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METHOD OF AND APPARATUS FOR COATING STRANDS

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This invention relates to methods of and apparatus for coating strands.

Objects of the invention are to provide uniform and effective coatings for strands and effective and efficient methods of and apparatus for applying coatings to strands.

In accordance with one embodiment of the invention, a steam wipe coating apparatus is provided having a steam outlet chamber provided with means for maintaining the chamber at an elevated temperature and provided with a down draft exhaust, and adapted to apply high melting point alloys or metals, such as zinc, to strands. The apparatus is also adapted to apply lead alloys which are incapable of being applied by mechanical wiping means.

A complete understanding of the invention may be had by reference to the following description taken in conjunction with the accompanying drawing, in which

Fig. 1 is a side elevation, partly in section, of an apparatus embodying the invention and by means of which the method of the invention may be practiced and the strands of the invention made; and

Figure 2 is a fragmentary sectional view of the steam wiping head and steam outlet chamber.

In the drawing, which illustrates a preferred form of the invention, reference numeral 10 designates a reel upon which is wound a supply of strand material, such as wire 11, to be coated. From reel 10 the strand material passes over pulley 12 to a fluxing bath 13, which is designed to remove impurities from the surface of the strand and prepare it to receive a coating. The construction and composition of the bath 13 will depend largely upon the material to be treated but a solution of zinc chloride, ammonium chloride and hydrochloric acid will be found satisfactory where copper wire is to be coated with tin.

From the bath 13, the strand passes over a pulley 15 to a coating bath 16, consisting of a liquid coating material, such as molten zinc, tin or tin-lead alloys which may contain bismuth or cadmium. Tin and lead form alloys in practically all percentages and these alloys may be applied to strands by this method and apparatus herein disclosed. The coating material is contained in a tank 17 which may be heated by any suitable means. However, if a metal of high melting point is to be applied to the strand, the container 17 is preferably placed in a second container 18 having a lead bath therein. In order to heat the lead bath the container 18 is

provided with a plurality of tubular heating elements 19 containing electrical heating elements for heating the bath. In this manner a uniform temperature is applied to the container 17 so that the heat applied to any point of this container will not be so high as to cause excessive corrosion of the container. The container 17 has a bracket 21 removably secured therein and is provided with a lateral member 22 under which the strand passes during its immersion in the bath.

From the coating bath the strand, having an excess of coating material applied thereto, next passes to the wiping mechanism 23, where the excess coating material is removed as described in detail hereinafter, and then passes to a cooling device 24. The cooling device has an inclined groove through which the strand passes and a stream of water is supplied to the groove from a pipe 25 having its outlet near the upper end of the groove. The strand is thereby brought into contact with the cool water and chilled, after which it may be dried by means of a blast of air from a pipe 26 and passed over a pulley 27 and a capstan 28 to a driven take-up reel 29.

The wiping mechanism 23 comprises a gas separating chamber 31 provided with a downwardly extending column 32 which passes through the molten lead bath in container 18 and is heated thereby. The wiping mechanism is mounted closely adjacent the edge of the container 17 of the liquid coating material and comprises a die 33 of the wire drawing type but of substantially greater diameter than the strand 11, thus allowing a substantial clearance between the strand and die so that when the strand passes through the die in the bath 16, only the gross excess of coating material is removed by the die. The die, which may be of diamond or other hard material, is mounted on a pivotally supported bracket 34 by means of which the die may be swung upwardly and away from the bath 16 in threading the wire through the die at the beginning of the coating operation, since the heat of the bath 16 is so intense as to make it inconvenient to thread the die in operative position. During operation, the bracket 34 is preferably secured in position by means of a thumb screw 35.

Mounted in alignment with the preliminary wiping die 33 is a steam wipe mechanism comprising a block 36 having a conical chamber 37 therein, which opens into a tube 38 having a conical interior wall 39. The chamber 37 is provided with an inlet for superheated steam 41. 55

The block 36 is provided with an aperture through which a cone-shaped member 42 is inserted into the chamber. This member is provided with an internal bore of such size that it will not contact with the coated wire and the member is provided with a peripheral flange 43 for setting the member in the block 36. The distance the conical portion of member 42 extends into chamber 37 may be varied by placing washers 44 under the flange 43. The wiping mechanism just described is designed to use superheated steam or other gas which enters the chamber 37 through the inlet and passes through the narrow opening at the apex of chamber 37, thereby tending to produce a suction through the bore of member 42 and draw air from the exterior of the wiping mechanism. Such an influx of air is undesirable since it prematurely chills the coating material and causes it to congeal on the strand and may be prevented by adjusting the member 42 by means of the washers 44 until adjustment is reached, at which there is no influx of air at a given gas pressure. From the apex of the chamber 37, the velocity of the steam increases due to its expansion in tube 38 so that the strand is subjected to a wiping action by the movement of steam at a high velocity longitudinally of the wire for a substantial distance. The excess coating material remaining on the surface of the strand after its passage through die 33 is thereby removed and broken up into droplets which are separated from the steam by gravity in chamber 31 and dropped into a container 45 at the lower end of column 32. Preferably two containers 45 are provided in the base of the column so that when one container is removed, the removed coating material will drop in the other container. The steam passes downwardly from the separating chamber 31 and is drawn laterally from the column 32 by an exhaust outlet tube 46. By thus providing a down draft exhaust, the droplets of coating material attain a sufficient downward momentum before reaching the exhaust outlet that they will continue downwardly into the containers 45, thereby preventing the accumulation of coating material in the exhaust outlet.

