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2,135,652

PROCESS FOR METAL COATING

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Fig. 1.

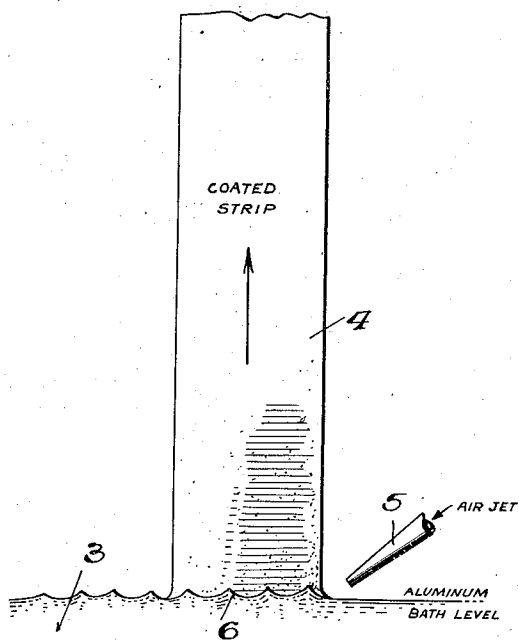
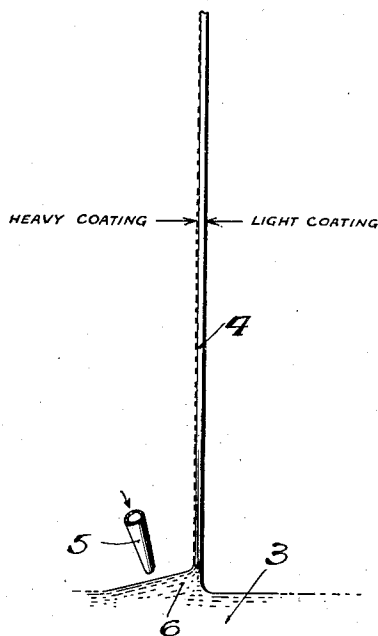


Fig. 2.



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PROCESS FOR METAL COATING

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10 Claims. (Cl. 91—70.2)

This invention relates to the coating of metal sheets, strips, ribbons, and the like, and more particularly to the coating of a suitable base metal with metals of the general character represented by aluminum.

It has heretofore been proposed, as for example in the patents to Pike, No. 2,062,795, granted December 1, 1936, for Manufacture of compound strip, and Steele, No. 850,548, granted April 16, 1907, for Method of coating metal sheets, to control the thickness of the coat of molten facing metal applied to the base metal by impinging steam, oil, or the like on the molten coating metal, by means of one or more jets disposed at right angles to the emerging base metal, so as to maintain a predetermined meniscus or wave whose form and elevation at the contact of the molten coating metal with the emerging base metal determines the thickness of coat and rate of congealing of the coating metal on the base metal. Procedures of this character, however, have been found to be ineffective to obtain the desired thickness and uniformity of coating with metals of the character of aluminum which have a substantial oxide film at the surface of the molten coating metal.

In the coating of ferrous base metal with aluminum or the like as heretofore practiced, the aluminum coat is likely to have succeeding areas which are of differing thicknesses. This is particularly true if a relatively thick coating of aluminum is desired, the resulting laminated metal being characterized by an aluminum coating which has successive transverse areas that are thicker and thinner in depth. Inasmuch as the utility of the laminated metal is ordinarily limited by the thinnest part of the coating, because the thinner areas of the coating determine the resistance of the coating to corrosion, etc., the thicker coating obtained in alternating portions of the laminated metal merely adds to the weight and cost without any corresponding increase in benefit.

Moreover, in the method of coating ferrous metal with aluminum and the like as heretofore practiced, the coated metal, particularly where an effort has been made to obtain a coating of substantial thickness, has been characterized by dark streaks transverse to the direction of movement of the base metal from the coating bath, these dark transverse areas not only interfering with the appearance and therefore the salability of the laminated metal, but also having a material effect in reducing the reflectivity of the laminated metal, even after buffing or polishing.

