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ZINC COATED FERROUS ARTICLE

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My invention relates to zinc coated wire and the like, and methods for producing the same. My invention comprises a method for producing steel wire, or similar article, having a ductile coating of zinc in which a metal blank is provided with a coating of zinc substantially free from iron and then cold drawing the coating blank to the desired gauge having a zinc coating of the desired thickness.

It is old in the art to produce zinc coated wire in various ways. The most common method is to prepare the wire of substantially the desired gauge and then pass the wire through a bath of molten zinc, the wire taking up a certain amount of zinc during the passage to form the coating. It is also old to electrolytically coat the wire, after having been rolled to the desired gauge. Both of these methods have certain objections. Wire of the most satisfactory physical characteristics is usually produced by effecting the drawing operations at relatively low temperatures; they are, to use the common expression, "cold drawn." Giving these wires a zinc coating by the "hot dip" method, that is, by passing the wire through a molten bath of zinc, acts deleteriously upon the physical characteristics of the cold drawn material, the temperature of the zinc bath being sufficiently high to give this effect. By producing the coating electrolytically this damaging effect of relatively high temperature upon the properties due to cold drawing is avoided, as electrolytic coating is ordinarily carried out at relatively low temperatures. However, the electrolytic coating of wire of relatively small gauge is somewhat expensive and with the smaller diameters there are considerable technical difficulties in getting the desired thickness of coating and having such coating of uniform thickness. My invention avoids the disadvantages of both of the above methods.

In my process the iron or steel is reduced to the desired size in the regular way, that is to say, I produce "rod" by the usual rolling methods. At this stage, or at some subsequent stage in the manufacture of wire, I electrolytically deposit a coating of zinc upon the rod or wire, and then proceed to cold draw the body thus coated to reduce the iron or steel and the zinc coating proportionately to each other to obtain a wire of the desired gauge and having the desired thickness of zinc thereon. It is desired to make clear, at this point, that the zinc coating is deposited upon the ferrous blank while it is still at a stage considerably removed from the finished gauge. By depositing the zinc while the blank is still of considerable dimensions, I am able to effect my electrolytic operation at the most economical stage and also at a stage which is most efficient for securing a zinc coating of uniform thickness.

In preparing the blank which is to receive the zinc coating, I first produce the steel in the form of "rod," as indicated above. At this stage I may effect the usual "patenting" operation. If there is to be no further patenting operation, or other type of heat treatment of the material, I may effect my electrodeposition upon the rod itself. However, if there is to be a patenting or equivalent operation upon the partially drawn wire, I defer the electrodeposition until subsequent to such heat treating. In other words, the zinc coating is not produced upon the blank until the last patenting or other heat treatment at relatively elevated temperatures.

It is advisable to effect the deposit upon the blank while its dimensions are still considerably removed from the finished product; in other words, the greatest gain in efficiency is secured in coating the wire while still having a diameter considerably in excess of the finished product.

I produce a zinc coating on the blank of a thickness which is determined by the thickness which is desired in the finished wire. Therefore, the thickness of the coating is a definite multiple of the thickness of the coating desired in the finished wire, which is dependent upon the relative diameters of the blank and the finished wire. After the blank has received the zinc coating it is then cold drawn to reduce the ferrous material and the zinc coating proportionately to each other until the desired coating of wire is reached and the finished wire will possess a coating of the desired thickness.

I have discovered that a blank containing the desired thickness of coating of zinc may be effectively drawn, as above outlined, providing the zinc coating is substantially free from iron and certain other impurities. If the coating, or a portion of the coating, were to contain an undue quantity of iron, it would be difficult to effect the proportional reduction of ferrous material and coating to obtain a satisfactory product, and one having just the thickness of coating desired.

Preferably I coat the iron or steel blank, whether at the rod stage, or somewhat later by electrolytically depositing the necessary amount of zinc thereon. The blank must have an effectively clean surface as it is important that there be a good bond between the ferrous surface and the coating. Preferably I pass the blank continuously through the zinc containing elec-

trolyte, using the blank as cathode in the electric circuit. I have secured excellent results by employing an electrolyte containing zinc sulphate and a considerable percentage of free sulphuric acid. Preferably I employ a high current density since it is frequently important that I effect the deposition of thick coatings upon the blank in order that the desired thickness of coating be obtained in the finished wire. I employ current densities as high as 1000 amperes per square foot of cathode surface, and, at times, even higher. It is important that the electrolyte be free from impurities which might produce a zinc deposit containing substantial amounts of embrittling impurities. Ordinarily I employ insoluble anodes, such as lead, or lead alloyed with a small percentage of silver.

