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APPARATUS FOR HOT DIP COATING OF METALS

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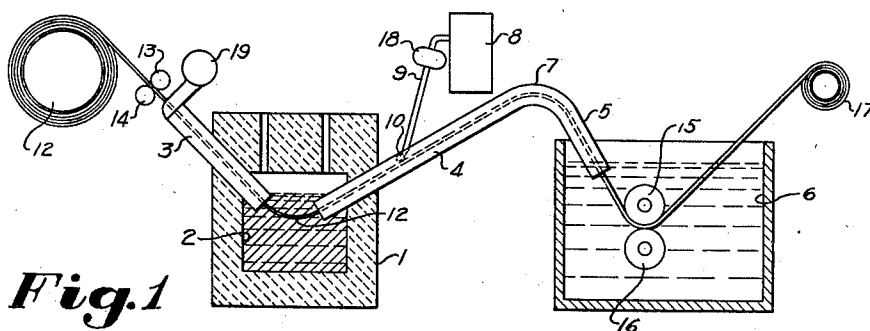


Fig. 1

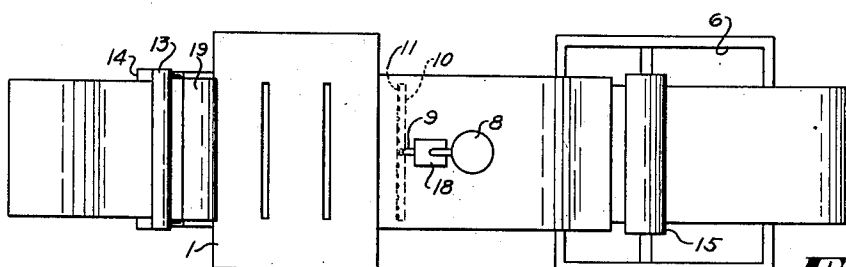


Fig. 2

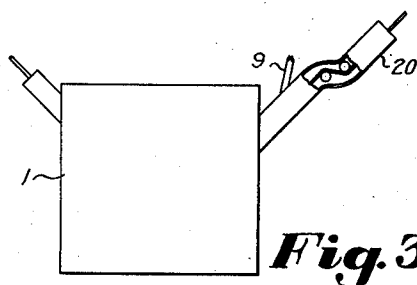


Fig. 3

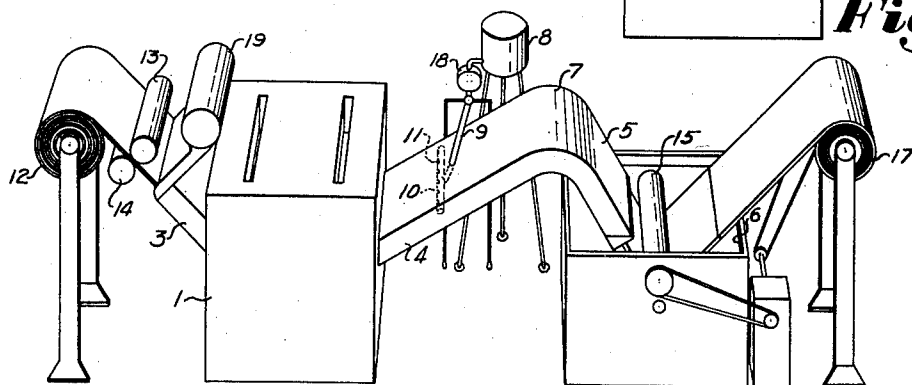


Fig. 4

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APPARATUS FOR HOT DIP COATING
OF METALS

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5 Claims. (Cl. 91—12.5)

This invention, as indicated, relates to an apparatus for hot dip coating of metals, particularly ferrous metal sheets or strips in a continuous process whereby such metal is drawn through a bath of the coating metal and removed therefrom with a predetermined thickness of coating thereon, and adapted for use directly or after further fabricating steps for various purposes of industry. The invention includes the use of a furnace for heating the coating metal wherein a non-oxidizing atmosphere is maintained above the coating area and over the coated ferrous strip throughout its period of coating and until after it has been cooled to normal temperature. The invention also includes the use of a flux in connection with a ferrous metal material operated on. The invention also includes the control of a suitable gaseous atmosphere to the end that a non-oxidizing atmosphere may be kept above the coating area continuously. It also includes the use of a protective gas in jet form so as to mechanically break the surface tension of the coating metal adhering to the emerging material under treatment and remove such excess material purely through the pressure exerted by such gas jet and return the same to the metal coating bath. It also includes the provision of an angular pathway for the emergence of the treated material from the coating bath whereby the action of the gaseous jet referred to above may be assisted through the action of gravity upon the excess metal which will be caused to flow back into the tank. The invention also includes the provision of a water trap over the exit passageway for the material so that the gaseous atmosphere supplied to the metal coating furnace and the conduit leading therefrom may be maintained free from ingress of air throughout the operation of the process.

