METHOD AND APPARATUS FOR OPEN COIL ANNEALING

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METHOD AND APPARATUS FOR OPEN COIL ANNEALING

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This invention relates to a method and apparatus for open coil heat treating and more particularly to the annealing of steel strip. In the common type of open coil annealing the coil is wound with a space between wraps roughly equal to the thickness of the strip being annealed in order to permit circulation of atmosphere gas to accelerate heating and cooling. The coils are opened by winding a cord into the coil at one edge, the cord being pulled out before the coil is annealed. This produces a very loose coil which has no rigidity and requires careful handling to prevent its collapse. After annealing it is necessary to rewind the coil into tight form, this requiring highly specialized equipment since no tension can be put on the strip being paid off the loose coil. Both the open and tight winding must be done with the eye of the coil vertical in order to permit handling of the opened coil. Because of the special equipment required and the difficulty in handling the coil the operation is an expensive one.

In order to eliminate the loose coil and the necessity of removing the cord prior to annealing, a special type of steel cord has been developed. However, the coil is also handled with the eye of the coil vertical and special handling equipment is necessary.

It is therefore an object of my invention to provide a method of open coil annealing in which the coil can be handled with its eye horizontal.

Another object is to provide such a method which does not require a cord between the convolutions.

Still another object is to provide inexpensive apparatus for carrying out the method my invention.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a schematic view of apparatus used in the practice of my invention;
FIGURE 2 is an enlarged view of a portion of the apparatus of FIGURE 1;
FIGURE 3 is a view taken on the line III—III of FIGURE 2;
FIGURE 4 is a plan view of another portion of the apparatus; and
FIGURE 5 is a view taken on the line V—V of FIGURE 4.

Reframing more particularly to the drawings, reference numeral 2 indicates a cleaning line which is used to clean strip prior to annealing it. On the exit side of the cleaning line is a standard cooler 4 for recollecting the strip. A pair of hoppers 6 and 8 are arranged on the entry side of the cooler 4, one adjacent each edge of the strip. An electromagnetic vibrator trough feeder 10 is connected to the hopper 6 and a similar feeder 12 is connected to the hopper 8. Any standard feeder may be used, such as the Model F—11 feeder manufactured by the Syntron Company of Homer City, Pennsylvania. Granular material G is placed in the hoppers 6 and 8 and is fed at a uniform rate through the feeders 10 and 12 to the top of the strip S at the tangent point of the strip and coil so as to form two bands A and B. Standard means, not shown, are preferably provided to raise and lower the center of the cooler 4 to maintain the outlet of the feeders at the tangent point. The rate of feed of the granular material will vary as the speed of the strip varies. It is preferred to use vermiculite, but other materials such as sand, steel shot, and pellets of a refractory material such as magnesium oxide may also be used. It is preferred that the granular material be of uniform diameter since otherwise the smaller grains will drop out of the coil and have to be collected. Depending upon the thickness of the strip, the thickness or diameter of the grains should be between one half and three times the thickness of the strip. For best results the material should be non-abrasive, should not be harder than the strip, must have sufficient strength at the annealing temperature to not break down between the convolutions and should not be chemically active with the strip material nor the annealing atmosphere. It will be noted that the granular material G covers only a minor proportion of the strip S and the grains are so spaced that the annealing atmosphere can pass therebetween.

The opened coil of strip from the cooler 4 is taken to a furnace 14 which is a standard box type furnace ordinarily used for open annealing. This includes a base 16 for supporting the coil C with its axis vertical, an inner cover 18 and an outer cover 20. The annealing atmosphere is introduced beneath the inner cover 18 and circulated between the convolutions of the coil. After the open coil is annealed it is placed on an uncoller 22 and passed through a temper mill 24 in the usual manner. A pair of rotary brushes 26 and 28 are located between the uncoller 22 and the temper mill 24. A guide roll 29 is provided between the uncoller 22 and brush 26. Motors 30 and 33 drive the brushes 26 and 28, respectively. It will be seen that the axes of the brushes 26 and 28 are arranged at acute angles 34 and 38 opposite edges of the strip. Shrouds 38 and 39 surround the brushes 26 and 28, respectively, and are connected to vacuum systems 42 and 44, respectively. Thus as the strip leaves the uncoller 22 the brushes 26 and 28 sweep the granular material G off the edges of the strip and the granular material is then sucked into the vacuum collectors 42 and 44. Similar brushes may also be applied to the under side of the strip, and air jets may be used in place of, or supplemental to, the brushes depending upon the characteristics of the granular material.

While two bands of granular material are shown other band arrangements such as a single wide band in the center or three or more narrow bands may be used with the feeding apparatus being modified accordingly. Also while the granular material feeding apparatus is shown in conjunction with the cooler of standard cleaning apparatus it may be used in conjunction with any cooler. The granular material may also be removed in conjunction with other uncollers. In no instance, however, is it necessary to provide special collers and uncollers for use in my method.