The cause for the variations in thickness, dark streaks, etc., is not known. Without wishing to be limited to the correctness of the following theory, it is now believed that these variations in thickness and appearance are attributable to the presence of the relatively tenacious oxide film at the surface of the molten bath. The surface film apparently is drawn onto the emerging base metal along with the molten metal therebeneath, and tends to adhere to coating metal as it congeals on the base metal. While the tenacity of the surface film permits temporary adhesion to the coating metal, the resistance to the drag of this surface film across the molten metal causes a more or less periodic rupture of the oxide film. Portions of the oxide film are thus left on the emerging coated metal to vary the thickness, resistance, capacity for reflection, alloying action, etc., of the coating, while the ruptured film, sliding down the emerging metal owing to the elastic action of the film following each rupture, tends to wipe some of the coating metal from the emerging base metal, thereby producing the successive transverse areas of greater and less thickness. These succeeding sections of oxide film are also believed to be the cause of the dark streaks and other variations of surface appearance, reflectivity, etc. The mere application of jets at substantially right angles to the surface of the emerging metal to depress the surface of said metal or to raise the surface thereof to a predetermined height by means of a wave or meniscus of predetermined thickness, does not overcome these difficulties, because such jets, while predetermining the thickness or amount of bath metal at the emergence of the base metal, do not prevent the ever present oxide film on the bath metal interfering with the regular and uniform application of a coating of predetermined thickness to the base metal.

Whatever the cause of these consequences following from the prior procedures used in coating with aluminum or the like, we have discovered that coatings of uniform thickness, appearance, etc., can be obtained by setting up a continuous series of small waves which run across the surface of the bath at its junction with the emerging metal, and at the same time the coatings may be made several times as thick as have heretofore been obtained in coating ferrous metal with aluminum.

It is therefore an object of the present invention to provide a method for coating metals whereby substantially uniform coatings of controlled thickness may be obtained.

Another object of this invention is to provide a method for coating metals whereby coatings of uniform appearance may be obtained.

Another object of this invention is to avoid the presence of alternating thick and thin areas of coating such as heretofore obtained, particularly in coating ferrous metal with aluminum.

Another object of this invention is to avoid dark streaks at the surface of the coated metal, particularly in the coating of ferrous metal with aluminum.

Another object of this invention is to provide a method for coating ferrous metal with aluminum wherein the coating at one or both faces of the base metal may be made of predetermined thickness and this thickness may be made several times that which has heretofore been obtained.

Other objects will appear as the description of the invention proceeds.

The process of the present invention can be carried out by means of any suitable apparatus which will set up a continuous series of ripples running along the surface of the bath at the junction of the emerging metal therewith. The accompanying drawing shows diagrammatically one suitable apparatus for effecting this purpose, Fig. 1 being a diagrammatic face view and Fig. 2 a diagrammatic edge view of the emerging metal treated in accordance with the present invention, but it is to be expressly understood that the ripples may be set up in any other suitable way or by any other suitable apparatus.

As here shown, a base metal, preferably a ferrous metal, of any suitable composition and in the form of a ribbon, strip, sheet, or the like, is drawn from a bath 3 of coating metal such as aluminum, the coated strip 4 being moved from the bath 3 at any suitable speed to obtain a coating of the desired characteristics. Disposed adjacent the junction between the emerging metal and the surface of the bath but preferably at a position to one side of the emerging metal are one or more jets 5 for impinging on the surface of the bath any suitable fluid, whether gaseous or liquid, compressed air being preferred, said jet or jets being preferably disposed so that the axis thereof lies in a plane parallel to or making only a small angle with the surface of the emerging metal, as clearly shown on the drawing.

Under the action of the compressed air impinging on the surface of the molten coating metal a continuous series of small waves or ripples 6 are set up across the face of the emerging metal at its junction with the surface of the bath, the pressure of the air or other fluid impinging on the surface of the bath being suitably selected with respect to the fluidity of the bath, the rate of movement of the base metal, the thickness of coating desired, etc. The height of the waves or ripples thus induced and their speed of traverse across the surface of the emerging metal do not appear to be critical, provided that a substantial ripple is maintained without splashing and the speed of traverse of the ripple across the face of the emerging metal is such as compared with the speed of the emerging metal that the succeeding portions of the emerging metal are subjected to the action of the ripples running across the same.

Whether or not the improved results obtained are due to the prevention of oxide-film adhesion to the emerging metal is not known, but experience has demonstrated that aluminum coated ferrous metal made in accordance with the pres-

ent invention has a coating of substantially uniform thickness, is free of transverse dark streaks, and has a substantially uniform appearance, reflectivity, etc., while at the same time such coatings may be made several times as thick as have heretofore been obtained. Thus uniform coatings of aluminum .55 ounce per square foot or higher have been successfully obtained by use of the present invention whereas prior to the present invention coatings of from .11 to .22 ounce per square foot were the maximum obtainable even under favorable conditions.

