Aug. 23, 1960 J. C. SLATER ET AL 2,950,215

METHOD AND APPARATUS FOR IMPROVING METALLIC COATINGS

Filed July 7, 1958 2 Sheets-Sheet 1

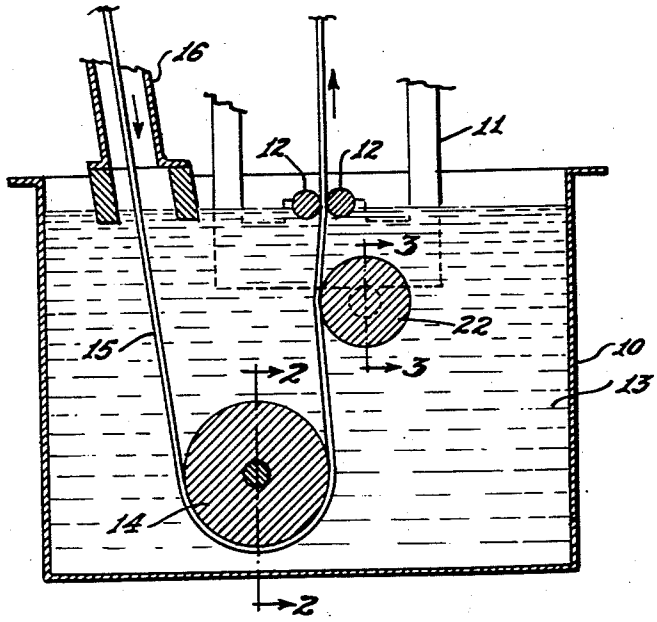


FIG. 1.

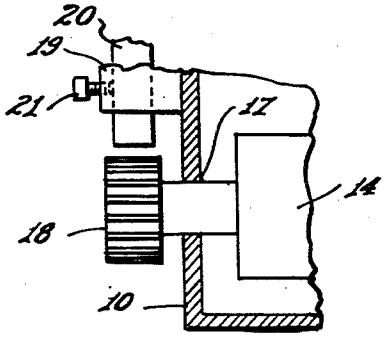


FIG. 2.

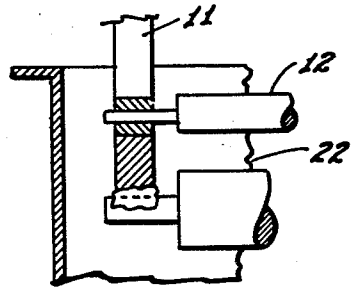


FIG. 3.

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FIG. 4.

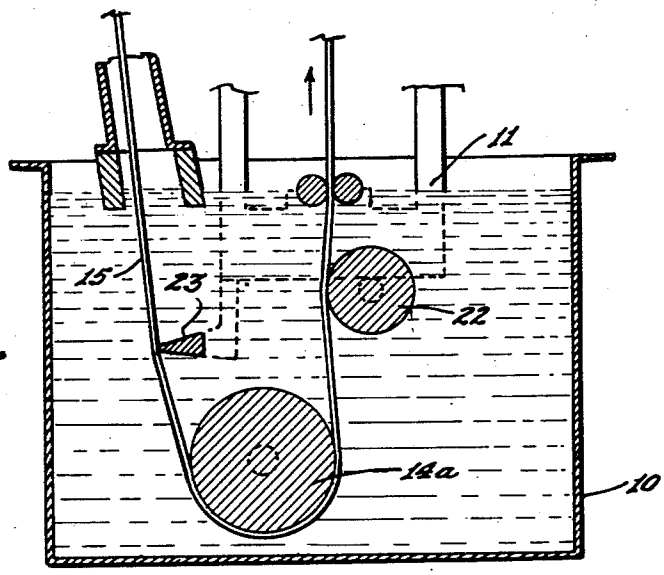
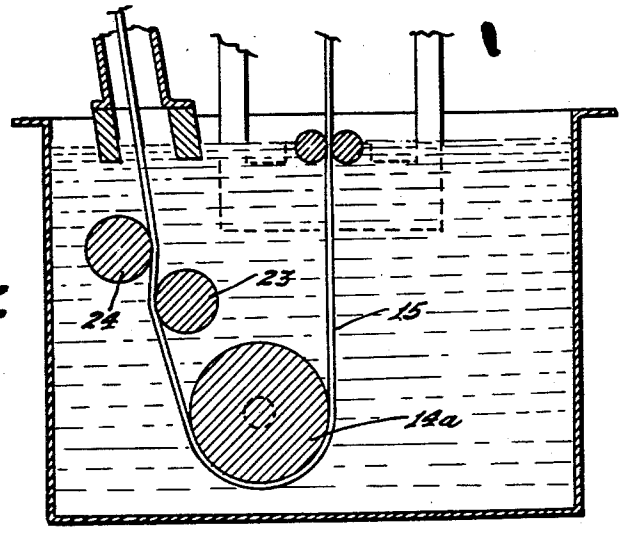


