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METHOD OF MAKING TIN PLATE

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FIG. 1

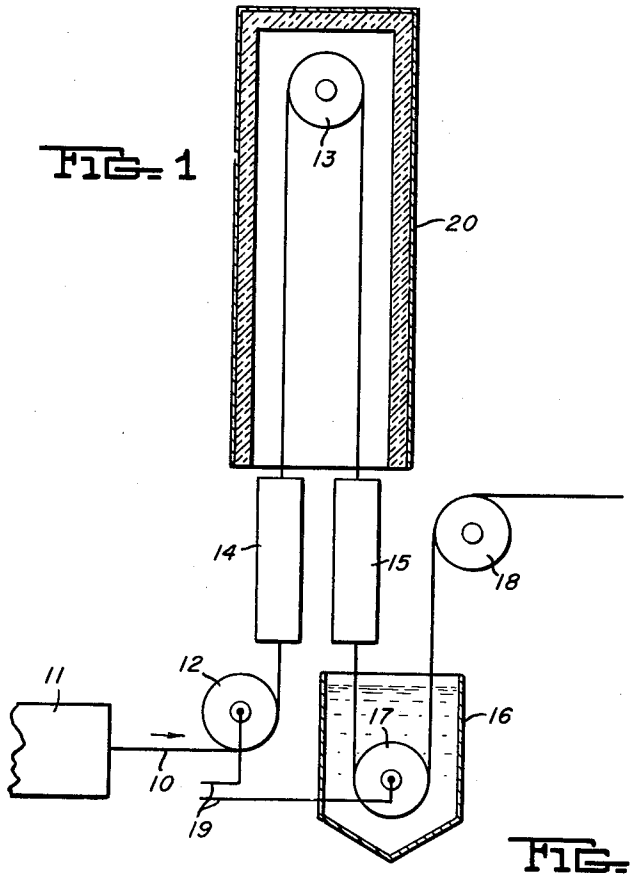
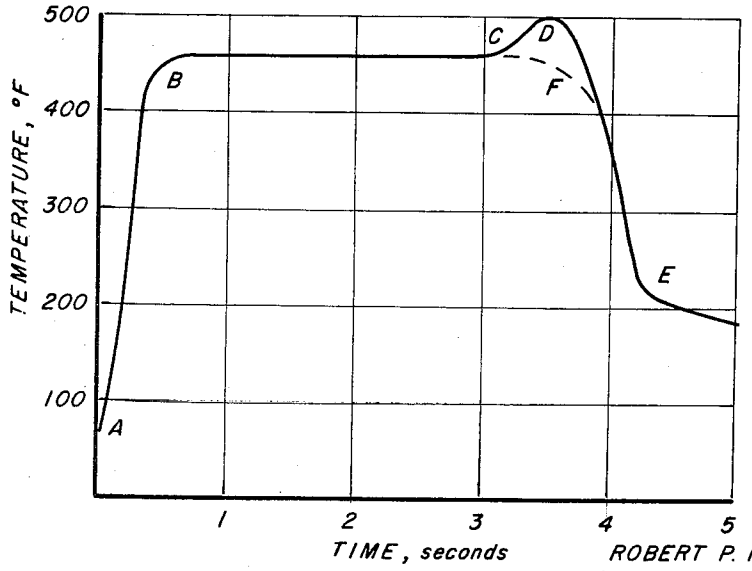


FIG. 2



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METHOD OF MAKING TIN PLATE

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This invention relates to a method of making tin plate and, in particular, to a method of making a product of improved corrosion resistance by the electrolytic process.

Most of the tin plate currently used is made by the electrolytic process which effects a considerable economy in tin consumption. For most purposes, the matte surface of the tin as deposited is not satisfactory so it is necessary to progressively heat the tin-coated steel strip after it leaves the electrolytic line, to a temperature above the melting point of tin to "reflow" or brighten its surface. It is the object of my invention to effect this heating in a manner such as to impart better corrosion resistance to the product.

Briefly stated, my invention comprises heating the strip substantially isothermally, at a temperature above the melting point of tin (450° F.) but not above 475° F., for a period of from 1 to 3 seconds. By isothermal heating, I mean substantially instantaneous heating to the final temperature with such supplemental heating as needed so that the strip remains at relatively constant temperature from the very beginning of the tin-melting step. Ordinarily, such heating will obviate the usual reflowing treatment.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating the present preferred embodiment. In the drawings:

FIGURE 1 is a schematic diagram of the apparatus I prefer for carrying out my improved method; and

FIGURE 2 is a time-temperature curve typical of my method.

