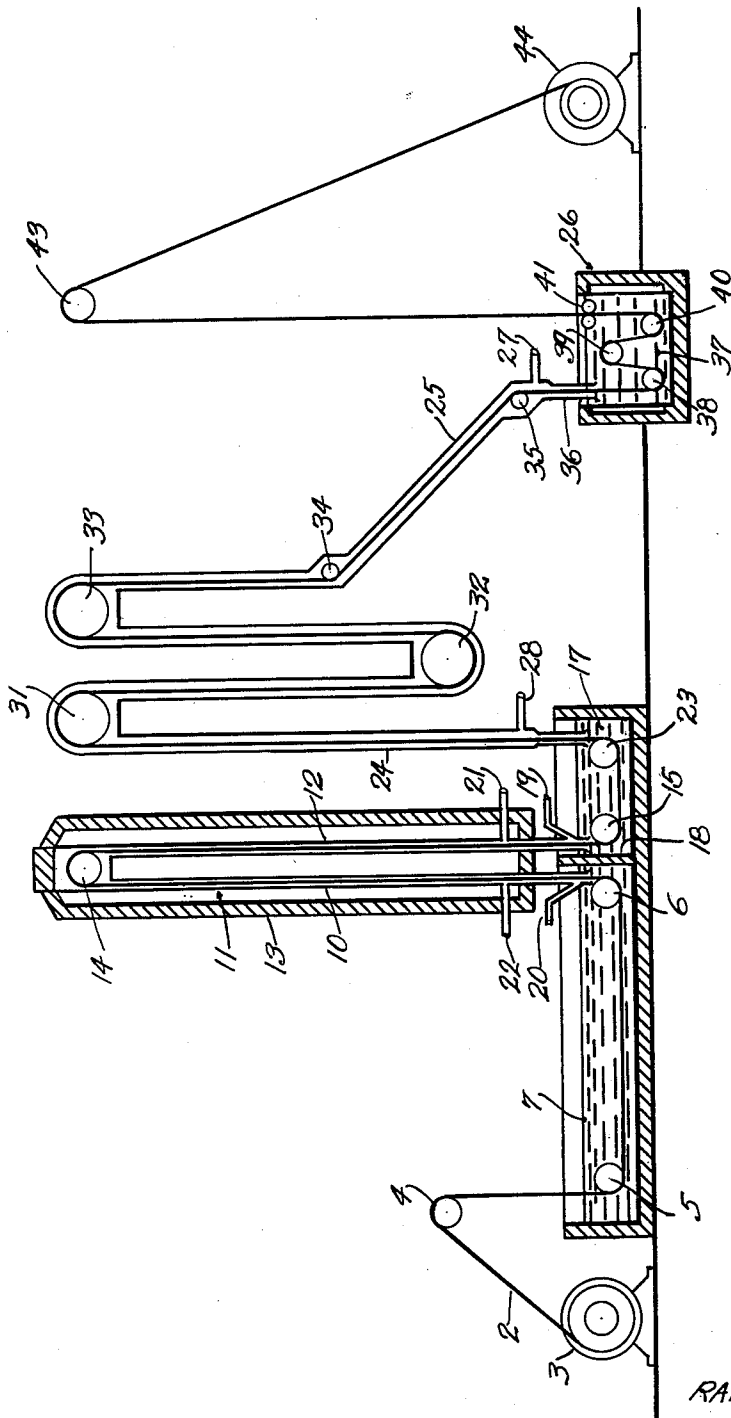


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HIGH TEMPERATURE CLEANING OF STEEL STRIP INCLUDING
REMOVING FERROUS CHLORIDE THEREFROM
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HIGH-TEMPERATURE CLEANING OF STEEL STRIP, INCLUDING REMOVING FERROUS CHLORIDE THEREFROM

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4 Claims. (Cl. 134-5)

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This invention relates to the cleaning of iron and steel to produce a true metallic surface preparatory to coating as by galvanizing, tinning, plating, painting, etc.

It has been proposed to produce a true metallic surface on steel strip by exposing the strip while at a temperature of about 1300° F. to the action of a chlorine compound which will react with iron and iron oxides to form iron chlorides, this temperature being just above the melting point of ferrous chloride with the result that there will be a film of iron chloride on the strip as it comes from the cleaning zone. When the next desired operation is hot dip coating as in galvanizing, the presence of this film of iron chloride presents a problem. If the strip is washed with water to remove the iron chloride there is the economic loss of having to reheat the strip to galvanizing temperature (800-900° F.). Moreover, washing with water presents other special problems not necessary to consider at this time. To avoid the washing operation it has been proposed to maintain a layer of flux on the molten zinc. However, to maintain this flux involves considerable trouble and expense. The object of the present invention is to provide a relatively simple and practical way of getting rid of all or substantially all of the iron chloride on the strip while the strip is at elevated temperature and before it enters the galvanizing pot whereby to avoid the trouble and expense incident to maintaining a flux on the surface of the molten zinc.

For a consideration of what I consider to be novel and my invention, attention is directed to the following specification and the claims appended thereto.

In the accompanying drawing forming part of this specification, the single figure is a more or less diagrammatic representation in longitudinal side elevation with parts in section of apparatus for processing steel strip in accordance with the present invention.

The strip to be processed is indicated at 2 and is shown as being unwound from a coil on a pay-out reel 3. From the reel the strip is guided by rollers 4, 5 and 6 into and through a bath of molten lead 7 and thence into an upright chamber 10 where it is exposed to an atmosphere which will react with iron and iron oxides to form iron chlorides. It is desirable to maintain the chamber 10 at a minimum temperature of 1300° F. and in order that the strip may be preheated to that temperature the bath of molten lead 7 will also be maintained at a minimum temperature of 1300° F.