FIG. 5.



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METHOD AND APPARATUS FOR IMPROVING METALLIC COATINGS

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13 Claims. (Cl. 117—114)

This invention relates to a method and apparatus for improving metallic coatings and is a continuation-in-part of application Serial No. 322,690, filed November 26, 1952, now abandoned, entitled "Method and Apparatus for Improving Metallic Coatings." More specifically, the instant invention has to do with a method and apparatus for insuring the uniform and even coating of a metallic strip when such metallic strip is fed through a pot containing molten coating metal.

In the coating of metal strip with a layer of another metal, it has been conventional practice to provide a pot of molten coating metal, the pot having near the bottom thereof a so-called pot roll. The strip to be coated has been led into the pot and passed around the pot roll and then led out of the pot between so-called exit rolls or wipers which generally have for their purpose the removal of excess coating metal so that a uniform coating of a desired weight can be obtained. In various coating procedures it is often found that a sort of scum forms on the surface of the molten coating metal and that this scum adheres to the strip as it passes into the coating bath with the result that the coating metal does not adhere uniformly to the strip. The scum particles picked up by the strip form a barrier on the strip which prevents the coating metal from bonding to the strip, with the result that there is a considerable amount of unsatisfactorily coated metal which must be rejected.

This problem is particularly apparent in coating processes wherein the strip passes into the coating bath through a controlled atmosphere. It has been found that such atmospheres, while inert with respect to the clean strip surface, are not inert with respect to the surface of the molten coating metal. The atmospheres react rapidly with the molten metal forming scums on its surface. These scums adhere to the strip and are pulled through the coating bath with the result that the continuity of the coating is spoiled by uncoated areas.

We have observed that the foregoing phenomenon takes place continuously and is decidedly more pronounced if the strip is allowed to vibrate. The frequency and size of the scum particles adhering to the strip surface under vibrating conditions is substantially greater and damage to the formation of a uniform bond is substantially more severe. In some cases completely uncoated areas are produced resulting in intolerable rejection losses.

With the foregoing considerations in mind, it is an object of the present invention to provide a method and apparatus whereby such scums as are picked up by the strip and carried into the bath are removed from the strip on both sides so that an even and continuous coating is provided.

A principal object of the present invention is the provision of a method and apparatus which provides for substantially vibration-free passage of the strip through the coating bath which results in a significant decrease in scum pick-up. Coupled with this objective, a further object of the invention is the provision of effective scum wiping on both sides of the strip while the strip is well

within the confines of the coating bath, the wiping of the strip serving to remove existing scum deposits at a sufficiently early stage to permit proper recoating and bonding of the wiped areas.

It is a further object of the present invention to utilize the presently conventional coating pot and to provide by a simple expedient means for wiping both sides of the strip, and in which the means for wiping one side of the strip may comprise the presently conventional pot roll.

Still a further object of the invention is to provide an apparatus along the lines outlined above which is essentially the metal coating pot well known today with relatively minor modifications which are inexpensive to install and which in no way affect the speed of production.

The foregoing together with other objects of the invention, which will be pointed out in greater detail hereinafter, or which will be apparent to one skilled in the art upon reading these specifications, we accomplished by those constructions and arrangements of parts, and by that series of method steps, of which we shall now describe certain exemplary embodiments.

Reference is now made to the drawings forming a part hereof, and wherein:

Figure 1 is a vertical cross-sectional view through a typical metal coating pot illustrating one form of the invention.

Figure 2 is a fragmentary cross-sectional view taken along the line 2—2 of Figure 1.

Figure 3 is a fragmentary cross-sectional view taken along the line 3—3 of Figure 1.

Figure 4 is a vertical cross-sectional view illustrating a modified form of metal coating pot.

