July 1, 1969 D. W. McLEAN ET AL 3,452,785

APPARATUS FOR DEPOSITING AND CONVEYING ROD RINGS IN SEQUENCE WITH ROD FORMING MEANS

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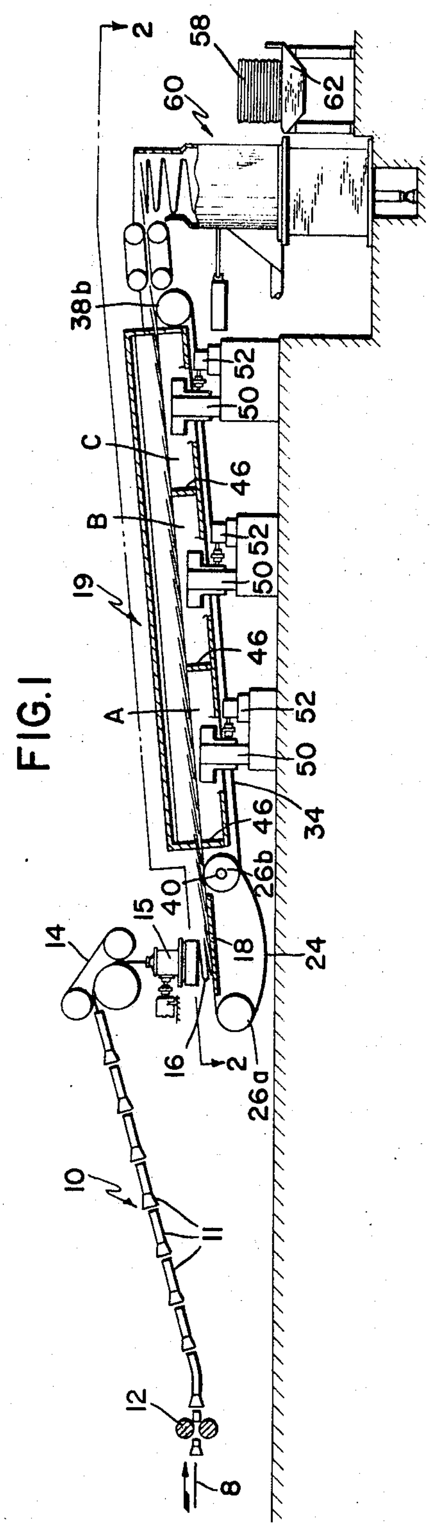

