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TERNE COATING PROCESS

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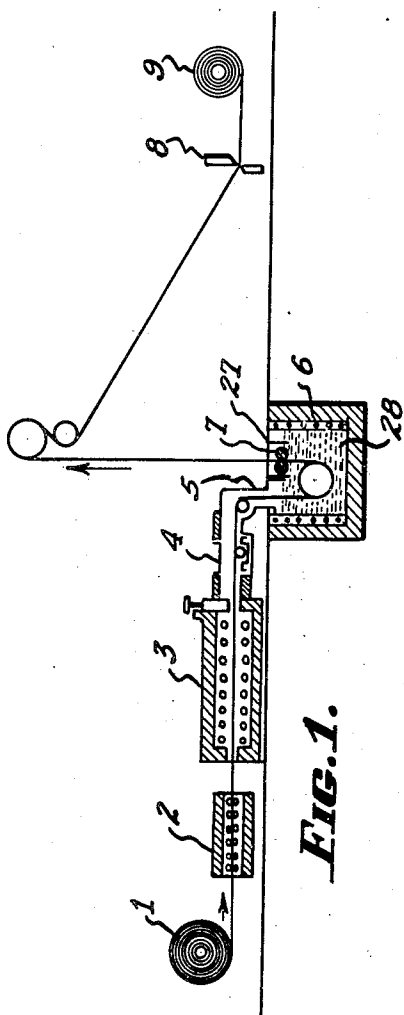


FIG. 1.

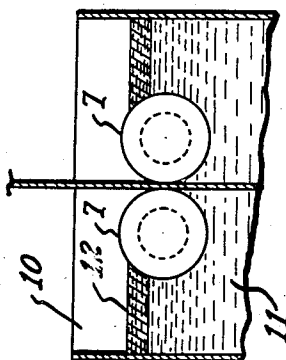


FIG. 2.

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TERNE COATING PROCESS

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6 Claims. (Cl. 117—52)

Our invention relates to the coating of iron or mild steel strip, sheet or the like with molten metals of the terne variety. Ordinarily terne coatings are alloy coatings comprising principally lead with some tin added; and it is useful also in connection with related alloys on a lead base but containing different quantities of tin and such additions as zinc, antimony, bismuth, and the like in minor quantities. Terne metal usually has an analysis of around 14½% tin and 85½% lead, but by the term "terne metal" as used hereinafter we intend to include alloys on a lead base presenting the same problems. Hitherto in terne coating it has been the common practice to employ exit rolls on or above the metal as it leaves the pot, the exit rolls being of complicated construction and being kept continuously submerged in oil.

The use of oil entails a number of operating disadvantages among which is the necessity of including a cleaning machine to remove the excess oil from the coated strip. The oil process is also limited to use with very light coatings.

Since the oil treatment has been the only feasible commercial treatment hitherto evolved, these light coatings have been the only coatings available. Terne coatings, especially in the light weights to which the art has had to confine its efforts, are subject to holes and imperfections, and improvement in the nature of the coating has long been desired.

A method by which ordinary exit rolls could be used partially submerged in the terne bath as is the common practice with zinc has long been sought, but no workable flux has been available to keep these exit rolls clean so that over a period of time a continuously good surface could be produced. Several fluxes for this purpose have been proposed but none of them have proved practical, and this one difficulty has hitherto prevented the commercial use of fluxed exit rolls in terne pots.

An object of our invention is the provision of a flux which can be used on exit rolls partially submerged in coating baths of terne metal or the like, without the use of oil. An object of our invention is the provision of such a flux as will not volatilize unduly or decompose at the temperature of the bath, and which may be caused to remain effective over long periods of operation by the addition of small quantities of the component ingredients. An object of our invention is the provision of a flux for use with terne metal which will permit the employment of exit rolls at least partially exposed to view so that their

condition can be readily ascertained and corrected, if necessary.

An object of our invention is the provision of a process whereby terne coatings may successfully be made not only in heavier weights which have hitherto been impossible, but in controlled weights. An object of our invention is the provision of a process whereby better and more perfect terne coatings are produced. An object of our invention is the elimination of the use of oil and its disadvantages, the improvement of control means for the coating, and the production of exit means which can be kept clean of impurities tending to damage the coatings.

We achieve these objects by the use of a novel flux which in its preferred form consists of molten zinc chloride in which ammonium bromide has been dissolved.

