April 7, 1942. R. J. WEAN 2,278,600

METHOD FOR COATING SHEET METAL

Filed Nov. 30, 1938 2 Sheets-Sheet 1

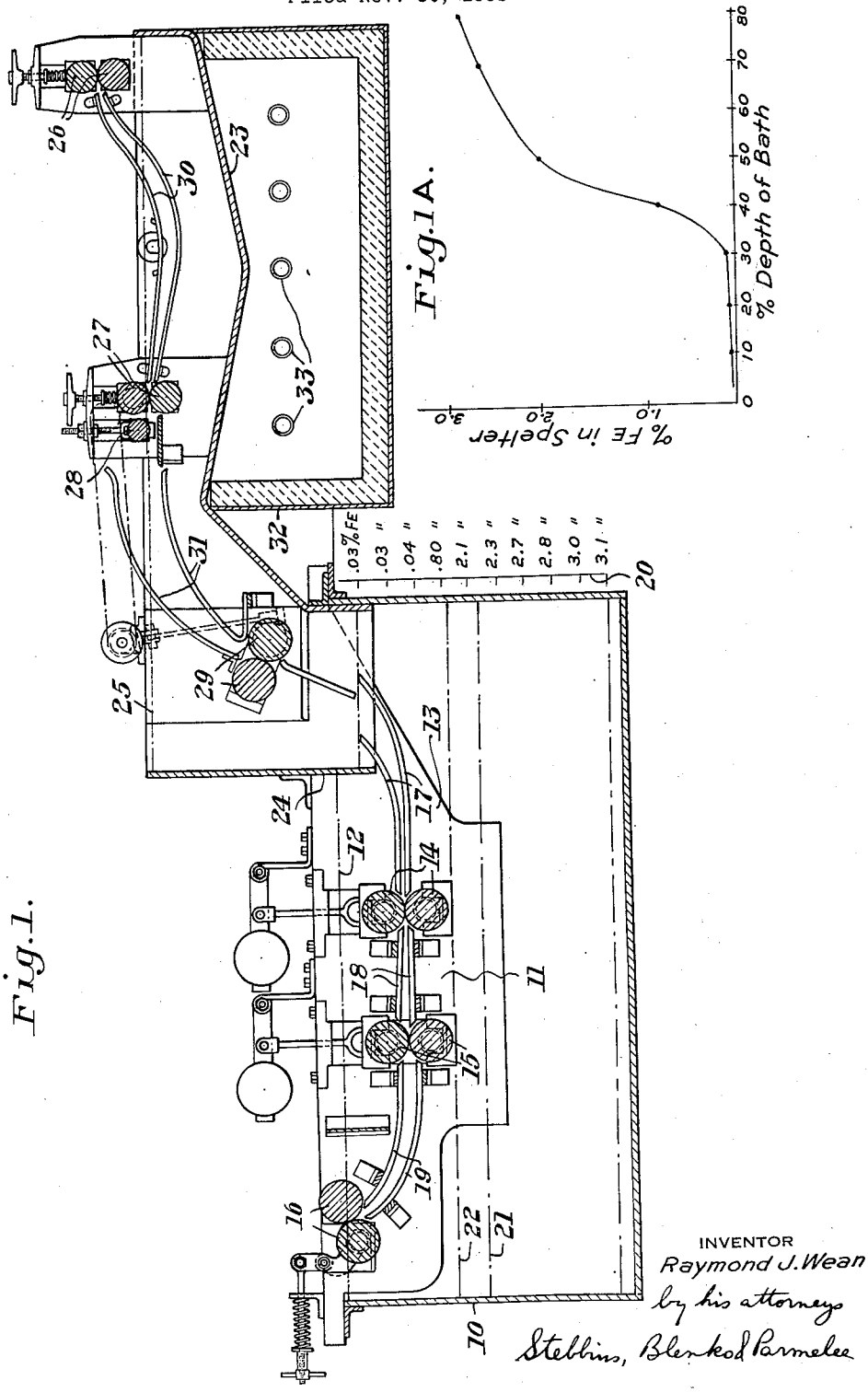


Fig. 1.

Fig. 1A.