Figure 5 is a vertical cross-sectional view illustrating still another modification of the invention.

Briefly, in the practice of the invention, means are provided under the surface of the molten metal in the coating pot for wiping both surfaces of the strip as it passes through the pot. At least one of the wiping means will be placed within the bath and positioned to contact the strip as it moves downwardly in the bath, such wiping member serving the additional function of damping the vibration of the incoming strip. Since it is conventional to pass the strip under a pot roll—which serves as a guide member to change the direction of travel of the strip—one form of the invention contemplates the provision of means to immobilize the pot roll to prevent its rotation so that the pot roll itself serves to damp the vibration of the strip and at the same time wipes the strip on one side as the strip passes around the surface of the pot roll. A second wiping means is also provided within the pot for the other side of the strip over which the strip passes in frictional contact.

Thus, as seen in Figure 1 of the drawings, a metal coating pot is indicated generally at 10. A so-called exit machine is indicated generally at 11, and it includes exit rolls 12 between which the strip passes as it emerges from the pot 10. The pot 10, as will be readily understood, contains a body of molten coating metal indicated at 13. Adjacent the bottom of the pot there is rotatably mounted the usual pot roll 14 about which the strip 15 passes to make certain that the strip passes well under the surface of the coating metal.

In the particular embodiment illustrated the strip 15 enters the coating pot through a duct 16 within which a controlled atmosphere is maintained. The particular coating procedure is not important to the present invention since even where a controlled atmosphere is in contact with the surface of the coating metal, a scum of indeterminate composition is often formed. This scum frequently adheres to the strip by a mechanical attachment and results in areas which are not coated by coating metal. It has been found that this scum can be removed

from the strip by suitable wipers immersed in the coating metal.

It has also been noted that the mechanical attachment of the scum material is aggravated by vibrations of the strip which are transmitted to it by various pieces of apparatus outside the pot, including coilers, conveyor rollers and the like.

According to the present aspect of the invention, and as best seen in Figure 2, the shaft **17** which carries the pot roll **14** is provided with a gear **18** positioned outside the pot where it is readily accessible; and in association with this gear, means are provided for preventing rotation of the pot roll **14**. These means may include a bracket **19** with a stop plate **20** which may be held out of contact with the gear **18** by means of a screw **21**, and which upon release of the screw **21** will drop downwardly into contact with the teeth of the gear **18** and thus hold the roll **14** against rotation. It will be clear that when the roll **14** does not rotate, the strip in passing around the roll **14** will be wiped on the side which is in contact with the pot roll. At the same time, the pot roll will serve to damp the vibration of the strip by means of the positive contact between the strip and the immobilized roll.

An additional wiper member **22** is positioned between the pot roll and the exit rolls **12**, the wiper member **22** taking the form of a bar or roll welded or otherwise suitably secured to the bottom of the exit machine **11**. It will be noted from Figure 1 that the wiper member **21** is so positioned that the path of the strip exiting from the pot is distorted from a line passing between the exit rolls **12** and tangent to the pot roll **14**. Preferably, the displacement of the strip amounts to about ½" from the normal pass line, but the specific amount of distortion does not appear to be critical. It will be clear that the strip in passing over the non-rotatable member **22** is wiped on its other side.

The structure just described performs two functions, both of which are desirable. In the first place, the strip in passing over the non-rotatable pot roll and rubbing against the wiping member **22** is steadied so that vibrations on the outside of the pot, either from cooling or coiling apparatus, are not carried through into the pot. The reduction of vibration has, as already indicated, the effect of minimizing the deposit of scum on the strip. Additionally, the rubbing action of the members **14** and **22** on the strip wipe off the scum which has attached itself to the strip at the controlled atmosphere coating metal interface. Since the adherent scum or smudge is wiped off both surfaces, the coating metal is uniformly and evenly deposited on both surfaces of the strip and, by reason of the fact that both wiping members are well within the confines of the pot, the strip will remain in contact with the coating metal for a sufficient length of time to allow proper reformation of the bond throughout the entire surface of the strip without interfering with the functioning of the exit rolls in controlling the weight and uniformity of the coating. In this connection, it may be observed that if the strip is not thoroughly cleansed of scum by the time it reaches the exit rolls, the exit rolls act to smear the scum over adjoining properly coated areas of the strip and hence further aggravate the problem.

