United States Patent [19]

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[11] **3,711,918**

[45] **Jan. 23, 1973**

[54] **SPLIT LEVEL CONVEYOR AND COLLECTING MEANS FOR CONTROLLED COOLED STEEL ROD**

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[21] Appl. No.: **60,319**

[52] **U.S. Cl.** ..... **29/200 B,** 266/3 R

[51] **Int. Cl.** **B23p 19/00**

[58] **Field of Search** ..... 266/3 R; 29/200 B, 417 R

[56] **References Cited**

UNITED STATES PATENTS

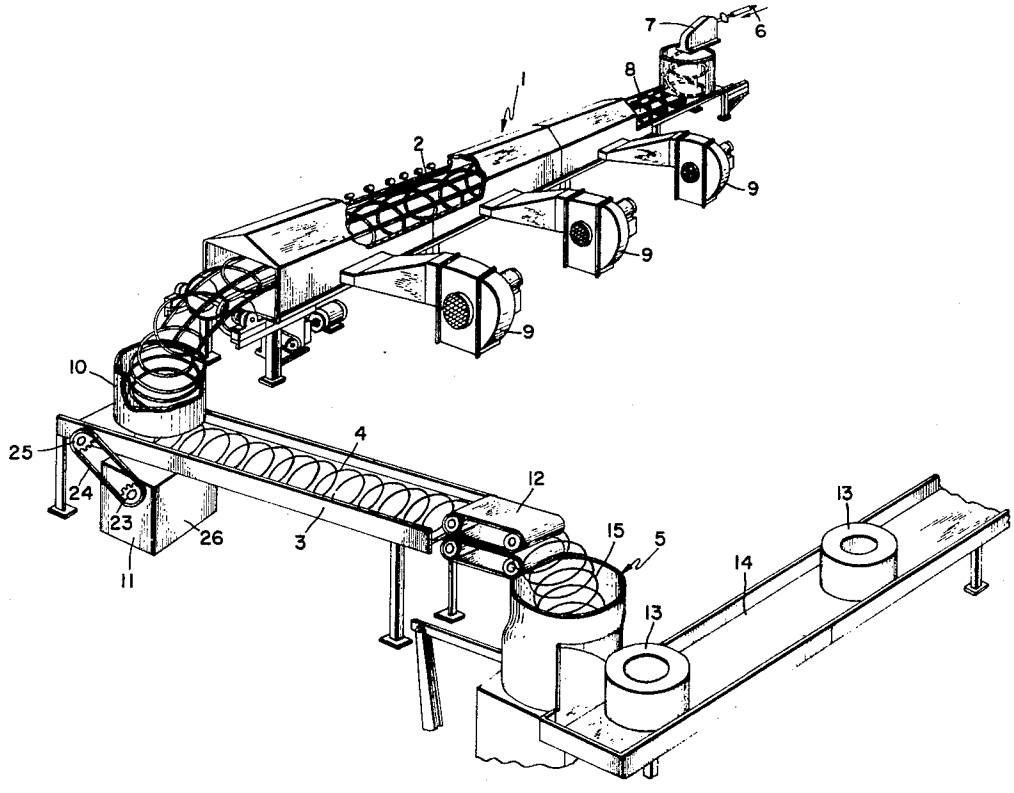
3,360,842	1/1968	Hill et al.	29/200 B
3,176,385	4/1965	Morgan et al.	29/417
3,490,500	1/1970	Dopper et al.	266/3 R

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[57] **ABSTRACT**

The conveyor and collecting apparatus described obtains several advantages in conjunction with the controlled cooling of steel rod through transformation and the ultimate collection of the rod. The apparatus includes a first-level conveyor for passing steel rod immediately after rolling through a controlled cooling zone, where transformation occurs, and a second-level conveyor for receiving the transformed rod at the end of the first conveyor and for transporting the rod to a collecting apparatus. On both conveyors the rod is transported in the form of overlapping, non-concentric rings, although the rate of progression of both conveyors is not necessarily equal, and hence the degree of overlap of the rings may be different for each conveyor. The second conveyor includes means to vary the rate of transport of the rod rings, and also means to stop the conveyor operatively in conjunction with means to cut the rod.

