

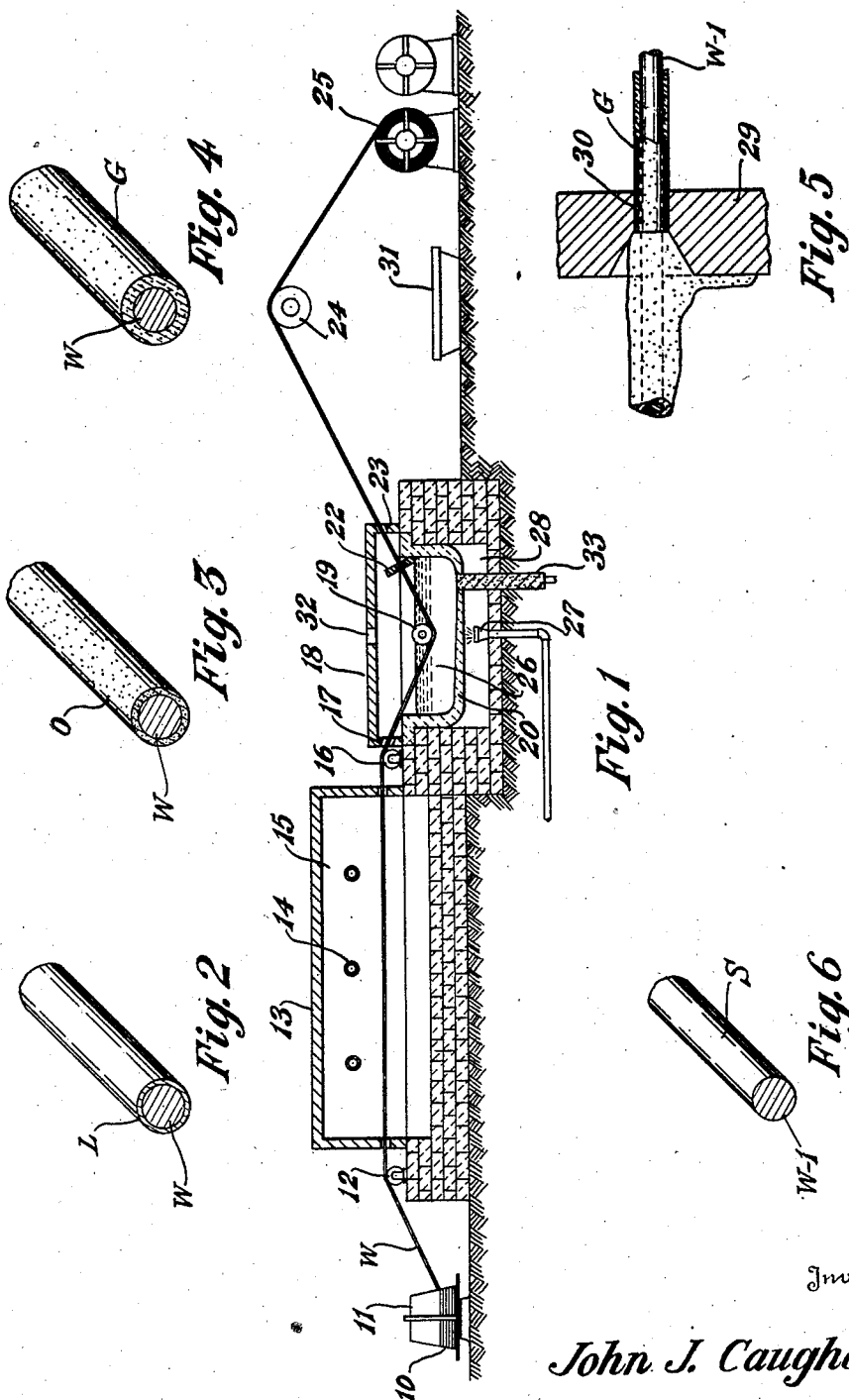
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METHOD OF DRAWING STAINLESS STEEL WIRE

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METHOD OF DRAWING STAINLESS STEEL WIRE

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11 Claims. (Cl. 205-21)

The invention relates to the cleaning of metal products, and more particularly to the removal of a relatively soft metal coating from metal products.

