ABSTRACT

The invention concerns a method and apparatus for coating a metallic strip comprising wetting a first surface of the strip, passing the wetted first surface adjacent to and at a predetermined constant spacing, throughout its width, from a first electrostatic device, and supplying a metallic powder to the latter so that the wetted first surface is provided electrostatically with a coating of the metallic powder, wetting a second surface of the strip which is opposite to the said first surface thereof, passing the wetted second surface adjacent to and at a predetermined constant spacing, throughout its width, from a second electrostatic device, and supplying a metallic powder to the latter so that the wetted second surface is provided electrostatically with a coating of the metallic powder, maintaining the last-mentioned predetermined constant spacing by passing the wetted coating on the first surface of the strip over at least one smooth surfaced cylindrical support roll disposed adjacent to the second electrostatic device, and drying the wetted coatings on the first and second surfaces and effecting firm adherence of the dry coatings to said surfaces.

11 Claims, 3 Drawing Figures
METHOD AND APPARATUS FOR COATING A METALLIC STRIP

This is a continuation of application Ser. No. 263,617 filed June 16, 1972, now abandoned.

This invention concerns a method and an apparatus for coating a metallic strip such as for example as a ferrous strip.

According to the present invention, there is provided a method of coating a metallic strip comprising wetting a first surface of the strip, passing the wetted first surface adjacent to and at a predetermined constant spacing, throughout its width, from a first electrostatic device and supplying a metallic powder to the latter so that the wetted first surface is provided electrostatically with a coating of the metallic powder, wetting a second surface of the strip which is opposite to the said first surface thereof, passing the wetted second surface adjacent to and at a predetermined constant spacing, throughout its width, from a second electrostatic device and supplying a metallic powder to the latter so that the wetted second surface is provided electrostatically with a coating of the metallic powder, maintaining the last-mentioned predetermined constant spacing by passing the wetted coating on the first surface of the strip over at least one smooth surfaced cylindrical support roll disposed adjacent to the second electrostatic device, and drying the wetted coatings on the first and second surfaces and effecting firm adherence of the dry coatings to said surfaces.

The invention is based upon the surprising discovery that it is possible to use one or more said smooth surfaced cylindrical support rolls in order to maintain the said constant spacing, without the support rolls thereby causing damage to the wetted coating which has already been placed on the first surface. The maintenance of the said spacing constant throughout the width of the strip is of great importance if a good quality powdered coating is to be produced, and if sparking in the electrostatic devices and cutting out of their power sources is to be avoided.

The wetted first surface is preferably passed over two support rolls which are respectively disposed immediately upstream and immediately downstream of the second electrostatic device.

Each of the first and second surfaces are preferably wetted with a solution of sodium or potassium silicate or of a gelatinous metal hydroxide.

The strip may be passed over deflector rolls which alter the direction of movement of the strip so that the relative vertical disposition of the first and second surfaces is reversed, each said surface being uppermost at the time that its coating is electrostatically applied thereto.

The strip, after the said drying, may be passed between compaction rolls to effect the said firm adherence of the coatings.

Except for its support by the support roll or rolls, the strip may be unsupported between the most downstream deflector roll and the compaction rolls.

Each said device may comprise an electrostatically charged grid which is disposed parallel to and is spaced from the respective surface by a distance in the range of 1.0 to 1.5 inches.

The strip may be a ferrous strip and the metallic powder may be an aluminum or chromium-containing powder.

The invention also comprises apparatus for coating a metallic strip comprising first and second wetting means for respectively wetting first and second opposite surfaces of the strip, first and second electrostatic devices by means of which the first and second wetted surfaces may be respectively electrostatically coated with metallic powder, means for moving the strip sequentially past the first and second electrostatic devices so that each of the first and second surfaces of the strip passes adjacent to and at a predetermined constant spacing, throughout its width, from the respective electrostatic device, the last-mentioned means including at least one smooth surfaced cylindrical support roll disposed adjacent to the second electrostatic device and over which in operation the wetted coating on the first surface passes, and means for drying the wetted coatings on the first and second surfaces and effecting firm adherence of the coatings to said surfaces.

The said apparatus may be provided with two support rolls which are respectively disposed immediately upstream and immediately downstream of the second electrostatic device. Moreover, the said apparatus may comprise deflector rolls over which the strip is entrained, the deflector rolls altering the direction of movement of the strip so that the relative vertical disposition of the first and second surfaces is reversed, each said surface being uppermost at the time that its coating is electrostatically applied thereto. Additionally, the said apparatus may comprise compaction rolls for compacting the dried coatings to the strip.

The invention also includes a metallic strip when coated by the method or by the apparatus as set forth above.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of an apparatus according to the present invention for coating a metallic strip;

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1 and illustrating what would be the relative positions of the parts if the support rolls shown in FIG. 1 were omitted; and

FIG. 3 is a view similar to FIG. 2 but illustrating the relative positions of the parts when the said support rolls are provided.