The principal object of the present invention is to provide an apparatus for the coating of strip and sheet material, particularly of a ferrous character with coating metal, preferably metal of a protective character, including copper, silver, aluminum, cadmium, and alloys of such metals as well as various other metallic protective coatings.

Another object of the invention is to provide an apparatus for treating strip and sheet material, particularly of a ferrous character, so as to provide thereon a protective coating having a high degree of adherence to the metal base and adapted for production at a relatively high rate of speed.

Another object of the invention is to provide an apparatus for coating metal strips and sheets,

particularly of a ferrous character, wherein a coating furnace is utilized in which a protective atmosphere is provided over a coating area which may be partly inside the furnace and partly in a passageway leading angularly out of the furnace whereby material may pass continuously through such coating bath and be free of danger of oxidation at all stages of its passage through and out of the furnace.

Another object of the invention is the provision of a mechanism for the application of an inert gas to the metal under treatment at a pressure ratio preferably sufficient to break the surface tension of any adhering metal globules.

Another object of the invention is to provide an outlet passageway for the metal undergoing treatment at an angle which is favorable to the retaining of a suitable thickness of coating metal on the base metal, but at the same time sufficiently inclined to return metal in excess of the predetermined amount desired to the furnace through the force of gravity, which, as stated, may be assisted by a jet reacting against the surface of the coating metal to return any excess metal to the coating bath.

A further object of the invention is to provide a coating bath wherein the inlet and outlet passageways are positioned beneath the surface of the coating metal bath, and wherein the outlet passageway is of arcuate shape with its free end immersed in a water sealing bath with an intermediate gaseous non-oxidizing atmosphere between the coating furnace and such water sealing bath.

Other and further objects of the invention will appear in the course of the following description.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawing and the following description setting forth in detail certain structures embodying the invention, such disclosed means constituting, however, but several of various forms in which the principle of the invention may be used.

In said annexed drawing:

Fig. 1 is a diagrammatic side elevation, partly in section, showing an apparatus embodying the principles of the invention;

Fig. 2 is a plan view of the structure shown in Fig. 1;

Fig. 3 is a fragmentary side elevation having a portion cut away illustrating a modified form of construction embodying the principles of the invention; and

Fig. 4 is a perspective view illustrating the operative units shown in Figs. 2 and 3 as connected with a gas supply and drive apparatus.

While the application of the coating metal to the base metal strip or sheet has been referred to as a coating, it is to be understood that a more than superficial coating is produced, the adherence of the applied protective metal to the base metal being in the nature of a very firm bond which will withstand rolling and various types of heat treatment without injury or causing any flaking or separation whatsoever, and hereinafter when the term coating is used it is to be understood that the formation of a close integral bond, between the coating metal and the metal being under treatment, is substantially in view.

As is clearly shown in Figure 1 of the drawing the apparatus comprises a furnace 1 for holding a coating metal bath, wherein a reservoir 2 for coating metals, such as copper, alloys, or any other suitable protection metal is maintained through heat applied through burners at the base of the furnace, or through electrical heating, or any other preferred manner. The metal bath within the furnace is provided on one side with an inlet passageway 3 inclined downwardly, the lower end being immersed beneath the level of the metal within the melting chamber. Opposite the inlet passageway, and in alignment therewith an outlet passageway 4 is provided, such passageway having one end within the furnace chamber beneath the level of the metal coating bath, and such outlet passageway being inclined upwardly and then downwardly somewhat in the manner of a siphon. The downwardly inclined outer end 5 of the outlet passageway is preferably immersed beneath a sealing bath which, for the material herein described, may comprise a water bath 6. The water bath, in addition to sealing the outlet passageway, will serve as a cooling medium to reduce the temperature of the strip or sheet of metal undergoing treatment to normal temperature and readiness for such further fabricating process as may be in view. Within the outlet coating area and arcuate central portion 7 of the outlet passageway an atmosphere of a non-oxidizing or of a reducing character is maintained through the supplying of a non-oxidizing gas, which may be nitrogen or the like, from a reservoir, or other source 8, through a passageway 9.

The passageway may communicate with a perforated T-outlet 10 having a plurality of orifices 11 directed to discharge jets against the strip of material 12 passing upwardly through the passageway. The upward angle of the downward passageway is preferably such that a gentle flow under the influence of gravity of the gas coated metal will take place in a return toward the coating bath. In order to prevent globules of adhering metal from escaping from the bath and marring the coating applied thereto, the pressure of the inert gas upon the adjacent coated surface will be such as to break up any adherence and dislodge any globules or metal held by surface tension to the newly coated surface and return of such excess metal to the coating bath. Any suitable means may be utilized for providing the inert or non-oxidizing gas utilized to maintain a satisfactory bond upon the metal undergoing treatment, but in every instance such gas must be supplied to the outer passageway under somewhat more than atmospheric pressure in order to prevent backward flow of the sealing liquid into the furnace.

