Feb. 6, 1968 A. P. BOCK 3,367,639

CONTINUOUS STRIP HEATING APPARATUS

Filed Aug. 9, 1965

FIG. 1.

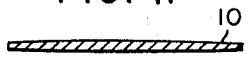


FIG. 4.

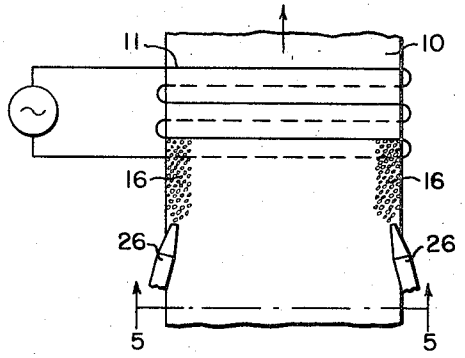
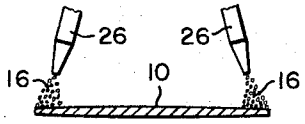


FIG. 5.



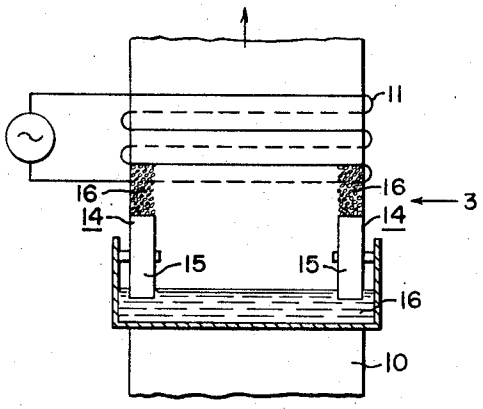


FIG. 2.

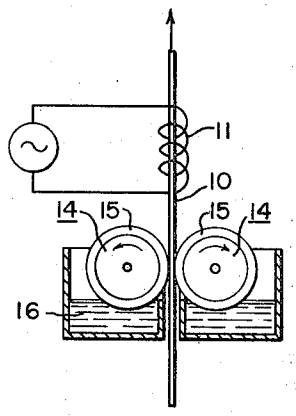
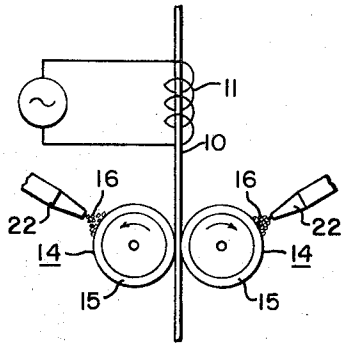


FIG. 3.

FIG. 6.



WITNESSES:

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CONTINUOUS STRIP HEATING APPARATUS

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ABSTRACT OF THE DISCLOSURE

An apparatus for continuous heating of coated metal strip such as electrolytically-coated low-carbon-steel tin-plate strip to alter the condition of such coating by passing the strip through an induction heating coil, wherein miscoloration at the edges of the strip due to overheating at such locations is prevented by use of means for applying a volatile non-coloring liquid to such edges prior to subjection to such induction heating coil.

In cases where it is desired to heat the strip to a uniform temperature across its width, as, for example, in the case of continuous heating for fusion of electrolytically-coated low-carbon-steel tin-plate strip, an excess temperature tends to occur at the edges which can result in miscoloration of such edges.

In view of the foregoing remarks, it is a prime object of the present invention to provide an apparatus for continuous heating of strip material to obtain a uniform temperature across the width of such strip, not withstanding widthwise variations in strip thickness.

In accord with the general features of the present invention the aforementioned object is realized by inclusion of means for applying a quantity of volatile liquid to the portions of such strip which tend to overheat, for extracting the excess heat applied thereto continuously by the heating means.

Other objects, features, and advantages of the invention will become apparent from the following detailed description of the several illustrative embodiments of the invention, when taken in connection with the accompanying drawings in which:

FIGURE 1 illustrates exaggeratedly a typical cold-rolled cross-sectional configuration of metal strip in which the edges are thinner than the mid portion of such strip;

FIG. 2 is a schematic representation of apparatus for inductively heating continuous metal strip, as embodying a means for preventing overheating of the edges of such strip; the view in FIG. 2 being from a direction in which a face of the moving strip is being observed;

FIG. 3 is a view of the apparatus shown in FIG. 2, as observed from the edge of the moving strip in the direction of the arrow 3;

FIG. 4 is a view of an alternate embodiment of the invention taken from a position in which a face of the moving strip is being observed;

FIG. 5 is a view taken along the line 5—5 in FIG. 4; and

FIG. 6 is a modification of the apparatus shown in FIGS. 2 and 3.

Referring to FIG. 1 in the drawing, there is shown therein a cross-sectional view of cold-rolled metal strip material **10** which is thinner at its edges than at its mid portion. The taper has been shown in FIG. 1 exaggeratedly and as a continuous variation from the edges to the mid-portion of the strip. It is not known precisely what the particular shape is in practice, aside that a certain percentage of the width of the edges of the strip is thinner than the mid portion of the strip and tends to become overheated during continuous travel of the strip through an induction heating coil means **11**. The precise shape of such strip is not critical with respect to applicant's invention.

