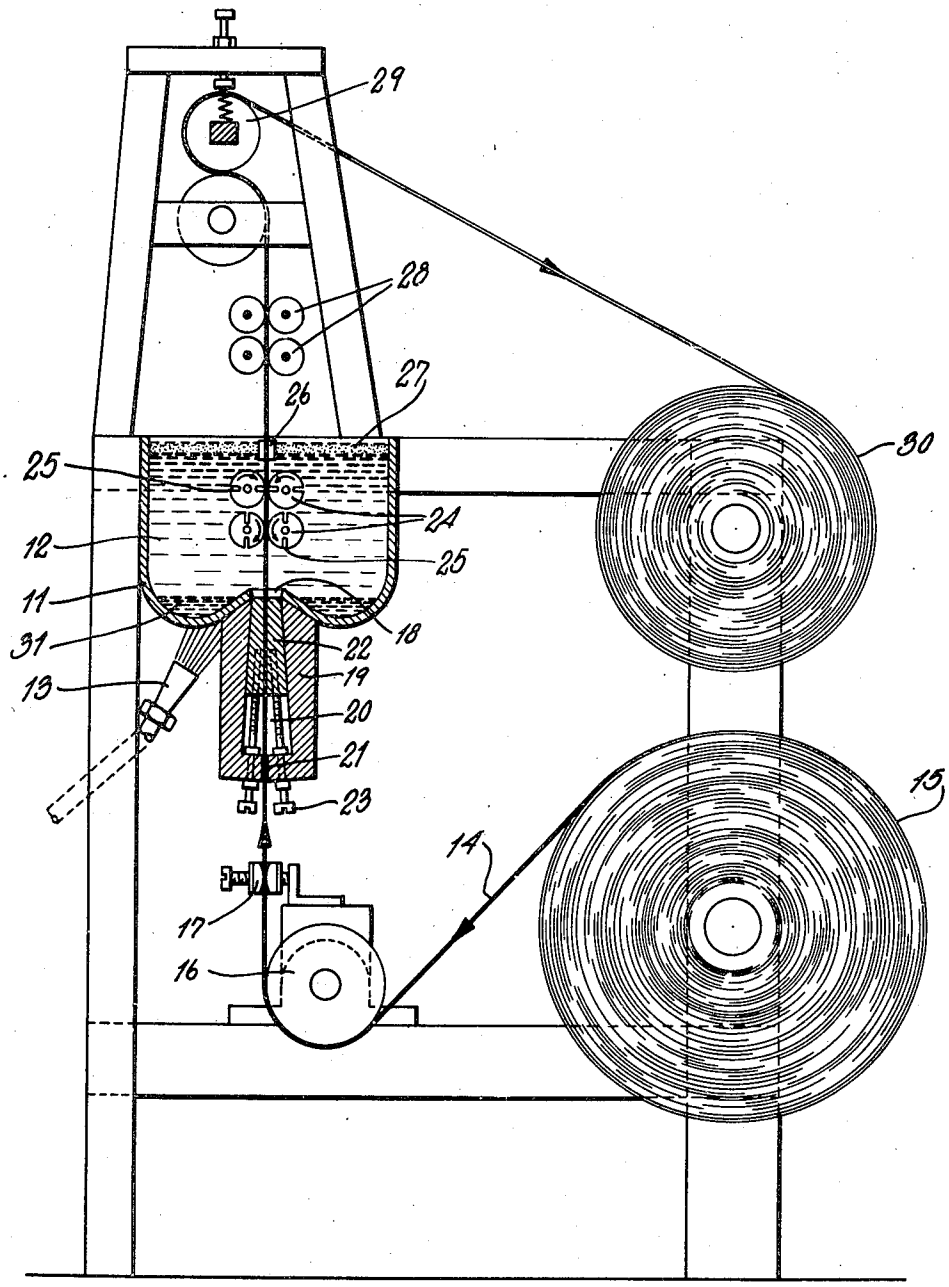
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APPARATUS FOR TINNING STEEL

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APPARATUS FOR TINNING STEEL

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4 Claims. (Cl. 91—12.5)

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This invention is concerned with the production of tin plate for use in the packaging of foodstuffs and the like, and it aims to provide a simple, economical method of producing tin plate, in sheets or continuous strips, with the tin applied only to predetermined areas. One phase of my invention involves a new method of feeding steel to be tinned into a tin bath; another phase of my invention involves the application of a flux, whose characteristics are determined by the bath temperature and speed of operation, to portions of a moving strip of steel, and wiping of the strip as it leaves the bath to get a strip tinned in predetermined areas.

In conventional tinning of steel by the hot dip method, a bath of molten tin maintained at 500 to 600° F. is provided in a pot having a central divider in the middle of the bath extending partially into the tin. Covering the molten tin in one-half of the bath is flux (such as zinc chloride); in the other half is palm-oil. Sheets are fed through the flux, into the tin, and out through the palm-oil, by appropriate rollers. The palm-oil is used to prevent excessive spotting of the plate by the accumulation of oxide dross at the top of the bath, while the sheets are kept at all times above the level of the tin-iron alloy dross at the bottom of the bath; in spite of all precautions, however, dross rejects are commonly obtained in considerable quantity.