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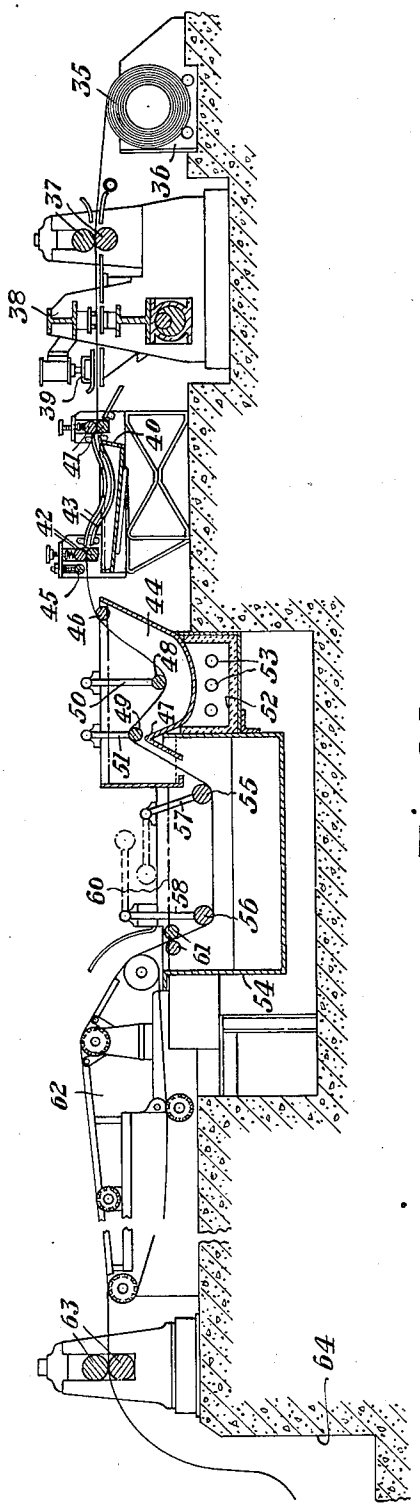


Fig. 2 A.

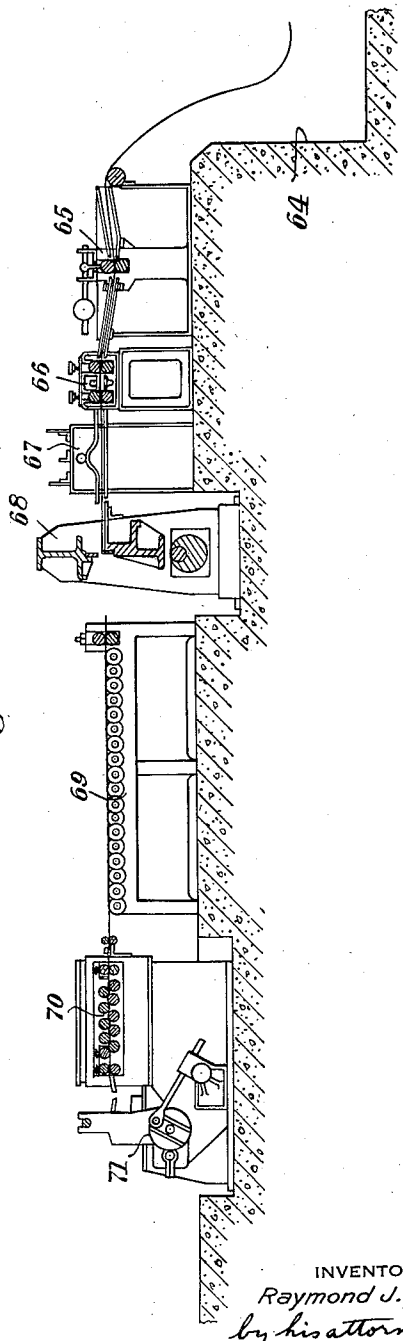


Fig. 2 B.

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METHOD FOR COATING SHEET METAL

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2 Claims. (Cl. 91—70.2)

This invention relates to the art of coating and, particularly, to the application to a metal base of a protective metallic coating. While the invention will be described herein as applied particularly to the galvanizing of steel sheets, it should be understood that the various phases of the invention are also applicable to other coating processes.

It is generally recognized by those concerned with the galvanizing of sheet steel that flaking of the protective coating from the base metal on deformation of the finished product as by bending is caused by a layer of zinc-iron alloy of excessive thickness, next to the surface of the steel base. Consumer demand increasingly requires that the protective coating be capable of withstanding forming operations of greater and greater severity. I have invented a novel method and apparatus for coating sheet metal whereby I am able to produce galvanized sheets having a highly adherent coating which will withstand severe deformation. In a preferred practice of the invention, I pass the sheet steel to be coated through a bath of molten spelter but confine the base metal in its passage through the bath to the upper layers of the latter wherein the amount of iron present in the form of zinc-iron alloy is quite small. The formation of a layer of zinc-iron alloy of excessive thickness on the material being coated is thus precluded and a relatively thin coating composed largely of pure zinc is formed on the base and adheres tightly thereto.