I appreciate the fact that it has been proposed to coat metal blank with ductile metals such as lead and tin for the purpose of facilitating the drawing operation, the lead or tin acting, as it were, like a lubricant. After the drawing operation in these prior proposals, the finished articles would have thin surface layers of tin or lead. It was usually indicated that these layers should be removed although in some cases it was deemed advisable that they be retained. Nowhere in the prior art, as far as I have been able to determine, has it been proposed to coat a blank with a predetermined amount of zinc and then draw the blank with proportional reduction of zinc and ferrous metal to give a product of the gauge sought with a predetermined desired thickness of zinc coating. No one has previously realized that a blank could be given a desired thickness of zinc coating and the drawing controlled to obtain the necessary thickness of coating in the finished product.

I believe it to be new to select an intermediate stage of manufacture of wire, or equivalent article, for the coating step. So far as I am aware, no one has selected, for electrolytically coating the article, a stage where the coating operation could be effected most efficiently and economically.

My invention finds special application in the manufacture of wire cables. These cables are ordinarily made up of a multiplicity of cold drawn steel wires. Cables, from the nature of their use and the fields of their application, are particularly susceptible to fatigue corrosion. Accordingly, efforts have been made to avoid this deleterious effect. The separate wires of the cables have been galvanized by the ordinary "hot dip" method. While this has reduced the tendency to fatigue corrosion, the "hot dip" treatment has considerably reduced the desirable physical characteristics obtained by the cold working. Moreover, the zinc has not been uniformly distributed, the thickness of the zinc coating on the separate wires not being uniform, resulting in the zinc not being utilized to its maximum capacity.

By my invention cables may be made of a multiplicity of wires each of which has a zinc coating of any desired thickness, the zinc being symmetrically distributed. Furthermore, the steel possesses the properties due to cold working in an unimpaired condition.

Cables produced by my invention offer remarkable resistance to corrosion fatigue. Not only does the zinc coating of substantially pure zinc, and of substantial thickness, protect the wire against corrosive attack, but the pure zinc, separating the wires from each other, acts as a lubricant to reduce stresses which are set up while the cables are in use. An important factor in giving this result is the symmetrical distribution of zinc on the separate wires.

At this point it is desired to indicate a little more fully this matter of uniform zinc distribution. It is more difficult to secure a uniform coating upon a low gauge wire than upon a higher gauge. Accordingly, I have found a real advantage in this respect in depositing the zinc upon the rod or upon wire of high gauge. Moreover, the drawing operations which succeed the coating step effectively remove any unevenness of coating thickness. In practice the wires produced by my invention possess coatings, the outer surfaces of which are concentric with the outer surfaces of the steel wires.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a process for making zinc coated ferrous wire, the steps of providing a ferrous blank with a coating of zinc substantially free from iron, said coating being of a thickness of a definite multiple of the thickness of the coating desired in the finished wire, drawing the coated blank to reduce the ferrous blank and the coating proportionately to each other to produce a wire having a desired predetermined thickness of zinc coating.

2. In a process for making a zinc coated ferrous wire, the steps of mechanically reducing the ferrous metal to a blank of dimensions adapted to be efficiently electroplated, electroplating zinc on the blank to produce a zinc coating free from substantial amounts of embrittling substances, said coating being of a thickness which is a definite multiple of the thickness desired in the finished wire, and cold drawing the coated wire to a pre-determined diameter having the desired predetermined thickness of zinc coating.

3. In a process for making a zinc coated wire, the steps of mechanically reducing ferrous metal by successive stages, heat treating the ferrous metal between certain of said stages, coating the ferrous metal with substantially pure zinc following the last heat treatment, the coating being of a thickness which is a definite multiple of that desired in the finished wire, and cold drawing to reduce the ferrous material and the zinc coating proportionately to each other to produce wire of the desired predetermined gauge and having a zinc coating of the desired predetermined thickness.

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