METHOD AND APPARATUS FOR COOLING WIRE ROD

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ABSTRACT

Wire rod of indeterminate length emerging from a hot mill at elevated temperature is bent into spiral loops and fed downwardly through an aqueous cooling bath of upright cylindrical form. At the lower end of the bath, conveyor means laterally remove and elevate the wire rod from the bath.

6 Claims, 1 Drawing Figure
METHOD AND APPARATUS FOR COOLING WIRE ROD

The present invention relates to methods and apparatus for cooling wire rod, particularly hard steel wire rod emerging from a hot mill.

Considerable research has been performed in recent years, aimed at improving the final quality of wire rod, the nature of its surface, its microstructure and the homogeneity of its microstructure, which however has been concerned almost exclusively with treatments to which the rod is subjected in the final units of the hot mill and upon cooling the wire rod when it leaves the hot mill.

In addition, it is highly desirable to eliminate the difficulties that now attend the treatment of wire rod obtained in known manners and intended for drawing, which treatments include pickling, patenting and hot coating.

Among the arrangements for the controlled cooling of wire rod which have been thus far proposed, the best known are those in which the wire rod is subjected to air cooling while arranged in a series of non-concentric spirals, either disposed on a conveyor or suspended about a common axis. These processes however permit the elimination only of the first patenting stage and a reduction of the thickness of the scale that forms on the wire rod. These known processes do not eliminate pickling at the drawing works. On the other hand, the known methods produce a longitudinal homogeneity of the wire rod that is acceptable although not as good as that obtained by lead patenting.

In connection with the known arrangements, of which many are in operation, it has been proposed to use fluid bed techniques. The results of fluid bed technique are on the one hand satisfactory with respect to the structure of the product. On the other hand, fluid bed techniques may introduce complexities of their own and greatly increase the capital cost of the plant. Also, fluid bed techniques increase the cost of operation by virtue of the abrasiveness of the materials that are involved. Also, it is necessary to use large installations to eliminate the heat transmitted to the fluidized bed by the wire rod.

The present invention overcomes these and other difficulties and disadvantages, by providing methods and apparatus in which the wire rod leaving the hot mill is bent to an open-loop spiral and then is introduced into an aqueous bath whose temperature is greater than 75 percent of its boiling temperature, expressed in degrees centigrade, which bath contains in suspension and/or solution materials such as calcium chloride and surfactants. The surfactants may be natural or synthetic.

The procedure for treating wire rod according to the present invention includes as an important characteristic that the wire rod, preferably at a temperature between 800°C. and 1050°C., is introduced in the form of a spiral whose loops are separated from each other, into a substantially cylindrical chamber containing an aqueous bath in which the loops are immersed, the loops remaining in the bath long enough to effect the desired metallurgical process. The wire rod is then removed from the bath to complete the cooling.

According to the invention, the coils are introduced into the aqueous bath preferably letting them descend therein without the aid of any mechanical means. At the same time, if desired, particularly when the density of the aqueous bath is important, it is possible to use apparatus for pushing or pulling to insure advancement of the loops through the bath.

A particular example of the process according to the present invention consists in immersing wire rod coils of indeterminate length at a speed, and into an aqueous bath of a depth, such that the dwell time in the bath of a transverse section at one point along the wire rod is as close as possible to the dwell time necessary to accomplish the metallurgical operation comprising the allotropic transformation of the steel during cooling, e.g., the formation of austenite by quenching from above the austenitic transformation temperature.

Another object of the present invention is the provision of apparatus to practice the above-described method.

The apparatus of the present invention is principally comprised of the following:

A receptacle of substantially vertical cylindrical form containing an aqueous bath in which the wire rod emerging from the hot mill is fed in the form of open loops;

Means to introduce the wire rod into the receptacle; and

Means to remove the wire rod from the receptacle.

According to a preferred embodiment, the receptacle containing the aqueous bath has a circular section; and preferably the longitudinal axis of the receptacle is substantially vertical and of a length substantially greater than the width of the receptacle.

According to the invention, the dimensions of the treatment receptacle are determined as a function of the metallurgical operation. Thus the height of the receptacle is advantageously arranged to accommodate foam that may form on the surface of the bath. Also, the depth of the bath should be sufficient to ensure substantial austenitic transformation in the course of the passage of the wire rod through the bath.

Thus the depth of the bath, the speed of movement of the wire rod loops and the spacing between them, may all be modified so as to correspond to the operational conditions.

Means are provided for removing the wire rod from the bath. One such arrangement which is particularly advantageous comprises a continuous inclined conveyor of which the lower end is situated at the bottom of the treatment vessel and the upper end emerges from an inclined casing whose upper end is at a level at least as high as the surface of the aqueous treatment bath. The conveyor may for example be an endless chain conveyor on which the loops of wire rod come to rest and are arranged and conveyed in overlapping nonconcentric fashion.

To reduce the length of such an inclined conveyor for the removal of the wire rod from the treatment path, it may be advantageous to use an elevator conveyor comprised by a chain having projections thereon that interdigitate with the loops, each finger of the conveyor receiving either one or a plurality of the loops.

Another advantageous arrangement is the provision of a vertical elevator in a casing adjacent the treatment bath, with a liquid lock at the bottom of the treatment bath through which completed coils of wire rod are bodily transferred to the elevator and raised by the elevator in the form of tight rolls of wire rod. Such an arrangement reduces the volume of the bath which must be maintained.
In the accompanying drawing, which shows by way of example one embodiment of apparatus according to the present invention, the wire rod from a hot mill (not shown) passes through a coiling device 1 by which it is bent into an open spiral, the loops of which are received on a roller conveyor 2 and fed through a guide device 3 disposed in an upright cylindrical container 4, into a bath 5 of aqueous calcium chloride solution or the like. The evaporated bath liquid is conserved by a condenser 6.

An inclined casing 7 communicates with the lower end of the bath 5 in container 4, and houses an inclined endless chain conveyor 8 whose lower end is disposed at the bottom of bath 5 and whose upper end emerges from the surface 9 of the bath liquid that fills both the container 4 and the inclined casing 7. The open loops of wire rod are then received by a roller conveyor 10 and pass through a guide device 11 onto a horizontal support where they are accumulated in the form of a tight roll of wire rod. A pusher 12 then pushes the roll off the support surface onto a further roller conveyor.

Although the present invention has been described and illustrated in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

Having described my invention, I claim:

1. Apparatus for cooling wire rod, comprising an upright substantially cylindrical container for an aqueous bath, said container having a height substantially greater than its width, means to bend wire rod of indeterminate length into a series of open loops, means to introduce said loops after bending into the bath in a downward direction, and means to remove the loops laterally from the lower end of the bath.

2. Apparatus as claimed in claim 1, said height being more than twice said width.

3. Apparatus as claimed in claim 1, said means for laterally removing the loops comprising conveyor means extending outside said container upwardly from adjacent the lower end of the bath to a level at least as high as the surface of the bath, and means beyond said conveyor means for collecting said loops and for assembling said loops into a roll of wire rod.

4. Apparatus as claimed in claim 1, said means to remove the loops comprising an inclined conveyor whose lower end is disposed at the lower end of the bath to receive the loops, and a casing outside said container, said conveyor being disposed in said casing, said casing having an upper end at least as high as the level of the liquid bath in said container.

5. Apparatus as claimed in claim 4, said container being outside said casing.

6. Apparatus as claimed in claim 1, said wire rod emerging from said bending means at a level above the liquid level of said bath.