5 Claims, 7 Drawing Figures



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SHEET 1 OF 3

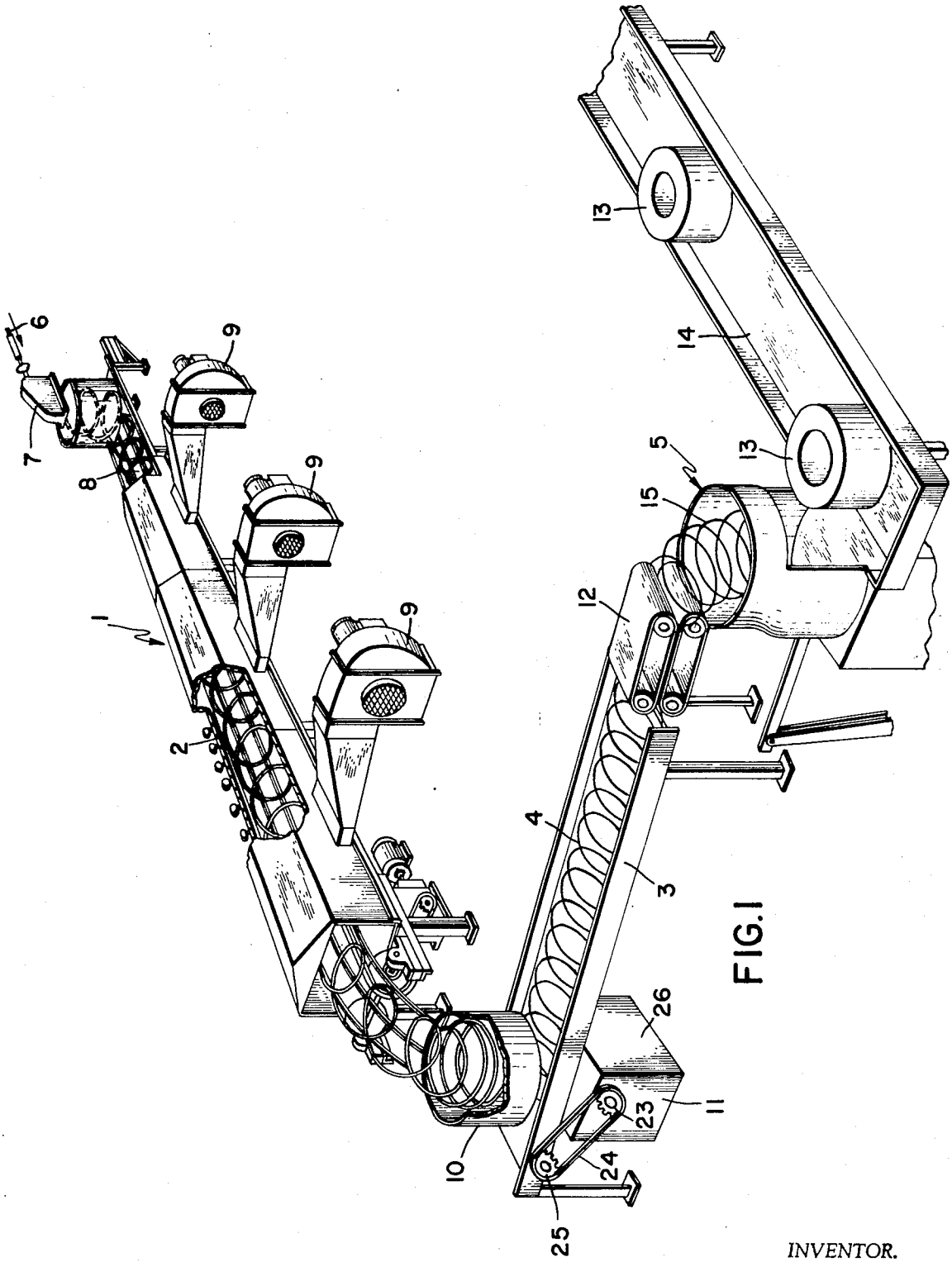


FIG. 1