By the use of this flux we are able successfully to coat strip or sheets with terne metal without use of oil finishing means, but using exit rolls partially submerged in the coating bath in the manner commonly employed in coating with zinc.

It is to be understood that this flux on the exit rolls of a pot of terne or similar metal can be used with any effective method of properly cleaning the strip or sheets to be coated. The most common method is to clean the material by acid pickling and then introduce it into the pot through a flux of aqueous zinc chloride.

Another method of preparing a strip for coating is the method of oxidation and reduction described in the Sendzimir U. S. Patent No. 2,110,893.

The use of our new exit roll flux in connection with a complete terne coat process is shown as an exemplary embodiment in the drawing in which:

Figure 1 is a diagrammatic view of a terne coating process and apparatus of the Sendzimir type.

Figure 2 is an enlarged view of an exit apparatus showing our flux in place.

In Figure 1, the metal to be coated, being withdrawn from a coil 1, is carried first through an oxidizing furnace 2 in which oil and carbonaceous materials are burned from its surface and the surface is oxidized in a controlled manner to give a very thin and uniform oxide coating of a thickness varying from straw to blue and into gray. It will be understood that the metal at the start of the operation is in scale-free condition; but it does not otherwise have to be cleaned. The metal, when in strip form, will usually be cold rolled strip, having a smooth and roll-polished surface and carrying some oil. Improved results, how-

ever, in terne coating may frequently be attained by starting with metal which, after cold rolling, has been passed through shot blasted rolls or has been given a chemical etching treatment, or both.

The strip is next passed through a reducing furnace 3. The thin controlled oxide surface is reduced in this furnace, giving a metal to be coated, the surface of which is completely clean. Annealing of the metal may also occur in this furnace and preferably the cycle is such that annealing for softening will occur. Connected with the furnace is a cooling hood 4 in which the metal is brought down to a temperature preferably above but only slightly above the temperature of the molten metal in the terne pot. The hood is connected at one end with the annealing furnace and at the other end has a bell or delivery means 5 extending below the surface of the molten metal in the pot; and a non-oxidizing atmosphere is maintained in the hood so that after the reduction which occurs in the furnace 3, the metal to be coated is not thereafter exposed to oxidizing influences before it is submerged beneath the surface of the molten terne metal. Suitable means may be taken to keep the atmosphere in the cooling hood 4 non-oxidizing. We have indicated a terne pot at 6 through which the metal is passed and whence it issues through a pair of rolls 7. Where the treatment thus far described is carried on, the surface of the metal to be coated will be in such condition that flux need not be applied prior to the entry of the metal into the bath.

The metal is withdrawn from the bath, appropriately cooled, and sheared as at 8 or coiled as at 9.

The exit rolls are surrounded by partition means 10 or are so isolated from the entrance end of the terne pot that a special flux may be maintained upon the surface of the terne metal 11 adjacent the exit rolls without contacting the metal as it enters the pot. In Figure 2 we have shown the exit rolls 7 partially submerged in the terne metal 11 with the special flux to which we have referred (and which is indicated at 12) kept floating on the surface of the terne metal in contact with the outside of the exit rolls by the partition means 10.

Although we do not wish to be bound by theory, we believe that the fluxing action which keeps the exit rolls clean and bright is due to the presence of the ammonium bromide. This material cannot be used alone, however, since it does not melt, but volatilizes very rapidly at the temperature of the coating bath. The action of the zinc chloride, we believe, is to melt and form a solvent for the ammonium bromide. The zinc chloride alone will not keep the rolls bright.

In making up our flux, the procedure is:

1. To place a quantity of zinc chloride around the exit rolls on the surface of the molten metal, where it melts.

2. To add small amounts of ammonium bromide to this molten layer until the exit rolls turning in contact with this flux become clean and bright.

The presence of too much ammonium bromide can be readily detected by the appearance of excessive fuming. The operator can readily determine by observation the minimum amount necessary to maintain the rolls in good condition. The relative proportions of the two ingredients for best operating conditions will vary somewhat with the type of equipment and other conditions,

such as the temperature and composition of the molten coating metal. We have found, however, that we have been most successful with a mixture containing around 90 to 95% of zinc chloride and 5 to 10% of ammonium bromide.

After the flux has been in use for some time, it will probably be found necessary to add small quantities of ammonium bromide, because this ingredient is slowly used up by the fluxing reaction and by volatilization. If the flux volume gets too low, additions of zinc chloride can be made. At no time should water be added to the flux.