In accord with the present invention, it is known, however, that the edges of metal strip, such as tin-plated steel strip, tend to become discolored when heated by passage of such strip in continuous fashion through a heating station employing such as an induction heating coil means, during such as a tin-fusion-heating process, where the strip may have a nominal thickness of about 5 mils and it is intended to heat such strip uniformly throughout its width to a temperature in the region of 700° F., for example. The excessive temperature may be due in part to the nature of the heating effect as imparted by the heating means at the heating station through which the strip passes, and/or due to the thinner edges of the strip material. In any event, the overheating is prevented in the present invention by applying a quantity of volatile liquid to the edges of such strip in that region of the strip which tends to be subjected to the overheating and/or discoloration. Where it is an object to prevent overheating of tin-plated steel strip in behalf of preventing discoloration, the overheat-preventing liquid is preferably one which is transparent and affords no protective coating in itself. Water appears to be a desirable liquid in view of its relatively high latent heat of evaporation and its transparency. For applying such overheat-preventing liquid to the edges of the strip, the illustrative embodiment of the apparatus in FIG. 2 employs roller applicators **14** which are provided with a suitable absorbent cover **15** constructed and arranged to consecutively be subjected to a pool of liquid **16** and to the edges of the strip **10** to effect rolling transfer of liquid from such pool to the critical edge areas of the strip during travel past such applicators and into and through the induction heating coil means **11**. The liquid **16**, such as water, thus applied by rolling action onto the strip will travel with the strip into the heating coil **11** wherein the heating of the strip by such coil will result in evaporation of the liquid and extraction of heat from the areas subjected to the liquid and prevent such areas from becoming overheated by the induction heating of the strip. As shown in FIG. 3, a pair of similar roller applicators **14** may be disposed on each side of the moving strip. As shown in FIGS. 2, 3 and 6, advancement of the strip **10** past the roller applicators **14** and through the induction heating coil means **11** may be effected by suitable conventional means (not shown).

FIG. 6 illustrates a modification of the apparatus shown in FIGS. 2 and 3, and employs nozzles **22** for applying makeup of overheat-preventing liquid to the absorbent surfaces **15** of the roller applicators **14**, in lieu of the liquid reservoir arrangement shown in FIGS. 2 and 3. In the arrangement in FIG. 6 the amount of liquid applied to the strip by the roller applicators is controlled by nozzle flow.

The embodiment of the apparatus shown in FIGS. 4 and 5 discloses an alternate construction in which the overheat-preventing liquid **16** may be applied to the strip edges directly by way of nozzles **26** constructed and arranged to direct the overheat-preventing liquid **16** onto the critical areas of the strip.

Wherein the present invention contemplates the use of water as the overheat-preventing liquid in accord with the present invention, the adhering and distribution properties of such liquid as applied to the strip may be improved when necessary by addition of wetting agent, such as ethylene-glycol, or a suitable one of the aryl alkyl sodium sulfonates, or other suitable wetting agent.

From the foregoing it will be apparent that applicant has provided an apparatus for the continuous heating of strip material in which overheating of the overheat-prone portions of such strip is prevented by the application of a

suitable quantity of volatile liquid which becomes evaporated by the heat applied to the strip.

While the invention has been described with a certain degree of particularity as to the illustrative embodiments thereof, it is intended that the true scope and spirit of the invention be so covered by the appended claims as to embrace those modifications which will be obvious to those versed in the art by virtue of the teachings in the present patent application.

I claim:

1. Apparatus for the continuous heating of coated metal strip material which tends to become overheated and thereby miscolored at its edge portions when subjected to continuous heating, said apparatus comprising a heating station including induction heating means through which the strip is moved continuously, and means for applying a non-coloring volatile liquid exclusively to said edge portions of such strip prior to subjection to said heating means for absorbing an amount of heat from the strip during heating by such heating means sufficient to prevent overheating and miscoloration of such edge portions.

2. The apparatus as claimed in claim **1**, wherein the last-recited means comprises roller applicator means for engaging faces of the selected widthwise portions of the strip to transfer liquid thereto, together with a means for continuously replenishing the liquid to the roller applicator means.

3. The apparatus as claimed in claim **2**, wherein the means for replenishing liquid to the roller applicator means takes the form of a reservoir of liquid through which a portion of the roller applicator means travels.

4. The apparatus as claimed in claim **2**, wherein the means for replenishing liquid to the roller applicator means takes the form of a nozzle means for delivering liquid to such roller applicator means.

5. Apparatus as set forth in claim **1**, wherein the means for applying liquid to the selected widthwise portions of the strip comprises nozzles for spraying liquid directly onto such strip.

6. The apparatus as claimed in claim **1** wherein said coated metal strip is electrolytically-coated low-carbon-steel tin-plated strip.

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