My invention further contemplates the preheating of the material to be coated as by passing through a specially heated flux bath, to prevent the chilling of the spelter bath itself to an undesirable extent. This makes it possible to fire the spelter bath at a lower rate and reduce the rapidity of dross formation therein.

The invention is applicable as well to the coating of strip as to the coating of sheets and novel forms of apparatus for handling both classes of material will be disclosed in detail herebelow. This apparatus is illustrated in the accompanying drawings which will be referred to in explaining the procedure and apparatus contemplated by my invention. In the drawings:

Fig. 1 is a longitudinal sectional view along a substantially central plane, through an apparatus in accordance with my invention for coating sheets;

Fig. 1—A is a graph of the percentage of iron contained in a spelter bath in the form of zinc-iron alloy, at various depths in the bath; and

Figs. 2—A and 2—B, taken together, constitute a longitudinal section along a substantially central plane through a line of apparatus for continuously coating strip, parts being shown in elevation.

Referring in detail to the drawings and, for the present, to Fig. 1, a spelter pot 10 is provided with sheet handling mechanism indicated generally at 11 removably disposed therein. The pot is heated by any convenient means and is filled with spelter to about the level indicated at 12. The sheet feeding mechanism 11 comprises side frames 13 in which are journaled feeding rolls 14 and 15 and exit rolls 16. Guides 17 direct an entering sheet between the rolls 14 and additional guides 18 and 19 are disposed between the rolls 14 and 15 and the rolls 15 and 16 respectively.

Investigations show that the amount of iron present in a spelter bath in the form of zinc-iron alloy varies directly with the depth below the surface. The iron content of the bath, in fact, remains quite small until a depth below the surface equal to about 40% to 50% of the total depth of the bath is reached. At that point, the iron content increases appreciably and continues to increase slowly at greater depths, to a maximum adjacent the bottom of the bath. This condition is illustrated graphically in Fig. 1 by a scale 20 adjacent the right-hand end of the pot 10. The zinc-iron alloy formed as sheet steel passes through a spelter bath, having a greater density than the molten zinc itself, tends to sink. It is found, furthermore, that in the operation of an ordinary galvanizing pot, the percentage of iron in the upper layers of the spelter bath decreases as the operating period is prolonged while the percentage of iron in the bottom layers gradually increases.

My invention is based on the theory that the formation of an excessively thick layer of zinc-iron alloy next to the surface of the sheet steel base will be prevented by maintaining the base sheet above the level of the spelter bath at which the percentage of iron is less than from .5% to 1% or, say .75%, or in other words, above the level adjacent which the percentage of iron contained in the bath increases sharply with further increase in depth. It will be understood, of course, that I do not wish to be bound by the foregoing theory but offer it merely by way of a supposed explanation of observed phenomena.

As clearly shown in Fig. 1, the sheet handling

mechanism 11 and particularly the feed rolls 14 and 15 thereof and the guides 17, 18 and 19 are so constructed and arranged as to maintain the sheet throughout its passage through the bath at a level above a median horizontal plane through the bath indicated at 21, and preferably above a plane spaced below the surface of the spelter indicated at 12 by a distance equal to about 40% of the total depth of the bath, which level is indicated at 22. By referring the plane traces 21 and 22 to the scale 20 as ordinates, it will be found that at the depth indicated by the latter, the iron content increased twenty times for a 10% increase in depth as compared to a very small increase in iron content for preceding like increments of depth. At the level indicated by the ordinate 21, the iron content is only about two and one-half times that at the ordinate 22, and at greater depths the rate of increase in the percentage of iron content is again quite small. This condition is illustrated graphically in Fig. 1—A, the legends applied to which make it self-explanatory. The data for this curve were obtained at the normal operating temperature of the bath, i. e., about 815° F.

In addition to maintaining the sheet metal being coated above the level of the spelter bath at which the percentage of iron contained therein increases rapidly with further increases in depth, I subject the sheet metal to preheating. This may conveniently be accomplished by the provision of a long flux pot 23 extending laterally from the spelter pot 10 and having a neck 24 overhanging and depending into the latter. The pot 23 is filled with molten flux to about the level indicated at 25 and is provided with feed-in rolls 26, guide rolls 27, 28 and 29, as well as guides 30 and 31 between the several sets of guide rolls. I also provide special means for heating the pot 23. The body portion of the pot, for example, is disposed over a heating chamber 32 having a refractory lining and provided with any convenient type of heaters such as indicated at 33, which may be either radiant tubes or direct firing burners, or the like.