In the manufacture of metal products, such as sheets, stripsheets, strips and wire, particularly in the lighter gauges, a number of successive reductions by rolling or drawing operations are required before the metal product is brought down to the desired gauge or thickness. Such cold working or reducing operations greatly diminish the ductility and workability of the metal product, so that at frequent intervals during the reducing operations the metal product must be subjected to annealing treatments to restore its ductility, followed by the usual acid pickling to remove any scale.

When the metal product is made of stainless steel, these operations become more involved as it is usually required, for instance in making stainless steel wire, that the wire be coated with a relatively soft metal, such as lead, prior to the drawing operations. Moreover, the lead coating must be removed after drawing and before annealing and must again be applied before further drawing after the pickling following the anneal.

Thus, the present practice in making stainless steel wire preferably includes passing hot rolled stainless steel rods through an acid etching pickle, fluxing, then passing the rod through a bath of molten lead to form a lead coating thereon, which acts as a lubricant during subsequent drawing operations, and then drawing the wire down as far as possible or until the wire becomes so brittle as to require further annealing. With present practice, three successive drawing operations or drafts seem to be the maximum amount of drawing which can be performed without further annealing.

The drawn wire is then passed through an acid bath to remove the remaining lead coating, and may be bright annealed or batch annealed. If it is bright annealed, it is again fluxed, lead coated, drawn up to three drafts and again pickled to de-lead. The material is sometimes shipped in this condition or it is lime coated and given one finish draw, or it may be again bright annealed and the last operations repeated. If the material is batch annealed, it must be pickled and lead coated for subsequent drawing operations.

In the manufacture of stainless steel wire in the manner outlined, which is in accordance with present practice, very high costs are involved,

as each pickling operation of stainless steel products is a very expensive operation. Moreover, the de-leading operation in each instance is expensive, not only for carrying out the operation, but the lead which is removed is lost and when it becomes necessary to change the pickle bath for carrying out the de-leading operation, the acid is also lost, as there is no economically satisfactory way of recovering the lead or acid in the spent bath.

Likewise, substantial expense is involved in the handling costs involved in connection with each of the operations. Moreover, due to the repeated acid treatments, the possibility of the development of acid brittleness in the material being processed is always present.

I have discovered, however, that all of these difficulties may be eliminated, that the cost of making stainless steel wire may be substantially reduced, and that a superior finished product may be obtained by eliminating the usual pickling, annealing and de-leading operations and departing from the present practice. Thus in accordance with the present invention, the wire after it has been first lead coated and drawn as far as possible, is passed into a preheating furnace wherein the lead coating remaining thereon is oxidized to form lead oxide. The material then passes immediately into a molten bath of glass wherein a uniform coating of glass of controlled thickness is formed on the wire. The lead oxide is absorbed in the glass coating and subsequent separation of the glass coating from the wire after cooling, carries with the glass all of the lead oxide, leaving a perfectly clean metal surface ready for further processing.

Meanwhile, the heating of the wire as it passes through the bath of molten glass also anneals the wire so that it is ready, after removal of the glass, to be either lime coated and finish drawn, or fluxed if desired and then lead coated and again drawn to provide the desired gauge wire, after which the lead coating can be again removed as just described. Moreover, the lead absorbed in the glass coating in the form of lead oxide and separated from the wire upon removal of the glass coating, can be readily recovered.

Accordingly, it is a principal object of the present invention to reduce the cost and eliminate many operations of the present method of making stainless steel wire and similar products.

It is a further object of the present invention to eliminate high pickling costs in the manufacture of stainless steel products such as wire and the like.

Also it is an object of the present invention to eliminate the use of an acid treatment for removing lead from drawn stainless steel wire and the like.