In the drawing the ripple is maintained at only one face of the emerging metal, and this is the suitable procedure where a thick uniform coating is desired at one face of the laminated metal and the opposite face is to have a relatively thin coating where appearance is of little or no importance. If it is desired that both faces of the laminated metal have coatings of controlled uniform thickness jets are employed to maintain the ripples at both faces of the emerging metal.

It will therefore be perceived that by the present invention a method of coating metals, particularly aluminum on ferrous metal, has been provided wherein substantially uniform coatings of controlled thickness may be obtained at one or both faces thereof. Experience has demonstrated that when the present invention is employed the recurring variations in the thickness of the coating, the transverse dark streaks, the variations in appearance, reflectivity, etc., which have heretofore characterized aluminum coated ferrous metal are entirely avoided. At the same time, the use of the method of the present invention enables the thickness of the coating at the side or sides subjected to the ripples to be nicely predetermined and made several times thicker than heretofore possible, the thickness of the coating being controlled by the speed of the base metal, the cooling effect of the jet or jets and the fluidity or temperature of the coating metal.

While the preferred procedure and apparatus for embodying the present invention have been described in considerable detail, it is to be expressly understood that the invention is not restricted thereto, as any suitable manner and means of setting up the transverse ripples across the emerging surface of the coated metal at its junction with the surface of the bath may be employed without departing from the spirit of the present invention. Reference is therefore to be had to the appended claims for a definition of this invention.

What is claimed is:

1. The method of forming laminated metal which includes the steps of passing a base metal through a bath of molten coating metal and maintaining at the surface of the bath a series of transverse ripples which agitate the surface of the bath along the entire width of the face of the emerging metal.

2. The method of forming laminated metal which includes the steps of passing a base metal through a bath of molten coating metal and maintaining at one or both faces thereof where the base metal emerges from said bath a continuous series of ripples which run across the entire width of the surface of the emerging metal from one edge to the other thereof.

3. The method of forming laminated metal which includes the steps of passing a base metal through a bath of molten coating metal and impinging fluid under pressure on the surface of said molten metal at one or both sides of the

emerging metal and in a direction to set up and maintain a series of ripples across the entire width of the face of the emerging metal.

4. The method of forming laminated metal 5 which includes the steps of passing a base metal through a bath of molten coating metal and impinging a fluid under pressure on the surface of said bath metal at one or both sides of the emerging metal and at a position to one side 10 of the emerging metal to maintain at the junction between the surface of said bath and the surface of the emerging metal a continuous series of ripples which run across the emerging metal from one edge to the other thereof.
5. The method of coating ferrous metal with 15 aluminum or the like which includes the steps of passing ferrous base metal through a bath of molten aluminum and setting up and maintaining at the surface of said bath at its junction 20 with the emerging metal a series of ripples which agitate the surface of the bath along the entire width of the face of the emerging metal.
6. The method of coating ferrous metal with 25 aluminum or the like which includes the steps of passing ferrous base metal through a bath of molten aluminum and forming on the surface of the bath metal at one or both faces of the emerging base metal a continuous series of ripples which run across the face of the emerging 30 metal from one edge to the other thereof.

7. The method of coating ferrous base metal 35 with aluminum or the like which includes the steps of passing ferrous base metal through a bath of molten aluminum and impinging on the surface of the bath in a direction across the face

of the emerging metal at one or both faces thereof a fluid under pressure which maintains a series of ripples on the surface of the bath which wipe across the face of the emerging metal.

8. The method of coating ferrous base metal 5 with aluminum or the like which includes the steps of passing ferrous base metal through a bath of molten aluminum and impinging on the surface of the bath at one or both faces of the emerging metal a fluid under pressure in a di- 10 rection across the surface of the emerging metal and from a position at one side thereof to set up and maintain at one or both faces of the emerging metal a continuous series of ripples which run across the entire width of the face or 15 faces of the emerging metal.

9. The method of coating ferrous metal with 20 aluminum or the like which includes the steps of passing ferrous base metal through a bath of molten aluminum and maintaining the surface of said bath in substantially uniform agitation 25 across the entire width of the face of the emerging metal at its junction with the surface of the bath.

10. The method of coating ferrous metal with 30 aluminum or the like which includes the steps of passing ferrous base metal through a bath of molten aluminum and maintaining the coating substantially uniform by agitating the surface of the bath metal at one or both faces of the 35 emerging base metal across the entire width of the face of the emerging base metal.

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