By preheating the base metal during its passage through the flux pot, I prevent excessive chilling of the spelter by the base metal, as well as the pulling of flux into and through the spelter bath by movement of the base metal. It has been necessary heretofore to fire spelter pots at a rate higher than is desirable from the standpoint of dross formation, in order to make up the loss of heat incurred by the passage of relatively cold base metal through the spelter. Preheating the sheets in accordance with the invention avoids this necessity and makes it possible to fire the spelter pot at a low rate at which excessive dross formation does not occur. By confining the base metal to the upper portion of a spelter bath, i. e., above the plane 22, I am able to produce a finished product having a tightly adherent coating composed principally of pure zinc, without the excessively thick layer of zinc-iron alloy next the surface of the base metal. This product is superior to that produced by conventional processes and apparatus from the standpoint of increased resistance to flaking or cracking of the coating on bending or other deformation.

Figs. 2—A and 2—B illustrate a modification of the invention adapted particularly for the coating of strip. As clearly shown in the drawings, a coil of strip 35 disposed in a coil-holder 36 is unwound by pinch rolls 37 and fed through a welder 38 and past a gripper 39. The welder 38 permits successive coils of strip to be joined end to end for continuous passage through the subsequent pieces of apparatus forming the coating line which will now be described. The strip passes first through a tank 40 for washing the material or subjecting it to the action of a light acid bath. Feed-in and exit rolls 41 and 42 and guides 43 cooperate with the tank 40 to insure immersion of the material in the bath.

From the wash tank 40 the strip passes into a flux pot 44 which is similar in general to the pot 23 of Fig. 1. A guide roll 45 adjacent the tank 40 and a roll 46 at the entering side of the pot 44 direct the strip into the flux contained therein. The pot 44 is provided with an elevated portion or baffle 47 (as is also the pot 23) to facilitate emptying the flux pot when closing down the coating line.

Guide rolls 48 and 49 are mounted in the pot 44 for swinging movement into and out of the flux bath, being carried on pivoted suspending arms 50 and 51. The latter may be held in position by suitable counter-weights (not shown). The pot 44, like the pot 23, is provided with a heating chamber 52 and radiant tubes or burners 53.

The pot 44 overhangs and depends into a spelter pot 54. Guide rolls 55 and 56 are swingably carried in the pot on arms 57 and 58 pivoted in suitable bearings so as to be movable to the dotted line positions, as in the case of the arms 50 and 51 supporting the guide rolls 48 and 49.

After traversing the spelter bath in the pot 54, the level of the surface of which is indicated at 60, the strip passes upwardly between exit rolls 61 and over a spangle forming conveyor indicated generally at 62. The specific construction of this conveyor is not part of the present invention but one form thereof is disclosed and claimed in a co-pending application of McArthur et al., Ser. No. 230,062. Briefly, it consists of a frame around which a reticulated or mesh belt is driven for supporting the material emerging from the coating bath during progressive cooling of the coating layer. Pinch rolls 63 engage the strip after the coating thereon has cooled and deliver it to a looping pit 64. From the latter, the strip passes through a washer 65, a squeezer 66, and a dryer 67 to a shear 68. The shear 68 is employed to cut out the welded joint between successive strip lengths.

From the shear 68, the strip passes over a conveyor 69 through a leveler 70 and a flying shear 71 which cuts it into predetermined lengths.

It will be apparent that the strip coating line of Figs. 2—A and 2—B is characterized by all the advantages of the sheet coating apparatus illustrated in Fig. 1, which have been enumerated above. The guide rolls 55 and 56 in the spelter tank 54 of the strip coating line are positioned at about the same level in the spelter bath as the rolls 14 and 15 of the sheet coating apparatus. The strip passing through the line is actuated by the pinch rolls 63 and is held taut by the tension gripper 39 so that the strip does not loop down below the rolls 55 and 56.

Although I have illustrated and described herein but a preferred embodiment with one modification, it will be understood that changes in the construction and practice disclosed may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a method of galvanizing sheet steel, the

steps including passing the base metal through a spelter bath including zinc-iron alloy, the iron of said alloy being of the order of 2% of the bath throughout the greater portion of the depth thereof, and maintaining said metal at all times in the top 40% of the depth of the bath in which the iron content of the bath is materially lower than 2%.

2. In a method of galvanizing sheet steel, the steps including passing the base metal through a bath of heated flux, thereby preheating the metal, then through a spelter bath including zinc-iron alloy, the iron of said alloy being of the order of 2% of the bath throughout the greater portion of the depth thereof, and maintaining said metal at all times in the top 40% of the depth of the bath in which the iron content of the bath is materially lower than 2%.

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