When the operations are carried on on an extended scale it is possible to dispense with the sealing bath and its cooling function by lengthening the outlet passageway 20 to such an extent that the heat losses will be adequate by the time the material emerges to prevent any deterioration of the product through oxidation. In such instances a larger quantity of inert gaseous atmosphere, such as nitrogen and the like, will have to be utilized to prevent access of air to the outlet passageway to a point where unfavorable action upon the metal undergoing treatment could take place. The metal stock undergoing treatment may be in the form of coils of strip steel or the like held upon reels 12, and then passed between suitable feed rollers 13, 14 into the bath, and thence carried through the passageways 3, 4 to rollers 15, 16, within the cooling bath, and thence to a reel 17 for the finished material. A suitable pump 18 may be utilized to supply adequate pressure to the inert gas to maintain the arcuate portion of the outlet passageway completely filled with such gas at all times.

The metal strip entering the bath should be thoroughly clean and free of an oxide coating. However, to insure the removal of all oxides and foreign matter it is desirable to treat the surface of the metal entering the bath with suitable scavenging and cleansing agents which may be in the form of a flux of a pulverized, liquid, or gaseous character. By applying such flux from a source of supply 19, immediately below the feed rollers 13, 14, the metal about to be coated enters the inlet passageway fully conditioned to have its surface reacted on by the metal of the coating bath and the formation of a bond of very durable and dependable character with such coating metal.

The flux used may be any of the conventional flux used in removing oxide coating from ferrous material. A pulverized flux, such as borax has been found to operate satisfactorily on thin sheet material but other scavenging and flux materials may be used, as desired. While the use of the inlet passageway has been found advantageous to insure even running of the material through the metal coating bath, it is to be understood that for some types of material it may be desired to feed the metal to be coated directly into the metal coating bath without the use of a separate inlet passageway. In such event suitable provision, such as rollers and the like within or adjacent the outlet passageway may be provided to insure satisfactory coating of the metal under treatment.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made as regards the structure and method herein disclosed, provided the means and steps stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. An apparatus of the character described having in combination a furnace chamber having a bath of molten metal for coating purposes, an inlet passageway for metal to be coated entering such furnace chamber at a downwardly inclined angle with the inner end portion of such passageway immersed beneath the surface of such coating metal bath, an outlet passageway for the metal to be coated positioned at an upwardly inclined angle and having one end immersed beneath the coating bath, and having an inter-

mediate arcuate portion with a downwardly inclined outer end immersed in a liquid sealing bath, and means including a jet manifold communicating with the arcuate portion of said outlet passageway to supply a non-oxidizing gas thereto at a point above atmospheric pressure to force excess coating metal back into the bath.

2. An apparatus of the character described having in combination a furnace chamber having a bath of molten metal for coating purposes, an inlet passageway for metal to be coated entering such furnace chamber at a downwardly inclined angle with the inner end portion of such passageway immersed beneath the surface of such coating metal bath, an outlet passageway for the metal to be coated positioned at an upwardly inclined angle and having one end immersed beneath the coating bath, and having an intermediate arcuate portion with a downwardly inclined outer end immersed in a liquid sealing bath, a reservoir for a non-oxidizing gas and a jet manifold outlet and pressure controlling means associated therewith and communicating with the arcuate portion of said outlet passageway at a point above atmospheric pressure to force excess coating metal back into the bath.

3. An apparatus of the character described having in combination a furnace chamber having a bath of molten metal for coating purposes, an inlet passageway for metal to be coated entering such furnace chamber at a downwardly inclined angle with the inner end portion of such passageway immersed beneath the surface of such coating metal bath, flux applying means positioned adjacent the outer end of said inlet passageway, an outlet passageway for the metal to be coated positioned at an upwardly inclined angle and having one end immersed beneath the coating

bath, and means including a jet manifold outlet to supply and maintain a non-oxidizing gas of a low temperature in the outlet passageway over the metal undergoing coating until the metal has reached a non-oxidizing temperature.

4. An apparatus of the character described having in combination a furnace chamber having a bath of molten metal for coating purposes, an inlet passageway for metal to be coated entering such furnace chamber at a downwardly inclined angle with the inner end portion of such passageway immersed beneath the surface of such coating metal bath, an outlet passageway for the metal to be coated positioned at an upwardly inclined angle and having one end immersed beneath the coating bath, and having an intermediate arcuate portion with a downwardly inclined outer end immersed in a liquid bath, and means including a jet communicating with the arcuate portion of such outlet passageway under pressure adequate to mechanically disrupt surface tension of excess coating material upon the work within such outlet passageway.

5. An apparatus of the character described having in combination a furnace chamber having a bath of molten metal for coating purposes, flux applying hopper and outlet means positioned adjacent the line of travel of the metal to be coated in said bath, an outlet passageway for the metal to be coated positioned at an upwardly inclined angle and having one end immersed beneath the coating bath, and means to supply and maintain a low temperature non-oxidizing gas in the outlet passageway over the metal undergoing coating until the same has reached a non-oxidizing temperature.

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