Electrolytic tinning of plate has also been introduced. While the method conserves tin as compared with hot dipping (except where a definite tin thickness is required, as with some food packages) it is more expensive, and seconds are produced in considerable quantity. Furthermore, due to the light weight of tin deposited (usually ½ pound to a base box) the protection obtained is not sufficient to permit the use of such plate on wet packs.

Progress has also been made, in an attempt to conserve tin, in partial tinning of the steel plate. This method proposes to tin only at the portions of the plate which form the edges of cans which must be soldered, where tin is essential; a portion of the tinned strip and the rest of the iron, is preferably coated with varnish, etc., to protect it from corrosion, as disclosed in my Patent No. 2,174,071, issued September 26, 1939. The principal difficulty with all hitherto known methods for strip tinning is that complicated special machinery is required to protect the portions of the sheet which are not to be tinned.

I have invented a method of producing tin

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plate, tinned as desired, which is simple and economical, and produces plate with a minimum of rejects. My invention, in one phase, involves a new method of feeding plate to be tinned into a bath of molten tin at a point below the oxide dross level, and above the iron-tin alloy dross level. In another phase of my invention, selective tinning is obtained by the cleaning of the object to be tinned, in selected areas, preferably by coating with a flux which remains on the plate at temperatures below those which it reaches in going through the bath, but which either evaporates or decomposes at the temperatures reached in the bath.

The invention can be best understood by referring to the accompanying drawing, which discloses various modifications of the invention as applied to webs of steel, and in which the drawing is a diagrammatic representation of the apparatus used in the practice of my invention.

Referring to the drawing, I provide a pot 11 which holds a body of molten tin or other metal or alloy 12, maintained at conventional temperatures (e. g. 550–600° F. for ordinary tin) as by a gas burner 13. The pot 11 has an opening 18 in the bottom, through which the web of steel 14 is drawn from the storage reel 15. The opening 18 is filled by a composite plug 19, having a central hollow opening 20 coinciding with the opening 18 at the top, and connecting with the outside by a slot 21 in the bottom of the plug 19. A pair of adjustable plugs 22, preferably made of mica or graphite, or, in the alternative, of metal faced with oxide or other material not wet by tin, are mounted on screws 23, so that they can completely fill the opening 18. When a run is made, they are opened just sufficiently to permit the web 14 to pass through; since the sides are not wet by the tin, no flow occurs. As speed is picked up, they may be further opened, since the cold steel chills the tin near the opening, and thus reduces the tendency to flow; at operating speeds, the opening is large enough to permit the passage of lap joints of the metal.

In the tinning operation, the web 14 is fed over a driving roll 16 through a flux coater 17 which applies the flux as desired, through the slot 21 into the tin pot. One or more pairs of rolls 24 forces the tin into intimate contact with the web. These rolls are preferably driven in a direction opposite the web travel, to insure optimum cleaning action. I provide them with cut-out slots 25, which carry the dirt off into the bath, and render the rolls self-cleaning. The web emerges from the bath through a wiper 26, which protects the

web from the bulk of the oxide dross in the layer 27. This wiper may, if desired, be positioned above the bath; in this case, the dross collecting on the plate must be removed with the tin. Two pairs of rolls 28 serve to remove what dross is accumulated; the web then passes through further drive rolls 29 to a rewind reel 30.

It will be observed that the pot 11 is shaped, in cross-section, somewhat like a W, with the opening 18 well above the top of the level at which the heavy dross of tin-iron alloy 31 accumulates. Thus, the web enters into clean tin, and leaves from clean tin.

This method, as applied to conventional overall tinning, has very definite advantages over ordinary methods. In the first place, the positive application of the flux by means of the felt coater permits the use of oily steel, since the pressure applied, and the squeegee action, insures complete wetting of even dirty plate. Another advantage arises through the feed—a clean tin surface is hit, since the dross collects below and above the level of feed. The union of tin and steel through flux, which is prevented by dross, is complete; and the improvement is indicated by the sharp reduction obtained in dross rejects as compared to conventional processes.

Where partial tinning only is desired, it is necessary to use flux coaters of special design, and to use special fluxes.

The tin may be stripped transversely to the direction of travel by printing flux onto the web, instead of by using a flux wiper.

If a horizontal feed is desired instead of a vertical feed for reasons of economy of space, the opening in the pot can obviously be made in the side thereof, instead of at the center of the bottom of the W. In such event, the pot can be of conventional cross-section.