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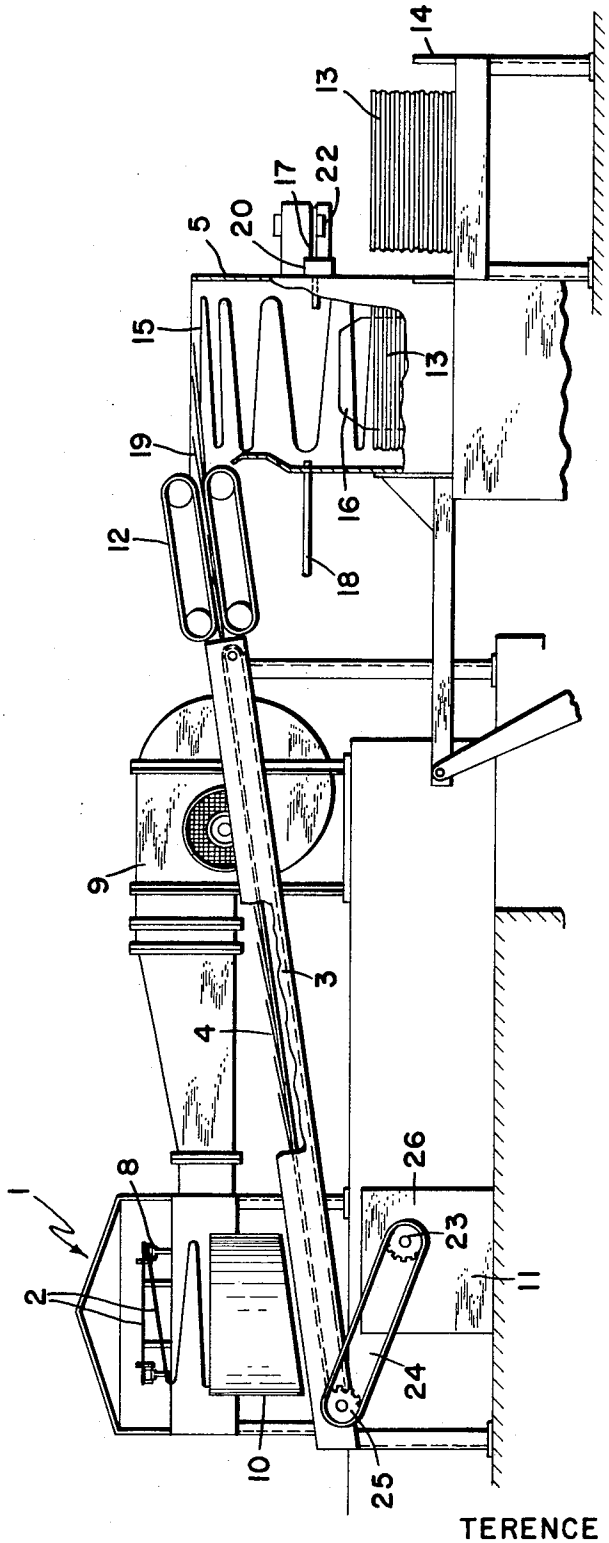


FIG.2

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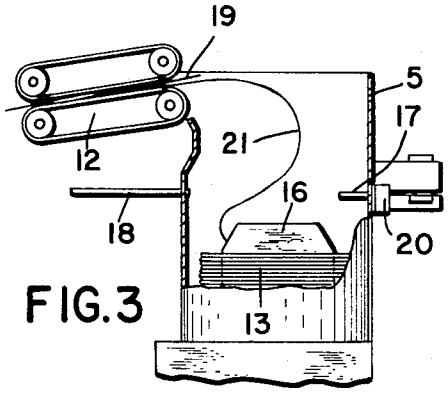