We have found that it is possible to replace a portion or all of the ammonium bromide with ammonium chloride. When ammonium chloride is used, however, better action is obtained if the coating metal is operated at around fifty degrees higher in temperature than when bromide is used. Using bromide, the preferred pot temperature for conventional terne metal is between 660 and 690° F. The use of ammonium chloride reduces the cost of the flux somewhat.

We have also found that zinc bromide can be used as a solvent in the place of the zinc chloride. Although this might have some technical advantages, its use would considerably increase the cost of the flux. Taking everything into consideration, we prefer to use zinc chloride and ammonium bromide.

With a flux of the character mentioned, the use of the complicated exit roll structures of the past have been eliminated as well as the use of oil and sawdust or other inert granular substances to keep the rolls clean. A comparison of the cost of the use of our flux as compared with the oil and sawdust hereto employed shows that a saving of from 50 to 75¢ per ton of sheets or strip metal is realized without counting investment, depreciation and maintenance charges on the cleaning equipment which has been eliminated.

Providing the base metal has been brought into proper association with the terne metal, the weight of the coating produced can be controlled by the usual means, including the degree of submergence of the exit rolls beneath the surface of the bath of molten terne metal. The nature of the surface of the metal being coated has an effect also, the very slick surface of cold rolled strip facilitating the production of lighter coatings. But our process greatly facilitates the making of very heavy coatings where desired, for example, up to two ounces per square foot and beyond, and thus has made possible the commercial production of heavily terne coated sheet and strip for use in severely corrosive conditions or in ordinary service where extremely long life is desired.

The sheet or strip emerges from the pot in a clean condition. Not only is the coating itself more perfect, weight for weight, than has hitherto been producible, but the surface is not coated with oil. Where it is desired to paint terne coated sheets made by our process, this may be done directly without first having to remove an oil film.

Modifications may be made in our invention without departing from the spirit of it. Having thus described certain exemplary embodiments of our development, we have set forth in the ensuing claims the invention inherent therein.

We claim:

1. A process of terne coating which comprises bringing a cleaned metal body into association

with molten terne metal and withdrawing the said metal body therefrom through exit rolls which are maintained in contact with a molten anhydrous flux, said flux comprising ammonium bromide and a solvent salt, namely chloride of zinc.

2. A process of terne coating which comprises bringing a cleaned metal body into association with molten terne metal and withdrawing the said metal body therefrom through exit rolls which are maintained in contact with a molten anhydrous flux, said flux comprising ammonium chloride and a solvent salt, namely chloride of zinc.

3. A process of coating metal bodies with terne metal which comprises oxidizing the surface of a scale-free metal body to be coated so as to burn combustible material therefrom and produce on the surfaces of said body a thin controlled coating of oxide ranging in color from straw to gray, thereafter passing said body through a heated zone in which is maintained a reducing atmosphere, and without re-exposing said body to oxidizing influences, passing it into molten terne metal and withdrawing it therefrom through exit rolls, which exit rolls are maintained in contact with a molten anhydrous flux comprising a material selected from the group consisting of ammonium chloride and ammonium bromide together with a solvent salt, namely zinc chloride.

4. A process of coating metal bodies with terne metal which comprises oxidizing the surface of

a scale-free metal body to be coated so as to burn combustible material therefrom and produce on the surfaces of said body a thin controlled coating of oxide ranging in color from straw to gray, thereafter passing said body through a heated zone in which is maintained a reducing atmosphere, and without re-exposing said body to oxidizing influences, passing it into molten terne metal and withdrawing it therefrom through exit rolls, which exit rolls are maintained in contact with a molten anhydrous flux comprising a material selected from the group consisting of ammonium chloride and ammonium bromide together with a solvent salt, namely zinc chloride, and controlling the said exit rolls to produce a heavy residual coating of terne metal on said metal body.

5. The process claimed in claim 3 including the step of roughening the surface of the metal body prior to cleaning and coating.

6. A process of coating metal bodies with terne metal without the use of oil at exit apparatus which comprises thoroughly cleaning said metal bodies and submerging them in a molten bath of terne metal, thereafter withdrawing them from said bath between exit rolls turning in a molten anhydrous flux, free of suspended solids, and comprising a material selected from the group consisting of ammonium chloride and ammonium bromide and a solvent salt, namely zinc chloride.

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