The flux used in partial tinning must be carefully chosen if tin specks are to be avoided on the untinned surfaces. If conventional fluxes are used, the spattering of the tin throws both flux and tin at the web as it emerges, and spots occur. I have found that clean tinning can be obtained by using a flux which is volatilized or decomposed rapidly at the temperatures attained in the bath, so that no flux floats on the surface. The flux must not be so volatile, however, that it is removed by the heat of the bath before it enters it. This lower limit obviously depends on the speed of the web, the insulation applied to the pot, etc. With an ordinary metal pot, heated to 550° F. and uninsulated, and a speed of 120 feet per minute, I find that suitable fluxes include succinic acid, ammonium succinate and ammonium lactate, or mixtures thereof; with higher speeds, more volatile fluxes, such as ammonium chloride (which decomposes before it reaches the bath at speeds of 120 feet per minute) may be used.

While the drawing discloses the application of my invention to web steel, it can obviously be applied to sheet steel by changing the feeding devices shown so that they can handle sheets.

The application of my invention to partial tinning, by the use of volatile or decomposible fluxes, is not limited to bottom feeding, although that is the preferred method of feeding. Thus, a sheet or web coated with flux, can be fed vertically downward into a bath of molten tin, and removed upwardly by redirecting, or downwardly through a wiper. In order to reduce dross specking with such a feed, a wiper 26, such as is shown in the drawing, can be used; the steel enters the bath below the surface, at a point where no oxide dross is collected. The principal difficulty with this method, as compared with the bottom feed, is that excessive drossing occurs due to oxidation of the tin.

This application is a division of my Patent No. 2,394,545, issued February 12, 1946.

I claim:

1. An apparatus for coating sheets of steel with molten tin, comprising a tank for molten tin an elongated, slot-like opening in the tank intermediate between the top and bottom thereof so that in normal operation, the opening will be above the level of the tin-iron alloy formed and below the level of the molten tin, each side and end of the slot carrying at least throughout its length a material that is not wet by molten tin, in such relation that the material on the sides and ends abut to form a barrier against the passage of molten tin, and a pair of rollers beneath the normal operation level of the molten tin with their axes parallel to and their bite aligned with the slot-like opening, whereby a sheet may be passed through the slot and the bite of the rolls in sequence, said rolls being provided with slotted grooves, extending axially along the rolls.

2. An apparatus for coating sheet steel with molten tin comprising a tank for molten tin including a floor having higher and lower portions, walls defining an elongated slot-like opening in the floor above the lower portion so that in normal operation, the opening will be above the level of the tin-iron alloy formed, and below the level of the molten tin, the walls at each side and end of the slot carrying at least throughout its length a non-metallic, heat-resistant material that is not wet by molten tin, in such relation that the material on the sides and end abut to form a barrier against the passage of tin, means for advancing sheet steel to be coated through the tank, means for varying the width of the slot by moving the non-metallic lining of the lateral sidewalls, the slot being kept narrow when the apparatus is at rest in order to prevent egress of molten tin and being progressively widened as the sheet is passed more rapidly through the opening, whereby lapped joints of sheet may be passed through the opening without obstruction during operation at full coating speed.

3. An apparatus for coating sheet steel with molten tin comprising a tank for molten tin including a floor having higher and lower portions, walls defining an elongated slot-like opening in the floor above the lower portion so that in normal operation, the opening will be above the level of the tin-iron alloy formed, and below the level of the molten tin, the walls at each side and end of the slot carrying at least throughout its length a non-metallic, heat-resistant material that is not wet by molten tin, in such relation that the material on the sides and end abut to form a barrier against the passage of tin, a winding reel for advancing sheet steel to be coated through the tank, means for varying the width of the slot by moving the non-metallic lining of the lateral side-walls, the slot being kept narrow when the apparatus is at rest in order to prevent egress of molten tin and being progressively widened as the sheet is passed more rapidly through the opening, whereby lapped joints of sheet may be passed through the opening without obstruction during operation at full coating speed.

4. An apparatus for coating sheet steel with molten tin comprising a tank for molten tin including a floor having higher and lower portions, and having a longitudinal cross-section of gen-

erally W shape with a short mid-section, walls defining an elongated slot-like opening in the floor above the lower portion at the apex of the mid-section so that in normal operation, the opening will be above the level of the tin-iron alloy formed, and below the level of the molten tin, the walls at each side and end of the slot carrying at least throughout its length a non-metallic, heat-resistant material that is not wet by molten tin, in such relation that the material on the sides and end abut to form a barrier against the passage of tin, means for advancing sheet steel to be coated through the tank, means for varying the width of the slot by moving the non-metallic lining of the lateral side-walls, the slot being kept narrow when the apparatus is at rest in order to prevent egress of molten tin and being progressively widened as the sheet is passed more rapidly through the opening, whereby lapped joints of sheet may be passed through the opening without obstruction during operation at full coating speed, and a pair of rollers beneath the operating level of the molten

tin with their axis parallel to and their bite alined with the slot-like opening, whereby a sheet may be passed through the slot and the bite of the rollers in sequence.

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