FIG.3

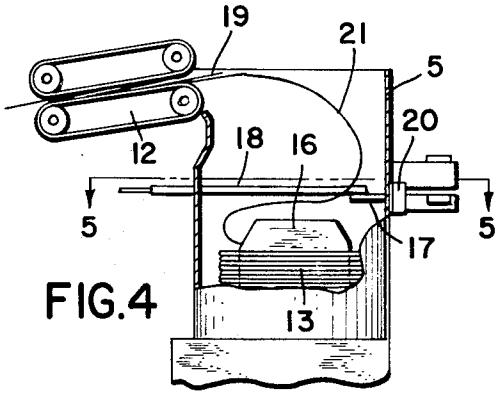


FIG.4

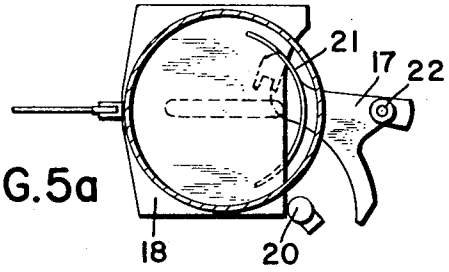


FIG.5a

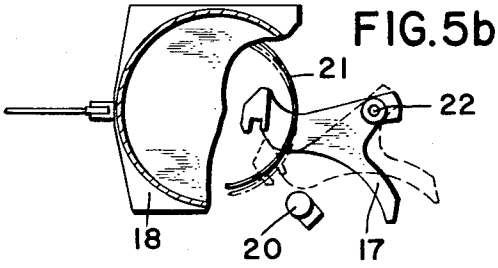


FIG.5b

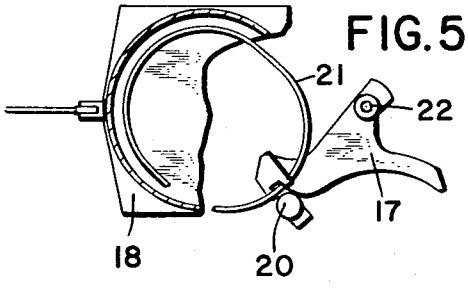


FIG.5c

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SPLIT LEVEL CONVEYOR AND COLLECTING MEANS FOR CONTROLLED COOLED STEEL ROD

BACKGROUND OF THE INVENTION

Those skilled in the steel rod treating art appreciate that controlled cooling of rod through transformation is a very desirable practice in order to obtain a product having superior or special metallurgical and physical properties. Typical references which disclose the methods and apparatus for controlled cooling include U.S. Pat. Nos. 3,390,871 and 3,231,432, both issued in the names of D. W. McLean and C. G. Easter. Another patent to these same inventors, U.S. Pat. No. 3,320,101, describes in some detail the superior product of a controlled cooling process. While the present invention is not limited in its application to any particular method of controlled cooling, a brief discussion of these methods should be useful in demonstrating the invention's utility and advantages.

The apparatus employed in controlled cooling may include, for example: means for rolling steel rod at an elevated temperature above the transformation temperature and for continuously depositing the rod onto a conveyor in the form of overlapping non-concentric rings; means associated with the conveyor for cooling the rod rapidly from a temperature above transformation temperature through transformation, whereby the rod is cooled substantially uniformly; and means for collecting the rod in coiled bundles. In the controlled cooling process, while the rod is transformed from austenite the cooling medium is applied to the non-concentric rings across the width of the conveyor substantially uniformly, and rapidly enough to avoid the development of coarse lamellar pearlite. The product of the controlled cooling is characterized, among other things, by high tensile strength and high ductility, by a light friable scale, and by a uniformity of properties throughout its length; the microstructure throughout the rod's length is characterized substantially uniformly by the fine pearlite grains, exhibits a minimum of grain-boundary ferrite and is substantially free of bainite.

The substantial improvement in the properties of the steel rod product can be attributed to the process of controlled cooling. It follows that any interruption or other adverse variation of the process will have a deleterious effect on its product. It has been observed, for example, that the stoppage of the main conveyor of the cooling apparatus necessarily interrupts the cooling process, with adverse effect upon the resulting product. Such stoppages are sometimes the result of difficulties in the collecting or cutting of the rod in coil bundles, in that, for example, the rod may get caught in a piece of the apparatus and thereby jam the mechanism.

It is a major objective of the invention to provide apparatus which at once permits optimal controlled cooling of steel rod and avoids much of the complications that result from inevitable breakdowns or variations in the collecting of the rod. In particular, a major objective is to provide a collecting mechanism for the steel rod which operates independently of the controlled cooling apparatus, such that any breakdowns in the collecting mechanism have little or no effect on the operation of the cooling process. These objectives and others will become more clear to those skilled in the art by the following detailed disclosure of the invention, wherein its major advantages will also become apparent.

BRIEF DESCRIPTION OF THE INVENTION

The invention relates to apparatus for controlled cooling through transformation of steel rod in the form of overlapping, non-concentric rings, and its collection in the form of ring bundles. In particular, the apparatus includes in addition to the primary conveyor carrying the rod through controlled cooling, a second conveyor for transporting the transformed rod to a collecting apparatus. This second conveyor is adapted to transport the rod at any desired rate and to interrupt the rod's progression, in order to facilitate its cutting into ring bundles. Accordingly, the present apparatus includes a first-level conveyor as part of apparatus for the controlled cooling of steel rod in the form of overlapping, non-concentric rings, a second-level conveyor for collecting the rod at the end of the first conveyor and for delivering the rod to a collecting means, and collecting means cooperating with the second level conveyor.