Referring now in detail to the drawings, low-carbon steel strip **10** of tin-plate gage which has been electrolytically coated with tin by one of the known processes, passes upwardly at a speed of, say, 100 f.p.m., from the end of the tinning line **11**, around a guide roll **12** and thence around a guide roll **13** and downwardly therefrom. Immediately after leaving roll **12**, the strip traverses an induction heating unit **14** of known construction, which raises the temperature of the strip from 450 to 475° F., preferably about 460° F., in .3 or .4 second. This portion of the heating cycle is shown by the portion A—B of the curve of FIGURE 2, in which the strip is heated at a rate of about 700–1200°, preferably about 1000° F., per second.

After the initial, substantially instantaneous heating of the strip on passing through induction-heating unit **14**, it proceeds upwardly, around roll **13** and then through a second unit **15** similar to that shown at **14**. Thereafter, the strip enters a quench tank **16** of water, passes around a sink roll **17** therein and, on emergence from the tank, around a guide roll **18** and thence on to subsequent processing operations such as cleaning and oiling.

The portion of the strip between rolls **12** and **17** is supplied with supplemental heating by electric resistance, to compensate for atmospheric cooling. To this end, connections **19** extend from the rolls through suitable control means to a source of low-voltage current. The upward and downward passes of the strip may be enclosed in a muffle **20** to reduce the loss of heat and supplemental heat may be supplied by electric resistors or fuel-fired radiant tubes therein. The supplemental heating of the strip maintains its temperature substantially constant as

shown by the portion B—C of the curve of FIGURE 2. This period may be from 1 to 3 seconds.

On passing through heating unit **15**, the temperature of the strip is further increased slightly to, say 470° F., to insure thorough fusion of the tin coating. This stage is represented by the portion C—D of the curve of FIGURE 2. Thereafter, the strip is rapidly cooled by atmospheric convection and almost immediately it is immersed in the water in tank **16**, reducing its temperature to 212° F. or below, as shown by portion D—E of the curve, after which further cooling to atmospheric temperature occurs.

The additional heating by unit **15** may not be necessary for satisfactory reflowing. In that case, the strip temperature falls from point C on the curve via the dotted portion F and thence directly to point E. The iron-tin alloy formed under this condition will only be from 0.04 to 0.06 lb. per base box, even after isothermal heating for 3 seconds. In order to prevent the formation of excessive alloy where the unit **15** is employed, the isothermal heating period (portion B—C of the curve) should be restricted to from 1 to 2 seconds.

The increase in corrosion resistance of the tin plate produced by my method compared to ordinary electrolytic tin plate is shown by the following figures for alloy-tin couple current, an electrolytic test for tin plate which has an inverse correlation with the pack life of citrus juice in cans made from the product.

Table I

Tin plate:	ATC current μa./cm.²
Conventional electrolytic	.44
Isothermally melted, as herein disclosed	.25

In addition to the increased corrosion resistance evidenced by the above data, the invention has the further advantage that it may be carried out while the strip is traveling at good speed and that very exact control of the temperature is not necessary, so long as it is above the melting point of tin and does not exceed 475° F. If the latter limit is not observed, the product will be similar to ordinary electrolytic tin plate in corrosion resistance.

Although I have disclosed herein the preferred embodiment of my invention, I intend to cover as well any change or modification therein which may be made without departing from the spirit and scope of the invention.

I claim:

1. In a method of making tin plate, the steps comprising electrolytically depositing a coating of tin on low-carbon steel strip of tin-plate gage, then, in the absence of preheating which would tend to initiate the formation of iron-tin alloy at the surface of contact between the tin coating and the steel base, heating the strip at a rate of from 700 to 1200° F. per second to impart to it a temperature between the melting point of tin and 475° F., thereafter supplementally heating the strip to hold it substantially at said temperature for from 1 to 3 seconds and then quickly cooling the strip to a temperature of about 200° F., whereby substantially all the iron-tin alloy resulting is formed at a temperature above said melting point and an increased corrosion resistance is imparted to the tin coating.

2. The method defined in claim 1, characterized by further heating the strip to a temperature higher than said holding temperature just before cooling it.

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