In FIG. 1 there is shown an apparatus 10 for coating each of the opposite surfaces 11, 12 of a mild steel strip 13 with a coating of aluminum or chromium-containing powder. The strip 13 may have a width of 48 inches or 54 inches and a thickness of 0.036 inches.

The strip 13, after having been scrubbed and pickled by means not shown, is passed over a series of driven deflector rolls 14, 15, 16, 17, 18, 19 which cause the strip 13 to be moved, (e.g. at a speed of between 50 and 150 feet per minute) successively past a wetting means 22, an electrostatically charged grid 23, a wetting means 24, and an electrostatically charged grid 25. A tension of 10,000 lbs may be applied to the strip 13 adjacent the electrostatically charged grids 23, 25.

It will be noted that, between the deflector rolls 17, 18 the strip 13 passes horizontally with the surface 11 uppermost, while the passage of the strip over the deflector roll 19 causes the strip to pass in a horizontal direction such that the relative vertical disposition of the surfaces 11, 12 is reversed so that the surface 12 becomes uppermost. Thus, when each surface 11, 12 passes beneath its respective wetting means and elec-
trostatically charged grid it is in the uppermost position.

The grids 23, 25 are supplied (by means not shown) with an aluminum or a chromium-containing powder which is to be coated electrostatically onto the adjacent surface of the strip 13. Each of the wetting means 22, 24 may be supplied with a liquid which assists in retaining the metallic powder on the strip 13. Thus, the liquid may be constituted by a sodium or potassium silicate solution, e.g. by an aqueous solution containing 3 per cent by weight of sodium silicate and applied to the respective surface of the strip 13 in an amount of substantially 2.5 cc/ft² of strip surface. Alternatively, a 0.05 to 0.25 per cent solution of sodium carboxymethyl-cellulose may be used, or one may use a suspension of a gelatinous metal hydroxide, e.g. Ni(OH)₂ or Al(OH)₃.

After passing the electrostatically charged grid 25, the strip 13 is passed successively through a dryer 26, in which the wetted coatings are dried, and then between compaction rolls 30, 31 which compact, and thus effect firm adherence of, the dried coatings to the strip 13, the angular speed of the rolls 30, 31 being matched to the linear speed of the strip 31 by reason of the fact that the rolls 30, 31 pull the strip 13 through the apparatus. The strip is then formed into a coil 32 which is heat-treated to effect diffusion of the metallic coating into the strip.

If the strip 13 were completely unsupported between the most downstream deflector roll 19 and the compaction rolls 30, 31, which may be separated by a distance of 75 feet, it would be impossible to maintain a desired constant spacing, throughout the width of the strip 13, between the surface 12 and the electrostatically charged grid 25. This is because not merely would there be sagging of the strip 13, but also the strip 13 would not be horizontally disposed, or indeed disposed in any single plane. In this connection it should be remembered that the strip 13 will inevitably have some "camber," which may be roughly defined as the difference in length between the two opposite edges of the strip 13. In other words, if a length of the strip 13 were laid out on a floor, the length would curve in one way or the other. This camber can be anything from 1 to 6 inches/100 ft. length of strip. Thus, if the distance between the deflector roll 19 and the compaction rolls 30, 31 is the said 75 ft., the effect of this camber at the electrostatically charged grid 25 can be quite considerable.

For example, the effect may be as illustrated in FIG. 2 in which the right-hand side of the strip 13 is disposed closely adjacent to the grid 25 while the left-hand side of the grid 13 is disposed at a considerable distance therefrom. If, however, a good quality powder coating is to be produced electrostatically on the surface 12, it is important to ensure that, throughout the whole width of the strip 13, the latter is spaced by a constant distance which should desirably be in the range of 1 to 1.5 inches. Not only is this not achieved when the parts are disposed as shown in FIG. 2, but also the electrostatic field will vary across the strip 13, so that in many cases sparking may occur at the right hand side thereof and this will finally cause the power packs (not shown), which effect charging of the grid 25, to "trip out."

In order to overcome these difficulties, the wetted coating on the surface 11 is passed over smooth surfaced cylindrical support rolls 33, 34 which are disposed adjacent to the grid 25 and are respectively disposed immediately upstream and immediately downstream of the latter. The angular speed of the support rolls 33, 34 will of course be matched to the linear speed of the strip 13 so that there is no slip therebetween. As a result, the grid 25 and surface 12 are disposed as shown in FIG. 3 in which the strip 13 is disposed parallel to the grid 25 and is spaced from the latter throughout its width by a constant distance of, preferably, 1.25 inches.