The controlled cooling apparatus may be of any suitable design. Preferably, the apparatus includes means for delivering steel rod immediately after it has been hot rolled at a temperature substantially above the transformation temperature of the rod, and means for forming the rod so delivered into overlapping, non-concentric rings on the conveyor. The design of the cooling means may also vary, but it should be capable of rapidly cooling the rod through transformation uniformly from end to end. At the downstream end of the conveyor, after the rod has been transformed, it is delivered to the second-level conveyor.

The second-level conveyor receives the transformed rod, still in the form of overlapping, non-concentric rings, and delivers it to a collecting means. Preferably, this latter conveyor operates on a level beneath that of the first-level conveyor—hence, the term "second level"—since in this arrangement, it is simplest to receive the rings as they fall from the end of the conveyor.

The second-level conveyor is capable of operating in conjunction with the first, but it is also capable of operating independently—for example, at a different rate. It is also capable of stopping even while the first conveyor continues operating, in which case the cooled rod delivered by the first conveyor collects in a pile at the head of the second. The primary purpose of the second-level conveyor is to provide means to deliver steel rod in the form of overlapping, non-concentric rings to a collecting means, in order to facilitate the collection and bundling of the rod. In such a manner, the collecting means is operated independently of the cooling apparatus, and its operation does not affect the cooling operation.

Preferably, the collecting apparatus includes means for cutting the rod at any chosen point. This is best accomplished in the preferred embodiment of the invention by stopping the second conveyor at the appropriate time for cutting the rod. In this way the rod can be cut by a suitable cutting device with maximum freedom from crimping and entanglement.

BRIEF DESCRIPTION OF THE DRAWINGS

This detailed description of the invention will be presented with reference to drawings of a preferred embodiment thereof selected for purposes of illustration and shown in the accompanying drawings, in which:

FIG. 1 is a perspective view of the preferred embodiment of the invention having a controlled cooling apparatus, which embodiment includes a first-level conveyor, a second-level conveyor, a collecting device, and a final conveyor which transports assembled bundles;

FIG. 2 is a side elevation view of the apparatus of FIG. 1 showing the discharge end of the first-level conveyor, the second-level conveyor, the collecting device, partially cut away, and a final conveyor, taken as all conveyors are running;

FIG. 3 is a side elevation view of the collecting device, including a collecting tub, tractor chains, a plate, a positioning arm, and a shear, with the collecting tub partially cut away and the tractor chains stopped;

FIG. 4 is similar to FIG. 3 with the plate having advanced into the collecting tub;

FIG. 5*a* is a vertical sectional view taken along line 5—5 of FIG. 4;

FIG. 5*b*, also a view taken along line 5—5 of FIG. 4, is a view with the plate partially cut away, showing two positions, one in phantom, of the positioning arm as it advances and catches the rod;

FIG. 5*c*, also a view taken along lines 5—5 of FIG. 4, with the plate partially cut away, shows the positioning arm having carried the rod to the shear.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the preferred embodiment illustrated in the Figures, hot-rolled rod is transformed in controlled cooling apparatus **1**, while in the form of overlapping, non-concentric rings **2**. These rings are transferred to a second conveyor **3**, which delivers the rod in the form of overlapping non-concentric rings **4** to a collecting means **5**. This collecting means **5** collects and bundles the steel rod.

The controlled cooling apparatus **1** illustrated in the preferred embodiment is similar to that disclosed in U.S. Pat. No. 3,231,432. With reference to FIG. **1**, a coiler **7** receives steel rod **6** in the form of a running strand at a temperature above the transformation point and deposits the rod onto a conveyor **8**, in the form of non-concentric, overlapping rings **2**. The rings **2**, when initially deposited on the conveyor **8**, are still at a temperature above transformation, but as the rings **2** are carried by the conveyor **8** down the controlled cooling apparatus **1** they are rapidly and uniformly cooled through transformation by the action of forced air generated by blowers **9**, blowing upwardly across the rings **2**.

With reference to FIGS. **1** and **2**, the transformed rod drops off the end of the conveyor **8** through a tub **10** and onto the second conveyor **3**. The rod is deposited on this second conveyor **3** in the form of non-concentric rings **4**. This second conveyor **3** carries the rings **4** of rod up to collector **5** where they are assembled into bundles **13** of desired size and carried away on a third conveyor **14**.

