

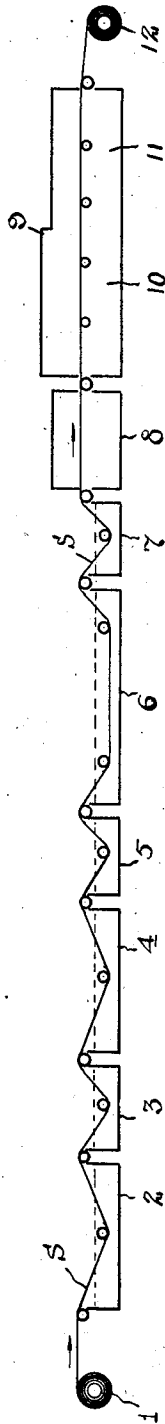
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METHOD OF COATING STRIP STEEL AND PRODUCTS THEREOF

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METHOD OF COATING STRIP STEEL AND PRODUCTS THEREOF

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This invention relates, as indicated, to a method of coating strip steel, but has reference more particularly to a continuous method of coating strip steel with nickel, whereby a ductile, non-porous, uniform and intimately bonded coating of nickel is formed on the steel.

The coating of tin on commercial tin plate, as now manufactured, is more or less porous, so that containers for food stuffs or food products made from such tin plate are not entirely resistant to the attack of chemical compounds contained in preserved food stuffs, fruit juices, etc. Moreover, the tin coating does not adhere tenaciously to the base metal, is rather soft and easily abraded, and is therefore likely to become punctured or ruptured during handling of the tin plate or during the container-forming operation.

The invention accordingly has as its primary object the provision of steel strip having a coating of an impervious, non-porous nature, which coating forms a protective medium for the strip, enabling the strip to resist corrosion and rendering it especially suitable therefore, for manufacture into containers for food stuffs and food products.

Another object of the invention is the provision of steel strip of the character described in which the coating is much harder than the coating of tin plate and adheres with a high degree of tenacity to the base metal, thereby facilitating handling of the strip and formation thereof into containers, without danger of puncturing or rupturing the coating during the handling and container-forming operations.

A further object of the invention is to provide a method of coating such strip which is of a continuous character, whereby production of the coated strip in desired commercial quantities is made feasible.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the steps hereinafter described and particularly pointed out in the claims; the annexed drawing and the following description setting forth in detail one approved method of carrying out the invention, such disclosed steps illustrating, however, but one of the various ways in which the principle of the invention may be used.

The method, broadly stated, consists in bringing the steel strip and the nickel into intimate contact, and while in such relation subjecting the same to heat under such conditions and for such a length of time as to effect a desired diffusion of the metals and a desired condition in the nickel constituent. In carrying out the heating step,

the same may be governed or controlled in such a manner, particularly as regards the temperature and time period, as to effect an annealing of the base metal and at the same time obtain the desired diffusion and condition of the nickel coating.

A simple and efficient means of bringing the metals into intimate contact is by electro-deposition of the nickel on the surface of the ferrous strip, the deposit being of any desired thickness and the deposition being accomplished by any of the approved methods of nickel plating. An electro-deposited coating of nickel is, however, of a porous nature and is capable of being stripped from the steel strip. Electro-deposited nickel accordingly does not provide an efficient corrosion-resisting covering as corrosion of the steel strip may start in the pin holes resulting from the porous nature of the nickel. However, the steel strip with its electro-deposited coating is subjected to a heating, or what may be termed as an annealing step in the process, in order to strongly unite the metals and render the electro-deposited nickel substantially impervious and ductile. This annealing step is preferably carried out in a furnace in which a neutral or reducing atmosphere is maintained as by means of gases, such as hydrogen and carbon monoxide, whereby oxidation of the metals is precluded during the heating and cooling periods.

The heating or annealing is accomplished at temperatures ranging from about 1100° F. to about 1800° F., the metals diffusing into one another to form a solid solution zone at their contiguous surfaces, and in this manner the iron and nickel constituents are tenaciously united. The heating is at all times controlled with respect to duration as to secure a definite depth of diffusion of the nickel into the ferrous metal, but restricting the solid solution zone to a depth less than that of the thickness of the nickel body constituting the coating. If the depth of the solid solution zone does not exceed the above indicated thickness, the exposed surface will be substantially pure nickel and free from pin holes. The heating moreover liberates and drives off any occluded gases, such as hydrogen, which may be taken up during electro-deposition, thereby making the coating more ductile and impervious.

The method may be practiced commercially by means of the apparatus shown in the accompanying drawing.

Referring to said drawing, the strip S is drawn from a coil mounted on reel I, and is passed suc-

cessively through an alkali cleaning tank 2, a rinse tank 3, an acid pickling tank 4, another rinse tank 5, a nickel plating tank 6, a rinse tank 7, a drying oven 8, a furnace 9 comprising an annealing chamber 10 and a cooling chamber 11, and is coiled up on a take-up reel 12.

Satisfactory results have been obtained by first electro-depositing one-tenth of an ounce of nickel per square foot of surface upon the ferrous strip in the plating bath 6 and by heating the strip thus coated in the chamber 10 at a temperature of about 1650° F., the strip passing through the furnace at a speed of about 14 feet per minute. The strip, upon emerging from the heating chamber 10 is cooled in the cooling chamber 11 at such a rate as will produce the desired annealing of the steel strip. A reducing atmosphere is at all times maintained within the furnace 9. The method is thus carried out in a continuous manner and at a uniform speed.

We have found that when the nickel coating has been applied and treated in this manner that it becomes strongly bonded to the steel strip and is of an impervious, lustrous and ductile nature.

The thickness of the nickel coating may be varied as desired. By using a lower temperature for the annealing and increasing the duration of such annealing, results comparable to those obtained by using higher temperatures and shorter periods of annealing may be secured, as will be readily understood. Any desired surface appearance, from a matte to a bright mirror finish, may be obtained by proper polishing and/or buffing procedures.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the method herein disclosed, provided the step or steps stated by any of the following claims or

the equivalent of such stated step or steps be employed.

We therefore particularly point out and distinctly claim as our invention:

1. The method of coating steel strip and the like which comprises consecutively subjecting the strip to the action of a nickel plating bath to form a coating of nickel thereon and to heating at a temperature of from about 1100° F. to about 1800° F. in a non-oxidizing atmosphere, whereby to form a solid solution zone at the contiguous surfaces of the steel strip and nickel.

2. The method of coating steel strip and the like which comprises continuously moving and consecutively subjecting the strip to the action of a nickel plating bath to form a coating of nickel thereon and to heating at a temperature of from about 1100° F. to about 1650° F. in a non-oxidizing atmosphere, whereby to form a solid solution zone at the contiguous surfaces of the steel strip and nickel.

3. The method of coating steel strip and the like which comprises electro-depositing nickel upon the strip, then passing the strip through a furnace chamber in which a reducing atmosphere is maintained and wherein the strip is heated to a temperature of from about 1100° F. to about 1650° F. whereby a solid solution zone is formed at the contiguous surfaces of the steel strip and nickel, and then cooling the strip at such a rate as will produce the desired annealing of the strip.

4. The method which comprises cleaning steel strip, depositing a coating of nickel thereon, then passing the strip through a furnace chamber in which a reducing atmosphere is maintained and wherein the strip is heated to a temperature of from about 1100° F. to about 1650° F., and then cooling the strip at a controlled rate.

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