Also it is an object of the present invention to avoid the possibility of the development of acid brittleness during the processing of stainless steel products.

Moreover, it is an object of the present invention to substantially eliminate any lead loss in connection with the coating of stainless steel products and the like with lead as a lubricant for cold drawing operations and the like.

And finally, it is an object of the present invention to generally improve the character and quality of the finished product made in accordance with the present invention over similar finished products made in accordance with present practice.

These and other objects and advantages may be obtained, the foregoing difficulties may be eliminated and beneficial results may be achieved by the present invention, which is hereinafter described in detail and claimed.

In the drawing,

Figure 1 illustrates diagrammatically one arrangement for carrying out the improved treatment in connection with the manufacture of stainless steel wire;

Fig. 2 is a view illustrating a section of stainless steel wire which has been drawn and on which some lead coating remains;

Fig. 3 illustrates a similar section of wire after the lead coating has been oxidized;

Fig. 4 is a view similar to Figs. 2 and 3 after a glass coating has been applied to the lead oxide coated wire;

Fig. 5 illustrates diagrammatically the operation of dies for providing a uniform controlled thickness of glass coating; and

Fig. 6 is a view similar to Figs. 2, 3 and 4, illustrating a clean stainless steel wire after removal of the glass coating.

Similar numerals refer to similar parts throughout the drawing.

In utilizing the present method in the manufacture of stainless steel wire and the like, hot rolled stainless steel rods which have been pickled and lead coated, are drawn the maximum number of drafts to form a coil 10 of hard, drawn, stainless steel wire W having some lead coating L remaining thereon. The coil 10 is placed on a reel 11 and the wire W is passed over a guide roll 12 into a preheating furnace 13, which is supplied with heat in any suitable manner as by burners 14. The chamber 15 of furnace 13 is maintained at a sufficient temperature, preferably with an oxidizing atmosphere therein so as to preheat the wire W in chamber 15 to a temperature of approximately 1000° F. and oxidize the lead coating L on the wire W and form lead oxide, as indicated at O in Fig. 3.

The wire W then passes directly from furnace 13 over another guide roll 16 through an opening 17 in the roof of glass heating furnace generally indicated at 18, under submerged roll 19 in pot 20, then out through die 22 and opening 23 and over deforming roll 24, preferably to a coil or reel 25.

A bath of molten glass 26 is maintained in pot 20 produced by melting a frit, preferably containing silica with soda and lime or other similar materials to form an alkaline glass; and the bath is maintained molten at the desired temperature,

preferably by burners 27 in the heating chamber 28 of the furnace 18 below pot 20.

The molten glass is maintained preferably at a temperature between 1800° F. and 2400° F. The speed of the wire passing through the molten glass is controlled so that the wire is immersed in the bath for a sufficient time, say 5 to 30 seconds, to anneal the wire, depending upon the size of the wire and the temperature of the bath.

In passing through the glass bath 26, a coating of molten glass adheres to the surface of the wire, but this coating is non-uniform in character and may be relatively thick. The thickness and uniformity of the coating may be controlled by passing the wire W as it emerges from the bath of molten glass, through a die 22 whose wall 29 (Fig. 5) is provided with a die opening 30 of such size and shape that the resulting thickness of the glass coating G on wire W is not more than about $\frac{1}{2}$ of an inch in thickness and is uniform throughout. The control of the uniformity and thickness of the glass coating, disclosed but not claimed herein is claimed in my copending application entitled Method of treating ferrous metal articles with glass coatings, filed September 9, 1942, Serial No. 457,725.

The lead oxide coating on the wire W is absorbed in the glass coating G as the wire passes through the glass bath and as the glass coating G is formed. The breaker roll 24 is located at a sufficient distance from die 22 so as to allow the wire W with a glass coating G thereon to properly cool to the desired temperature. The glass coated wire in passing over breaker roll 24 is deformed or distorted or flexed so as to break or crack the glass, whereupon the glass separates and falls from the wire, dropping to a receiver 31, carrying with it all the lead oxide on the wire and leaving a perfectly clean surface for further processing, as indicated at S in Fig. 6.