In the practice of the invention, the stop **20** is retracted so that the pot roll may rotate while the strip is being fed through the pot. As soon as the strip has been threaded through and the coating operation is ready to begin, the stop **20** will be lowered into contact with the gear **18** and further rotation of the pot roll **14** prevented. While it has been found that there is no appreciable accumulation of scum on the wiping elements **14** and **22** during the relatively short time between replacement of the exit machine, nevertheless, if it should be found under certain conditions that some of the scum deposits on these members they can be readily cleaned. Thus, for example, the bottom pot roll may be permitted to rotate for a few revolutions, while the exit machine can be tilted so as to shift the member **22** out of contact with the strip. These expedients have not, however, been found necessary in actual practice.

It will be clear that the particular means for preventing rotation of the pot roll **14** is not critical, and numerous modifications can be made therein. Similarly, the wiper member **22** need not be a non-rotatable cylindrical object, but could be a plate or blade. Similarly the location of wiper **22** may be altered. Thus, the member **22** could be placed ahead of the pot roll, in which event the wiper would be first contacted by the strip and would serve to damp its vibration. Actually, the wiper for one side of the strip need not be the pot roll at all, excepting for the fact that conventional metal coating apparatuses are provided with pot rolls making it possible to utilize the invention with only very minor modifications of the existing equipment.

In Figure 4 there is illustrated a modification of the invention wherein the pot roll **14*a*** is permitted to revolve, and wherein the damping of the strip is accomplished by placing a wiper bar **23** on the entering side of the coating apparatus ahead of the pot roll **14*a***. With this arrangement, the wiper bar **23** will wipe one side of the strip, and the other side may be wiped by the wiping member **22**.

It is also possible to wipe both sides of the strip by suitable wiping means installed on the entry side of the bath. Thus, as seen in Figure 5, an additional wiping member **24** may be positioned adjacent the wiper **23** for contact with the opposite side of the strip. With this arrangement, both sides of the strip are wiped prior to the passage of the strip around the pot roll **14*a*** which, as in the embodiment of Figure 4, will be free to rotate. It will be evident that the addition of the wiping members **23** or **24** to the coating pot is a relatively simple matter and does not require any major modification of existing equipment.

It will be clear from the foregoing that numerous modifications may be made in the invention without departing from the spirit of it, and it will be therefore understood that we do not intend to limit ourselves otherwise than as set forth in the claims which follow.

Having now fully described our invention in several exemplary embodiments, what we claim as new and desire to secure by Letters Patent is:

1. In apparatus for coating metallic strip with a layer of another metal, wherein the strip to be coated enters a pot containing a bath of molten coating metal and is first led downwardly through the coating metal toward the bottom of the pot and then upwardly therethrough so as to emerge from the bath between exit rolls; a first stationary wiping member fixedly mounted within the pot beneath the surface of the molten coating metal and positioned to make full width contact with one side only of the metallic strip, said first wiping member being of rigid non-yielding construction and acting to deflect the strip from its initial downward direction of travel so as to effectively dampen vibration of the strip as it enters the bath and at the same time effect a positive wiping action on the side of the strip contacted thereby, and a second rigid non-yielding wiping member fixedly mounted within said pot beneath the surface of the bath intermediate said first wiping member and the exit rolls, said last named wiping member being positioned to make full width contact with the remaining side of the strip and deflect it in the opposite direction, whereby to effect a positive wiping action on the remaining side of the strip.

2. The apparatus claimed in claim 1 wherein said first named wiping member comprises a pot roll, wherein means are provided to prevent rotation of said pot roll, and wherein said second wiping member is located within the pot intermediate said pot roll and the exit rolls.

3. The apparatus claimed in claim 1 wherein one of said wiping members comprises a pot roll located within

said pot roll, and wherein means are provided to prevent free rotation of said pot roll.

4. The apparatus claimed in claim 3 wherein said pot roll comprises said second named wiping member.

5. In an apparatus for coating metallic strip with a layer of another metal, wherein the strip to be coated enters a pot containing molten coating metal, passes downwardly through the coating metal and around a pot roll and then emerges from the coating metal between exit rolls; wiping means positioned in the pot for contact by the strip after it has entered the molten coating metal and is moving downwardly therethrough, said wiping means comprising a pair of rigid non-yielding wiping members positioned ahead of the pot roll and arranged in non-opposed relation so as to sequentially contact opposite side of the strip and deflect it first in one direction and then in the other, whereby to effectively damp the vibration of the strip as it passes downwardly through the coating metal and at the same time effect a positive wiping action on first one side of the strip and then the other.