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The chamber 10 constitutes one leg of a retort 11 of hair pin type, the other leg being indicated at 12. A furnace 13 surrounds the retort for maintaining the latter at the predetermined temperature. At the top of the retort is a roller 14 where the strip makes a reverse bend for downward travel in the downcomer leg 12 to a roller 15 outside of the retort and shown as submerged in a bath of molten lead 17 shown as separated from the lead bath 7 by an upright wall 18. The lower ends of the retort legs 10 and 12 are extended downwardly into the lead baths 7 and 17, respectively, to form gas-tight seals therewith. Molten ferrous chloride will collect in the lower ends of the retort legs 10 and 12 but will not exceed a predetermined level because of overflow traps 19 and 20.

The atmosphere for use in the retort 11 is delivered thereto by a supply pipe 21 near the lower end of the leg 12 and the spent gas leaves through a pipe 22 near the lower end of the leg 10. At the moment it suffices to say that said atmosphere will contain a chlorine compound which will react with iron oxides and with iron itself to form iron chlorides and that there will be residual iron chloride on the strip as it comes from said retort.

In the present invention the residual iron chloride on the strip as the latter comes from the retort 11 is removed by floating it off while it is in molten condition by causing the strip to pass through a bath of molten lead 17 maintained at a temperature above the melting point of ferrous chloride or at a minimum of 1300° F. which is not much above the melting point of ferrous chloride, it being understood that it is because of the relatively greater specific gravity of the lead as compared to that of the iron chloride (ferrous chloride) that the latter is wiped off or floated off from the strip as the latter passes through said bath. In practical operation it is found that the removal of the residual iron chloride is sufficiently complete to permit the strip to be passed into the zinc bath without the necessity of maintaining any flux on the surface of said zinc. Because the strip is already at a minimum temperature of 1300° F. when it enters the lead bath 17 very little heat is required to maintain the latter at temperature.

From the roller 15 in the lead bath 17 the strip passes to a roller 23 and thence upwardly out of the molten lead and into a closed cooling chamber 24-25 for cooling down to galvanizing temperature (800-900° F.) preparatory to entering the galvanizing pot generally indicated at 26.

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During cooling, the strip is protected against oxidation by a suitable protective gas delivered to the cooling chamber by a feed pipe indicated at 27, a vent for the gas being indicated at 28.

Guide rollers for the strip in the cooling chamber are indicated by numbers 31 to 35. The exit end 36 of the cooling chamber dips into the molten zinc 37 in the zinc pot. Rollers 38 to 41 conduct the strip into and through and out of the zinc pot. From the zinc pot the strip passes to an overhead roller 43 and thence to a wind-up reel 44.

It is preferred that the chlorine compound in the atmosphere for use in the retort 11 be hydrogen chloride, it being understood that this compound will react with iron and iron oxides to form iron chlorides. The atmosphere may also contain enough of an oxidizing constituent to oxidize carbonaceous matter on the strip, such as carbonized oil and free carbon, so that on emerging from the retort there may be no free carbon on the surface of the strip, the preferred oxidizing constituent being carbon dioxide. To increase the oxidizing potential, some free oxygen may be added and to decrease the oxidizing potential carbon monoxide and hydrogen may be added. A typical atmosphere will contain from 15 to 45% hydrogen chloride; from 10 to 12% carbon dioxide and the balance nitrogen except that under some operating conditions it may be desirable to increase the oxidizing potential of the atmosphere by adding up to 2% initial oxygen with or without up to 3% initial water vapor whereas under other operating conditions it may be desirable to decrease the oxidizing potential by adding up to 3% carbon monoxide with or without up to 2% hydrogen.

The strip 2 as it comes from the pay-out reel 3 will ordinarily be hard and oily from cold working but by the time it has passed through the first lead bath 7 and the retort 11 it will have become annealed and after it has passed through said retort all carbonaceous matter on the surface of the strip such as carbonized oil will have been removed primarily by oxidation due to the presence of the oxidizing constituent in the iron chloride forming atmosphere in the retort.

Certain of the processing steps herein disclosed but not claimed are described and claimed in a copending application owned by the same assignee as the present application.

What I claim as new is:

1. The method of removing ferrous chloride from the surface of steel which comprises pass-

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ing the steel through a bath of molten lead at a temperature above the freezing temperature of said chloride whereby to remove said chloride from said steel by flotation.

2. The method of cleaning steel strip which comprises exposing the strip to the action of a hot cleaning atmosphere containing a chlorine compound capable of forming ferrous chloride on the surface of the strip and removing the said ferrous chloride from said strip by immersing the strip in a bath of molten lead at a temperature above the freezing temperature of said ferrous chloride whereby to remove said ferrous chloride from said strip by flotation, all during endwise movement of the strip.

3. The method of removing ferrous chloride from the surface of steel which comprises passing the steel through a bath of molten lead at a temperature not less than about 1300° F. whereby to remove said chloride from said steel by flotation.

4. The method of cleaning steel strip which comprises exposing the strip to the action of a hot cleaning atmosphere containing a chlorine compound capable of forming ferrous chloride on the surface of the strip and removing the said ferrous chloride from said strip by immersing the strip in a bath of molten lead at a temperature not less than about 1300° F. whereby to remove said ferrous chloride from said strip by flotation, all during endwise movement of the strip.

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