferably using the usual sulfuric acid pickle, and, after washing the article, putting it through a bath composed of muriatic acid and sal-ammoniac, or zinc chlorid, or both, and water, such as is ordinarily used in a galvanizing process, the article is then passed through molten bath of lead, tin and zinc covered with a sal-ammoniac flux, in which flux is present zinc and iron in small percentages. By reason of the great affinity of the zinc for iron or steel, the article immediately picks up small percentages of zinc, and the zinc forms on the surface of the iron a zinc-iron alloy, to which the composition of the bath will adhere. As soon as the article has reached approximately the temperature of the molten bath, which is preferably between 650° and 760° F., the article is withdrawn from the molten bath, and then is kept in motion until the coating has set, so as to prevent the coating from depositing unevenly.

The bath is preferably of the following composition: Lead 94.45, zinc 1.81, tin 3.74, which we have found to give the best results. Other compositions found to give favorable results are: lead 99.55, zinc .45; lead 97.20, zinc .80 and tin 2; and lead 90.54; zinc 1.96 and tin 7.5. These alloys contain in each instance approximately the stated amount of zinc at the saturation point, when temperatures between 650° and 760° F. are used. When the temperature is increased more zinc may be added, or when the percentage of tin is increased the higher is the percentage of zinc which is necessary to saturate the bath.

The zinc vaporizes readily, and also, in addition to being taken up with the other ingredients to form the coating on the article, it combines with the iron of the article to form a zinc-iron alloy and it also is taken up by the flux, so the bath becomes depleted of its zinc, unless special steps are taken to prevent this. We have found that it is of great importance to keep the quantities of zinc in the bath uniform, and, to this end, we add small quantities of zinc at frequent intervals, to keep up the necessary percentage of this metal in the alloy, preferably near to saturation. The zinc is preferably added in a molten state, to facilitate the ease with which it is dissolved in the bath, and it is added and maintained in slight excess of the amount desired to alloy with the other metal in the bath; thus the zinc collects around the edge of the pot and is automatically taken up by the bath as the proportion of zinc in the alloy becomes depleted, and the presence or absence of the free zinc serves as an indication to the workman as to whether or not the alloy contains the desired proportion of zinc. By introducing the zinc in a molten state we are enabled to maintain the bath at a temperature below the melting point of zinc, which results not only in saving the cost of fuel, but in a saving in the zinc, since the zinc, if maintained at such lower temperature, does not vaporize as readily as it would at a higher temperature. This also results in a saving of time in cooling and in the production of a more uniform coating. To replenish the volume of the bath, lead, tin and zinc are added in the usual proportions.

Analysis and examination of an article coated with the coating described above has shown the coating to consist of an underlying layer of a zinc-iron alloy, which is cov-

ered and combined with an alloy of lead, tin and zinc, which forms the exterior coating. We have found that lead alone, or lead and tin, will not readily adhere to iron or steel when low percentages of tin are used. Zinc, however, by its affinity for iron, readily unites with the iron, and the resultant zinc-iron alloy forms a base for adhesion of the lead-tin-zinc alloy.

An alloy made in the proportions described is very resistant to weather and acid attack, and it is electro-positive to iron. The alloy forms a smooth and uniform coating, which can be readily applied to pipes, sheeting and similar articles, and it has been found to be very valuable in protecting iron castings, especially those which are malleableized. This coating, by reason of being applied to the articles at a low temperature, will not change the condition of the carbon content due to the article having been malleableized.

It is obvious that various modifications may be made in the process which we have described and claim herein, without departing from our invention.

It is to be understood that in our co-pending applications, Serial No. 760,903, filed April 14, 1913, and Serial No. 43,528, filed August 4, 1915, we have described and claimed articles coated by the process described herein.

What we claim is:

1. The herein described process of applying protective coatings to metallic articles, which consists in introducing the article to be coated into a molten bath consisting of lead, with small percentages of tin and zinc, the zinc being present substantially up to the point of saturation of the bath, the molten metal being covered by a flux of sal-ammoniac containing iron and zinc salts.

2. The herein described process of applying a protective coating to iron and steel articles, which consists in introducing metallic articles into a bath, the temperature of which is between 650° and 760° F. and being protected by a flux of sal-ammoniac containing iron and zinc salts, the said bath containing mainly lead, but having alloyed with it enough zinc to render the coating obtained from said bath electro-positive to iron but not in excess of 3% of zinc.

3. The herein described process of applying protective coatings to metallic articles, which consists in introducing the metallic articles to be coated into a bath of lead containing zinc heated to between 650° to 760° F., and adding more zinc periodically so as to maintain the proportion of zinc in the alloy at a point below 3% but above an amount necessary to render the coating formed from the bath electro-positive to iron.

4. The herein described process of applying protective coatings to metallic articles, which consists in introducing metallic articles into a lead bath containing tin and zinc, covered with a flux of sal-ammoniac, said flux containing zinc and iron salts, the bath forming upon the surface of the articles a zinc-iron alloy, and forming upon the zinc-iron alloy, an alloy of lead, tin and zinc.

5. The herein described process of applying a protective coating to metallic articles, which consists in introducing metallic articles into a bath containing lead and zinc substantially up to the saturation point, and periodically adding zinc in such proportions as will maintain the zinc content at a uniform percentage in the bath at temperatures less than the melting point of zinc.

6. Process of coating iron articles, consisting in immersing them in a lead bath maintained at a temperature between 650° and 760° F., said lead bath containing tin under 7.5% and zinc substantially up to the point of saturation of the bath at the operating temperature, the maintenance of this zinc content being provided by the periodical addition of zinc in such quantity that a portion of it floats upon the surface and thus furnishes an indication as to the condition of the bath.

7. The herein described process of applying a protective coating to metallic articles, which consists in introducing articles into a bath containing lead and zinc substantially up to the saturation point, and periodically adding zinc in such proportions as will maintain the zinc content at a uniform percentage in the bath.

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Witnesses:
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