6. In the coating of metallic strip with a layer of another metal by passing said strip through a bath of molten coating metal, a method for improving the quality of said coating which includes the steps of advancing the strip downwardly into the bath of molten coating metal and, as the strip is moved downwardly, drawing one side of the strip across the surface of a rigid non-yielding wiping member fixedly mounted within the bath and positioned to deflect the strip in one direction as it is drawn over the rigid wiping member, and thereafter drawing the opposite side of the strip over a second rigid non-yielding wiping member also located within the bath, said second wiping member lying beyond the first named wiping member and positioned to deflect the strip in the opposite direction, and then withdrawing the strip from the bath and, as the strip emerges from the bath, passing it through a finishing means effective to control the weight and uniformity of the coating thereon.

7. In an apparatus for coating metallic strip with a layer of another metal, wherein the strip to be coated enters a pot containing molten coating metal, passes around a pot roll and then emerges from the pot between exit rolls; means to prevent the rotation of said pot roll whereby said strip in passing around said pot roll will be wiped on one side, and wiping means in said pot for the other side of said strip, said last named wiping means being positioned to displace said strip from its normal path of travel through said pot.

8. In an apparatus for coating metallic strip with a layer of another metal, wherein the strip to be coated enters a pot containing molten coating metal, passes around a pot roll and then emerges from the pot between exit rolls, said pot roll having a shaft extending out of said pot; means accessible on the outside of said pot to prevent rotation of said pot roll, whereby said strip in passing around said pot roll will be wiped on one side, and wiping means in said pot for the other side of said strip, said last named wiping means being positioned to displace said strip from its normal path of travel through said pot.

9. In an apparatus for coating metallic strip with a layer of another metal, wherein the strip to be coated enters a pot containing molten coating metal, passes around a pot roll and then emerges from the pot between exit rolls, said pot roll having a shaft extending

out of said pot; a gear on said shaft outside said pot, and means selectively engageable with said gear to prevent rotation of said pot roll, whereby said strip in passing around said pot roll will be wiped on one side, and wiping means in said pot roll for the other side of said strip, said last named wiping means being positioned to displace said strip from its normal path of travel through said pot.

10. In an apparatus for coating metallic strip with a layer of another metal, wherein the strip to be coated enters a pot containing molten coating metal, passes around a pot roll and then emerges from the pot between exit rolls; means to prevent the rotation of said pot roll, whereby said strip in passing around said pot roll will be wiped on one side, and cylindrical wiping means in said pot for the other side of said strip, said last named means being positioned to displace said strip from its normal path of travel through said pot.

11. In the coating of metallic strip with a layer of another metal by passing said strip through a bath of molten coating metal having a pot roll in the bath, the method of improving the quality of said coating which includes the steps of holding said pot roll against rotation to cause the side of the strip contacting the pot roll to be wiped, and wiping the other side of the strip by causing it to pass in frictional contact with a second wiping surface located under the surface of said bath.

12. In the coating of metallic strip with a layer of another metal by passing the said strip through a bath of molten coating metal having a pot roll located within the bath, the method of improving the quality of the coating which includes the step of feeding the strip into the bath and causing it to pass around said pot roll, whereby to change the direction of movement of the strip, wiping at least one side of the strip by means of a rigid stationary wiper positioned to contact and deflect the strip prior to its change in direction, and wiping the remaining side of the strip at least prior to the time it emerges from the said bath by means of a second rigid wiper positioned to contact and deflect the said strip.

13. In the coating of metallic strip with a layer of another metal by passing the strip through a bath of molten coating metal, the method of improving the quality of said coating which includes the step of moving the strip downwardly into the bath in a first direction of movement and, while the strip is moving in said first direction, wiping at least one side of the strip against a first rigid wiper positioned to deflect the strip as it moves downwardly in said pot, thereafter causing the strip to change its direction of movement so as to move upwardly through the bath toward an exit station, wiping the remaining side of the strip against a second rigid wiper positioned at a point within the bath well in advance of said exit station, and, as the strip passes through said exit station, contacting both sides thereof with a finishing means effective to control the weight and uniformity of the coating thereon.

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