The speed of this second conveyor **3** can be adjusted through a suitable drive mechanism **11** so that the second conveyor **3** can be adjusted to a desired speed or stopped, independently of the speed of the cooling conveyor **8**. With reference to FIG. **2**, the drive mechanism includes a motor and gear box **26**, drive pulley **23**, and a belt **24**, connecting the drive pulley **23** to a conveyor drive **25**. This second conveyor **3** carries the rings up to the collector **5**.

The collecting device **5** receives the steel rod in the form of overlapping, non-concentric rings **19** and collects them into bundles **13** of desired size. The collector illustrated in FIGS. **1–5** is similar to that disclosed in U.S. Pat. No. 3,360,842, and is an example of a suitable collecting device.

With reference to FIG. **3**, tractor chains **12** of the collecting device **5** receive the rings **4** of rod from the second conveyor **3** and feed the rings **19** uniformly into the collector **5**. The tractor chains **12** are driven at a speed slightly greater than, and proportional to, the speed of the second conveyor **3** by conventional, cooperating means (not shown), for example, drive chains connecting the drive wheels of conveyor **3** and those of tractor chains **12**. This results in the rings **19** being accelerated while being held in a substantially horizontal plane until the rings **19** are released. Thereafter, the rings **15** fall into the collector **5**, stretching into a helical arrangement, and form around the positioning guide member **16** in the shape of a bundle **13**.

When the desired bundle size is attained for the purpose of cutting the rod, conveyor **3** and tractor chains **12** are halted. As illustrated in FIG. **3**, this results in a stationary hanging rod portion **21** connecting the rings **19** still held by tractor chains **12** to the assembled rings **13**. It has been discovered that the hanging portion **21**, when stopped, obtains substantially the same drop helix every time, due to the positioning of the rings **19** on the tractor chains. Since the shape of this helix **21** is substantially consistent and readily determined, means can be devised for accurate severing of the rod portion **21**; this results in a minimum of entanglements and shutdowns due to failure to sever the rod at portion **21**. Such consistent severing is accomplished in the preferred embodiment by means of a combination of a horizontal plate **18**, a positioning arm **17**, and a shear **20**, as shown in FIGS. **4** and **5***a–c*.

After the conveyors **3** and **12** are stopped with the hanging rod portion **21** in the shape of the drop helix, horizontal plate **18** slides into its operative position in the collecting tub **5** (FIG. **4**). The plate **18** is driven by conventional means (not shown). The horizontal plate **18** thus positions the rod portion **21** such that when the positioning arm **17** pivots around on its point **22**, the arm **17** can consistently catch the rod **21**; the arm **17** then completes its pivot, carrying the rod **21** onto the shear **20** which severs the rod portion **21** (FIG. **5***a–c*). The positioning arm **17** is also driven by conventional means (not shown).

Once the rod portion **21** is severed, the bundle **13** is removed, the positioning arm **17** is returned to its original position, and horizontal plate **18** is withdrawn. Conveyor **3** and tractor chains **12** are restarted and another bundle **13** begins to form as the rings drop around guide member **16**. Bundle **13** is removed to conveyor **14**, which may be any suitable, conventional conveyor, and is carried away.

The controlled cooling apparatus **1** continues to run even while the conveyor **3** is halted, in which event, rings **2** of rod temporarily pile up on conveyor **3** in the tub **10**, until the conveyor **3** is restarted. In order to

compensate for the stoppage, conveyor 3 may be run at a somewhat higher speed than the first conveyor 8, until the excess rings in the tub 10 are removed. Once this is done, the conveyor 3 may be slowed to its usual speed.

The problems which this invention directly meets lie in the difficulties inherent in providing a means of assembling and bundling steel rod in the form of non-concentric, overlapping rings 2, as removed from the controlled cooling apparatus 1. Any stoppage or delay of the conveyor 8 can cause unpredictable thermal changes to the rod being cooled, and render its properties non-uniform.

The present invention meets the problems in two ways. First, since it provides means for stopping or slowing the rings feeding into the collecting device 5 without affecting the controlled cooling process, no harm is done to that rod 2 being cooled through transformation if a stoppage or slow-down should occur in the collecting device 5. Also, stoppage of the conveyor 3 at the time the desired bundle size 13 is attained results in the severing of rod 21 when it is in such a position that much surer cutting action can be employed. This greatly diminishes the frequency of entanglements resulting from insufficient severing of the steel rod 21.