The support rolls 33, 34 are preferably provided with hardwearing surfaces and thus may be constituted by chromium plated steel support rolls. Except for the support rolls 33, 34, however, the strip 13 is unsupported between the deflector roll 19 and the compaction rolls 30, 31.

Whilst it would be expected that the support rolls 33, 34 could be employed to maintain the strip 13 at a constant predetermined distance from the grid 25, it is surprising that it is possible to do this without damage to the wetted coating on the surface 11. It is however a fact, however surprising, that this wetted coating can pass successfully over the support rolls 33, 34 and be deflected by the latter without the rolls 33, 34 damaging the coating on the surface 11.

It is, of course, equally important that there should be a constant spacing of 1.25 inches across the width of the strip 13 between the surface 11 and the grid 23. This may, however, in this case be easily effected partly because it may not be necessary to provide a great distance between the deflector rolls 17, 18 so that the problem may not arise in any acute form in any case, and also partly because if it did arise it could be solved by providing support rolls beneath the grid 23 and over which the surface 12 would pass, since at that stage the surface 12 would be neither wetted nor coated with powder.

No rolls should be disposed after the dryer 26 upstream of the compaction rolls 30, 31 since if these are provided they cause damage to the now dry coatings on the surfaces 11, 12.

After passage through the compaction rolls 30, 31 the strip 13 is provided with coatings having a thickness of 0.0015 inch.

I claim:

1. In a method of coating a metallic strip comprising: wetting a first surface of the strip, passing the wetted first surface adjacent to and at a predetermined constant spacing, throughout its width, from a first electrostatically charged grid supplying a metallic powder to the wetted first surface and applying the metallic powder electrostatically to said first surface to provide said surface with a coating of the metallic powder; wetting a second surface of the strip which is opposite to the said first portion thereof, passing the wetted second surface adjacent to a second electrostatically charged grid, supplying a metallic powder to the wetted second surface and applying the metallic powder electrostatically to said second surface to provide said surface with a coating of the metallic powder; and drying the wetted coatings on the first and second surfaces and effecting firm adherence of dry coatings to both said surfaces; the improvement comprising at least one smooth surfaced cylindrical support roll disposed adjacent to
and below the second grid to maintain a predetermined constant spacing between the metallic strip and the grid, throughout its width, from said second grid while passing the wetted coating on the first surface of the strip in direct contact with said support roll, the strip being a relatively wide strip of at least about 48 inches, and each of said grids being disposed parallel to and spaced from the respective surface throughout the whole width of the strip by a constant distance in the range of 1.0 to 1.5 inches.

2. A method as claimed in claim 1 further comprising passing the wetted first surface over two support rolls, which are respectively disposed immediately upstream and immediately downstream of the second grid.

3. A method as claimed in claim 1 further comprising wetting each of the first and second surfaces with a solution of sodium or potassium silicate or of a gelatinous metal hydroxide.

4. A method as claimed in claim 1 comprising passing the strip over deflector rolls which alter the direction of movement of the strip so that the relative vertical disposition of the first and second surfaces is reversed, each said surface being uppermost at the time that its coating is electrostatically applied thereto.

5. A method as claimed in claim 4 further comprising passing the strip, after the said drying, between compaction rolls to effect the said firm adherence of the coatings.

6. A method as claimed in claim 5 further comprising ensuring that except for its support by the support roll, the strip is unsupported between the most downstream deflector roll and the compaction rolls.

7. A method as claimed in claim 1 in which the strip is a ferrous strip and the metallic powder is aluminium or chromium-containing powder.

8. In an apparatus for coating a relatively wide metallic strip of at least about 48 inches comprising first and second wetting means for respectively wetting first and second opposite surfaces of the strip, first and second electrostatically charged grids by means of which the first and second wetted surfaces may be respectively electrostatically coated with metallic powder, each grid being disposed parallel to and spaced from the respective surface throughout the whole width of the strip by a constant distance in the range of 1.0 to 1.5 inches, means for moving the strip sequentially past the first and second grids so that each of the first and second surfaces of the strip passes adjacent to and at a predetermined constant spacing, throughout its width, from the respective grid, means for drying the wetted coatings on the first and second surfaces and effecting firm adherence of the coatings to said surface, the improvement comprising including at least one smooth surfaced cylindrical support roll disposed adjacent to and beneath the second grid and over which, in operation, the wetted coating on the first surface passes.

9. Apparatus as claimed in claim 8 in which there are two support rolls which are respectively disposed immediately upstream and immediately downstream of the second grid.

10. Apparatus as claimed in claim 8 further comprising deflector rolls over which the strip is entrained, the deflector rolls altering the direction of movement of the strip so that the relative vertical disposition of the first and second surfaces is reversed, each said surface being uppermost at the time that its coating is electrostatically applied thereto.

11. Apparatus as claimed in claim 8 further comprising compaction rolls for compacting the dried coatings to the strip.

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