When zinc or other metals having a high melting point are used, it is necessary to prevent the coating material from freezing on the strand before being wiped. For this reason the die 33 is mounted as nearly adjacent the bath of coating material as possible and the walls of the gas chamber 31 are heated by providing a plurality of electrical resistance elements 27 therein. The exterior of this chamber is also preferably provided with insulating material 48. The superheated steam, therefore, loses heat chiefly by the work performed from wiping the coating material, and the coating material removed from the strand will not tend to collect on the back of the die or the walls of the inner walls of the chamber. Since the column 32 is immersed in the lead heating bath in container 18, this column will also be maintained at such a high temperature that the molten material will not adhere to the walls thereof.

The thickness of a coating remaining on the strand will be controlled by varying the speed of the wire or the pressure of the gas, or both. As an illustration of the steam temperature and pressure used for steam wiping tin-lead alloy comprising 35% tin and 65% lead, the superheated steam may be introduced into the chamber 37 at a temperature of 750° F. and a gauge pres-

sure of 150 pounds. The melting point of this alloy is 520° F., and the steam in its expansion in moving through the tube 38 cools down to a temperature of 250° F. In general the temperature of the superheated steam should be substantially higher than the melting point of the coating metal; otherwise the steam in expanding will cool to such a low temperature as to chill the coating metal and prevent effective wiping of the coating.

The melting point of zinc alloys can be made substantially lower than that of zinc by alloying the zinc with suitable metals; for instance, by alloying 95% zinc with 5% aluminum, the melting point is lowered from 787° F. to 716° F. Other suitable alloys which may be used are: zinc 96.8% and magnesium 3.2% having a melting point of 692° F.; zinc 25% and lead 75% having a melting point of 700° F.; zinc 17% and cadmium 83% having a melting point of 506° F.; and zinc 8% and tin 92% having a melting point of 376° F. These lower melting points result in the possibility of lower temperatures for the superheated steam, which, as pointed out above, should be substantially higher than the melting point of the coating alloy.

In some cases it may be desirable to apply a zinc or zinc alloy coating to tempered high carbon steel wire. This may be done by running the wire at such a high speed that only the outer layer of skin of the wire is heated appreciably. The coating may then be chilled immediately upon leaving the wiping head without destroying the temper of the wire. In galvanizing a steel wire, of course, the wire must first be fluxed as is well known in the art.

The expressions "strand" or "strand material", as used in the specification and claims, are intended to embrace any elongated material, such as strips, sheets, rods, or the like.

What is claimed is:

1. In an apparatus for coating strands, means for applying coating material to the strand, means for applying a heated stream of gas to the strand to remove excess material therefrom, a gas chamber surrounding said means, and a down draft gas exhaust means associated with said chamber.
2. In an apparatus for coating strands, means for applying coating material to the strand, means for applying a heated stream of gas to the strand to remove excess material therefrom, a gas chamber surrounding said means and having a downwardly extending column, an exhaust outlet connected to said column, and means for collecting material removed from the strand in the base of said column.
3. In an apparatus for coating strands, means for applying coating material to the strand, means for applying a heated stream of gas to the strand to remove excess material therefrom, a gas chamber surrounding said means and having a downwardly extending column, means for heating said column, an exhaust outlet connected to said column, and means for collecting material removed from the strand in the base of said column.
4. In an apparatus for coating a strand, means for applying coating material to the strand, means for applying a heated stream of gas to the strand to remove excess material therefrom, a gas chamber surrounding said means and having a downwardly extending column, an exhaust outlet connected to said column, means for collecting material removed from the strand in the base of said column.

base of said column, and heat insulating means over the exterior of said chamber.

5. In an apparatus for coating a strand, means for applying coating material to the strand, a gas chamber, means extending into said chamber for applying a heated stream of gas to the strand, a die preceding said means for removing a portion of said material before said stream of gas is applied, and means for movably supporting the die on a hinged arm provided with a locating latch to permit threading the strand there-through.

6. A method of coating a strand which comprises moving the strand through a bath of molten coating metal and passing a stream of superheated steam longitudinally of the strand to remove the excess coating metal, the temperature of said superheated steam when it first strikes the strand being higher than the melting point of the coating metal.

7. The method of wiping a freshly applied molten metal coating on a moving body of small heat storage capacity which comprises simultaneous impingement of the body coating on opposite sides of the body by a gaseous wiping medium having a temperature higher than the melting point of the metal coating directed with force thereupon to even and smooth the coating while arresting solidification thereof, the force of said wiping medium being sufficient to displace a portion of said metal coating.

8. The method of wiping a freshly applied molten metal coating on a moving strand which comprises simultaneous impingement of the

coating on opposite sides of the strand by a gaseous wiping medium having a temperature higher than the melting point of the metal coating directed with force thereupon to even and smooth the coating while arresting solidification thereof.

9. The method of wiping a freshly applied molten metal coating on a metal strand which comprises the steps of projecting a gaseous wiping medium having a temperature higher than the melting point of the metal coating on the strand with sufficient force to remove a portion of said molten coating and smooth the remaining coating.

10. The method of coating an article of small heat storage capacity with a metal coating which comprises applying to said article a molten metal coating in excess of that desired in the finished product, removing excess coating mechanically, and projecting a gas having a higher temperature than the melting point of the coating metal longitudinally of the article to smooth the coating thereon.

11. In an apparatus for coating strands, means for applying a coating of molten metal to the strand, means for applying a heated stream of gas to the strand to remove excess coating metal therefrom, a gas chamber surrounding said means, a passage extending downwardly from said chamber and having a normally closed bottom and an exhaust passage extending laterally from a position between the bottom of the passage and the chamber.

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