This discussion of the use of the invention in the devices shown will serve as an illustration of the effect of the invention with specific devices. Other means of controlled cooling and other means of collecting the rod into bundles could be employed as well, and numerous variations of this preferred embodiment will now be apparent to those skilled in the art in light of these teachings. The primary advantages lie in those systems where the steel rod is in overlapping non-concentric rings as it is being collected and where the controlled cooling cannot be interrupted without risk of detrimental thermal effects to the steel rod.

I claim:

1. Controlled cooling and collecting apparatus for receiving hot rolled steel rod at a temperature above transformation, cooling said rod uniformly through transformation, and collecting said transformed rod in ring bundles, which comprises:

a first-level conveyor including continuous rod-laying means for receiving steel rod immediately after rolling at a temperature above transformation and for depositing said rod on said first-level conveyor in the form of overlapping, non-concentric rings still at a temperature above transformation, and means for cooling said rod through transformation substantially uniformly throughout the length of said rod;

a second-level conveyor, operative independently of said first-level conveyor, which second-level conveyor includes means for receiving transformed steel rod from said first-level conveyor in the form of overlapping, non-concentric rings and means for stopping the movement of said rod along the second-level conveyor;

collecting means including means for receiving said rod at the downstream end of said second-level conveyor, means for serially advancing and dropping said rings, means for stopping said advancing rings, and means for collecting and forming said rod into ring bundles; and

severing means operative in conjunction with said second-level conveyor for stopping the movement of said rod along said second-level conveyor and for stopping said advancing rings and having a positioning arm and shear, wherein said positioning arm is adapted to move a hanging rod portion of said rod when its movement is stopped into engagement with said shear;

whereby, when said stopping means are operated the last of said advancing rings to drop assumes substantially an identical drop helix every time.

2. The controlled cooling and collecting apparatus of claim 1, wherein said means for advancing and dropping said rings includes tractor chains; and wherein said severing means includes a collecting tub and guide member for collecting rod rings in bundles and a horizontal plate movable into the collecting tub, when the movement of said rod is stopped, for positioning said hanging rod portion for engagement by said positioning arm.

3. The controlled cooling and collecting apparatus of claim 2, wherein engagement means are provided in conjunction with said means for stopping the movement of said rod along said second-level conveyor for engagement of said horizontal plate, positioning arm and shear, operative in sequence to stop said second-level conveyor, to advance said horizontal plate into said collecting tub, to move said positioning arm into contact with said hanging rod portion thereby advancing said rod into engagement with said shear, and to sever said rod with said shear.

4. Controlled cooling and collecting apparatus for receiving hot rolled steel rod at a temperature above transformation, cooling said rod uniformly through transformation, and collecting said transformed rod in ring bundles, which comprises:

a first-level conveyor including continuous rod-laying means for receiving steel rod immediately after rolling at a temperature above transformation and for depositing said rod on said first-level conveyor in the form of overlapping, non-concentric rings still at a temperature above transformation, and means for cooling said rod through transformation substantially uniformly throughout the length of said rod;

a second-level conveyor, operative independently of said first-level conveyor, which second-level conveyor includes means for receiving transformed steel rod from said first-level conveyor in the form of overlapping, non-concentric rings and means for stopping the movement of said rod along the second-level conveyor;

collecting means including means for receiving said rod at the downstream end of said second-level conveyor and means for collecting and forming said rod into ring bundles; and

severing means operative in conjunction with said second-level conveyor for stopping the movement of said rod along said second-level conveyor and having a positioning arm and shear, wherein said positioning arm is adapted to move a hanging rod portion of said rod when its movement is stopped into engagement with said shear; wherein said severing means includes (a) a collecting tub and guide member for collecting rod rings in bundles, (b) tractor chains for advancing the rod rings from

the end of said second-level conveyor means to said collecting tub and (c) a horizontal plate movable into the collecting tub, when the movement of said rod is stopped, for positioning said hanging rod portion for engagement by said positioning arm.

5. The controlled cooling and collecting apparatus of claim 4, wherein engagement means are provided in conjunction with said means for stopping the movement of said rod along said second-level conveyor for engagement of said horizontal plate, positioning arm and shear, operative in sequence to stop said second-level conveyor, to advance said horizontal plate into said collecting tub, to move said positioning arm into contact with said hanging rod portion thereby advancing said rod into engagement with said shear, and to sever said rod with said shear.

* * * * *