It will be understood that the type of heat treatment to which the strip is subjected has nothing to do with the present invention. For example, the strip may be carburized or nitrided, or it may be necessary that a heat treating atmosphere be provided which can circulate between the convolutions of the coil.

While one embodiment of my invention has been shown and described it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. The method of heat treating a coil of strip which comprises feeding a length of strip toward a coiler having a generally horizontal axis, feeding granular material to the surface of said length of strip, said granular material being chemically non-active with the strip material at said heat treating atmosphere, having sufficient strength at the heat treating temperature to retain its granular form and having a hardness the same as or less than that of the strip, then coiling said length of strip with the granular material on the strip.
material thereon to form an opened coil, then placing said opened coil in a heat treating furnace, then heating said coil of strip and passing a heat treating atmosphere between the convolutions of the opened coil, then removing the opened coil from the furnace, then uncoiling the heat treated coil, and removing the granular material from the surface of the heat treated strip as it is being uncoiled.

2. The method of heat treating a coil of strip which comprises feeding a length of strip toward a coiler having a generally horizontal axis, feeding granular material to the surface of said length of strip, said granular material being of the class consisting of vermiculite, sand, steel and magnesium oxide, then coiling said length of strip with the granular material thereon to form an opened coil, then placing said opened coil in a heat treating furnace, then heating said coil of strip and passing a heat treating atmosphere between the convolutions of the opened coil, then removing the opened coil from the furnace, then uncoiling the heat treated coil, and removing the granular material from the surface of the heat treated strip as it is being uncoiled.

3. Apparatus for heat treating a coil of strip which comprises a coiler arranged with its axis substantially horizontal, means adapted for feeding a length of strip toward said coiler, a hopper containing granular material adapted to be arranged above said strip, means adapted for feeding said granular material at a uniform rate from the hopper to the top surface of the strip adjacent the point where the strip being fed enters the coiler, said coiler thus being adapted for having an opened coil of strip formed thereon with said granular material between the convolutions thereof, a heat treating furnace adapted for receiving and heat treating said opened coil of strip, an uncoiler adapted for receiving and uncoiling said heat treated coil of strip, and means arranged adjacent said uncoiler adapted for removing the granular material from the strip being uncoiled.

4. Apparatus for heat treating a coil of strip according to claim 3 in which the means for feeding granular material includes a vibrating trough feeder connected to receive granular material from said hopper.

5. Apparatus for heat treating a coil of strip which comprises a coiler arranged with its axis substantially horizontal, means adapted for feeding a length of strip toward said coiler, a pair of hoppers containing granular material adapted to be arranged above said strip one adjacent each edge of the strip, and a pair of vibrating trough feeders one connected to receive granular material from one hopper and adapted to feed it to the strip adjacent one edge and the other connected to receive granular material from the other hopper and adapted to feed it to the strip adjacent the other edge.

6. Apparatus for heat treating a coil of strip which comprises a coiler arranged with its axis substantially horizontal, means adapted for feeding a length of strip toward said coiler, means at the inlet side of said coiler adapted for feeding granular material to the surface of said strip, said coiler thus being adapted for having an opened coil of strip formed thereon with said granular material between the convolutions thereof, a heat treating furnace adapted for receiving and heat treating said opened coil of strip, an uncoiler adapted for receiving and uncoiling said heat treated coil of strip, and means arranged adjacent said uncoiler adapted for removing the granular material from the strip being uncoiled, said means for removing the granular material including a rotary brush adapted to bear against the surface of the strip and having its axis extending at an acute angle to one edge of the strip, a shroud around said brush, and means connecting said shroud to a vacuum adapted to remove the granular material.

7. Apparatus for heat treating a coil of strip which comprises a coiler arranged with its axis substantially horizontal, means adapted for feeding a length of strip toward said coiler, means at the inlet side of said coiler adapted for feeding granular material to the surface of said strip, said last named means including a hopper adapted to be arranged above said strip and a vibrating trough feeder adapted to receive granular material from said hopper, said coiler thus being adapted for having an opened coil of strip formed thereon with said granular material between the convolutions thereof, a heat treating furnace adapted for receiving and heat treating said opened coil of strip, an uncoiler adapted for receiving and uncoiling said heat treated coil of strip, and means arranged adjacent said uncoiler adapted for removing the granular material from the strip being uncoiled, said last named means including a rotary brush adapted to bear against the surface of the strip and having its axis extending at an acute angle to one edge of the strip, a shroud around said brush and means connecting said shroud to a vacuum adapted to remove the granular material.

8. Apparatus for heat treating a coil of strip which comprises a coiler arranged with its axis substantially horizontal, means adapted for feeding a length of strip toward said coiler, means at the inlet side of said coiler adapted for feeding granular material to the surface of said strip, said last named means including a pair of hoppers containing granular material adapted to be arranged above said strip one adjacent each edge of the strip and a pair of vibrating trough feeders one connected to receive granular material from one hopper and adapted to feed it to the strip adjacent one edge and the other connected to receive granular material from the other hopper and adapted to feed it to the strip adjacent the other edge.

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