Thus the wire W-1 with a clean surface S has been annealed and de-leaded and is ready for further processing either by lime coating and finish drawing, or by being again lead coated, drawn the maximum number of drafts, and heat treated and de-leaded in accordance with the present invention.

The broken glass and lead oxide received in receiver 31 may be charged back through opening 32 in roof of furnace 18 into the molten glass 26, together with a sufficient amount of a reducing agent such as ordinary flour. The reaction between the reducing agent and lead oxide in the molten glass bath reduces the lead oxide to molten lead, which settles to the bottom of pot 20 and may be drawn off through a tube 33 filled with magnesite to allow the recovered metallic lead to be recovered without being oxidized. The tube 33 is extended through the heated chamber 28 of furnace 18 so as to be maintained hot while the lead is filtering through the magnesite; and the metallic lead may be collected in any suitable way for further use.

If desired, instead of recovering the lead directly in the molten glass bath, the operation may be carried out in a separate recovery pot.

Thus, in carrying out the present invention, expensive acid pickling operations on stainless steel are eliminated, and the acid de-leading costs are also eliminated, including the cost of acid and lead lost, and attendant handling costs; because the entire operation of de-leading in accordance with the present invention takes place at the same time that the material is annealed.

The cost of the combined de-leading and annealing or heat treatment of the present invention is only slightly more than the cost of annealing carried out in accordance with present practice. Against this cost, however, must be offset the value of the lead recovered.

The elimination of operations shortens the time of processing and handling required. The present invention also eliminates the possibility of the development of any acid brittleness in the product, because no acid is used. Furthermore, the resultant surface of the finished product will resist oxidation for a longer length of time because of the elimination of any acid treatment during processing, and a very superior surface finish results on the finished product.

In the specification, certain terms are used for brevity and not for the purposes of limitation. For instance, the invention contemplates the treatment of wire, rods, strip and like steel products which may be desirably coated with a soft metal such as lead for facilitating reducing operations such as drawing. Moreover, the material may be stainless steel of either the straight chrome or nickel chrome type or other steel products provided with a soft metal coating for acting as a lubricant for reducing operations.

Having now described the features of the invention, the difficulties overcome, the method to be practiced, and an example of the treatment of wire utilized in accordance with the present invention; the new and useful methods, steps, procedures and arrangements constituting the present invention, and reasonable mechanical equivalents thereof, are set forth in the appended claims.

I claim:

1. A method of cleaning a ferrous metal article having a lead coating thereon, which includes heating the article to oxidize the lead coating and form lead oxide, then passing the heated article through a bath of molten glass to form a coating of glass thereon, and then cooling the glass coated article and separating the glass therefrom, the separation of the glass from the article carrying the lead oxide with the glass and leaving a clean metal surface.

2. In a method of de-leading and annealing a hard, cold worked, ferrous metal article having a lead coating thereon, the steps of oxidizing the lead coating to form lead oxide, passing the article through a bath of molten glass to anneal the article and form a glass coating thereon in which the lead oxide is absorbed, then cooling the article and removing the glass to provide an annealed article having a clean ferrous metal surface.

3. In a method of de-leading and annealing stainless steel wire having a lead coating thereon for cold drawing, the steps of heating the wire in an oxidizing atmosphere to oxidize the lead coating and form lead oxide, then immediately coating the heated wire with glass by passing the wire through a bath of molten glass maintained at the proper temperature for annealing the wire, maintaining the wire in the molten glass for a sufficient time to anneal the wire, then cooling the glass coated wire and separating the glass therefrom, the separation of the glass from the wire carrying the lead oxide with the glass and leaving a clean metal surface.

4. In a method of de-leading and annealing a hard, cold worked, ferrous metal article having a lead coating thereon, the steps of heating the article to about 1000° F. in an oxidizing atmosphere

to oxidize the lead coating and form lead oxide, then passing the article through a bath of molten glass maintained at a temperature high enough to anneal the article as it passes there-through and forming a glass coating thereon as the article emerges from the molten glass bath in which glass coating the lead oxide is absorbed, then cooling the article and removing the glass to provide an annealed article having a clean ferrous metal surface.

5. In a method of de-leading and annealing a hard, cold worked, ferrous metal article having a lead coating thereon, the steps of oxidizing the lead coating to form lead oxide, then passing the article through a bath of molten glass maintained at from 1800° F. to 2400° F. to anneal the article and apply a coating of molten glass thereto in which glass coating the lead oxide is absorbed, then cooling the article, and then separating the glass from the article to provide an annealed article having a clean ferrous metal surface.

6. In a method of de-leading and annealing a hard, cold worked, ferrous metal article having a lead coating thereon, the steps of oxidizing the lead coating to form lead oxide, passing the article through a bath of molten glass to anneal the article and apply a coating of molten glass thereto, controlling the thickness and uniformity of thickness of said glass coating, cooling the glass coated article and then separating the glass therefrom, the separation of the glass from the article carrying the lead oxide with the glass and leaving a clean metal surface.

7. In a method of de-leading and annealing a hard, cold worked, ferrous metal article having a lead coating thereon, the steps of heating the article in an oxidizing atmosphere to about 1000° F. to oxidize the lead coating and form lead oxide, passing the article through a bath of molten glass maintained at from 1800° F. to 2400° F. to anneal the article and apply a coating of molten glass thereto in which glass coating the lead oxide is absorbed, controlling the thickness and uniformity of thickness of said glass coating, cooling the glass coated article, and then separating the glass from the article to provide an annealed article having a clean ferrous metal surface.

8. In a method of cold drawing stainless steel wire, the steps of applying a coating of lead thereto, drawing the lead coated wire, then heating the wire in an oxidizing atmosphere to oxidize the lead coating and form lead oxide, then passing the wire through a bath of molten glass to anneal the wire and form a glass coating thereon in which the lead oxide is absorbed, then cooling the wire, then removing the glass, and then lime coating and finish drawing the wire.

9. In a method of cold drawing stainless steel wire, the steps of applying a coating of lead thereto, drawing the lead coated wire, then heating the wire in an oxidizing atmosphere to oxidize the lead coating and form lead oxide, then passing the wire through a bath of molten glass to anneal the wire and form a glass coating thereon in which the lead oxide is absorbed, then cooling the wire, then removing the glass, then again coating the wire with lead, and then further drawing the lead coated wire.

10. In a method of cold drawing stainless steel wire, the steps of applying a coating of lead thereto, drawing the lead coated wire, then heating the wire in an oxidizing atmosphere to oxidize

dize the lead coating and form lead oxide, then passing the wire through a bath of molten glass to anneal the wire and form a glass coating thereon in which glass coating the lead oxide is absorbed, then cooling the wire, then removing the glass, then again coating the wire with lead, then further drawing the lead coated wire, then heating the further drawn wire in an oxidizing atmosphere to oxidize the last lead coating to form lead oxide, then passing the wire through a bath of molten glass to anneal the wire and form another glass coating thereon in which glass coating the lead oxide is absorbed, then cooling the wire, and then separating the glass to provide an annealed wire having a clean ferrous metal surface.

11. In a method of cleaning a ferrous metal article having a lead coating thereon, the steps of oxidizing the lead coating to form lead oxide, passing the article through a bath of molten glass to anneal the article and form a glass coating thereon in which glass coating the lead oxide is absorbed, cooling the article, separating the glass and lead oxide contained thereby from the article to provide an annealed article having a clean ferrous metal surface, introducing the separated glass and contained lead oxide and a reducing agent into the bath of molten glass to reduce the lead oxide in said bath to metallic lead, and drawing off and collecting the metallic lead from said bath.

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