FIG. 1

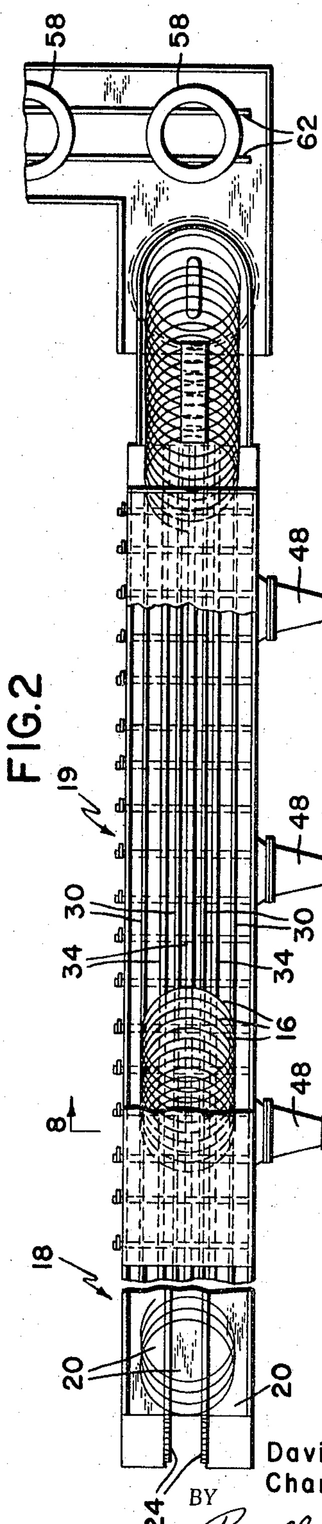

FIG. 2

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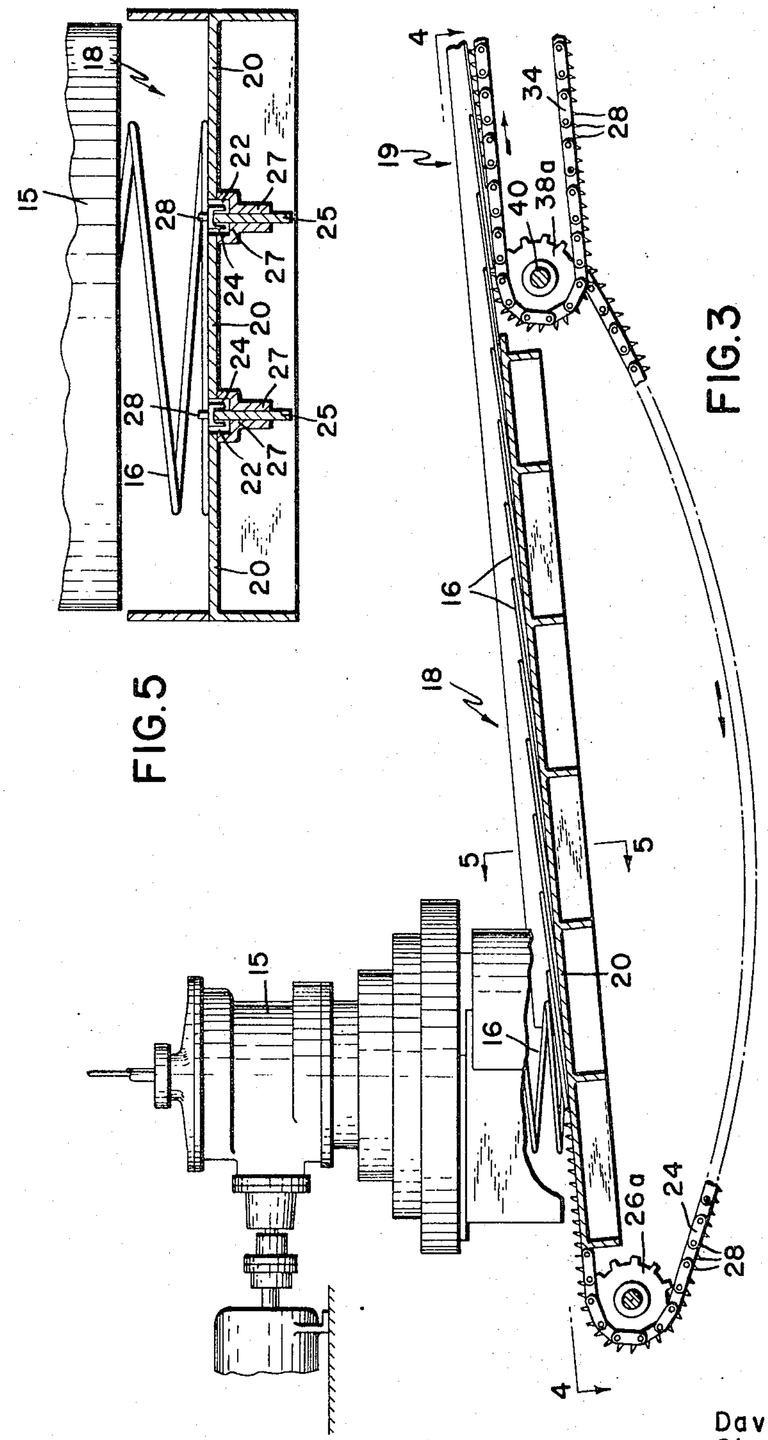

FIG. 5

FIG. 3

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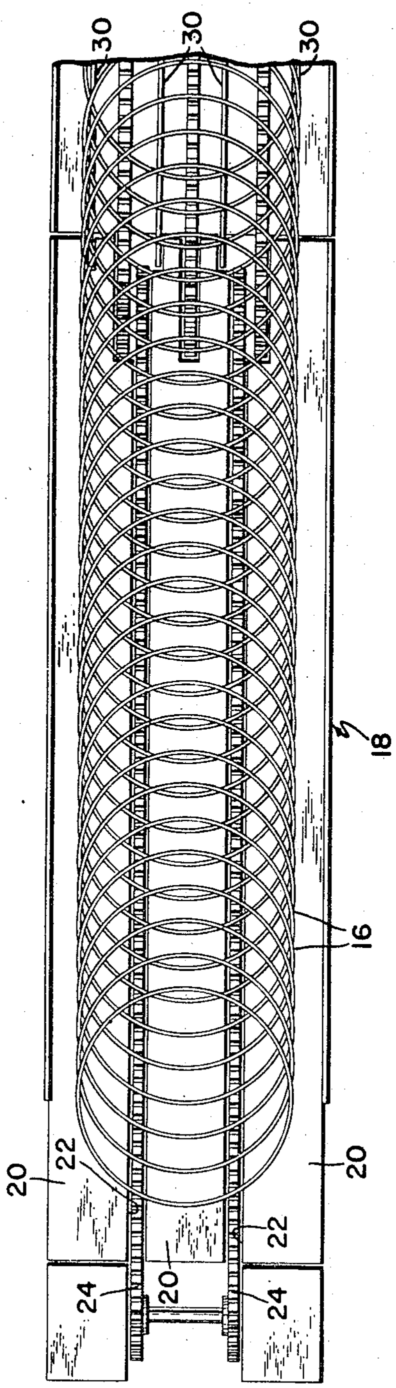

FIG. 4

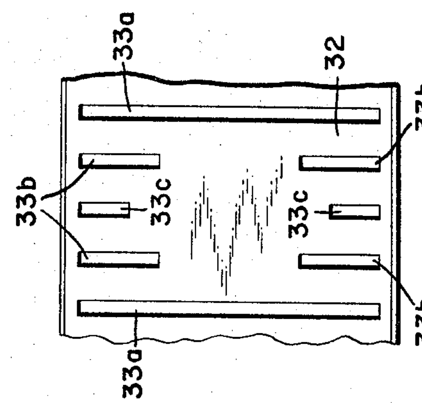

FIG. 9

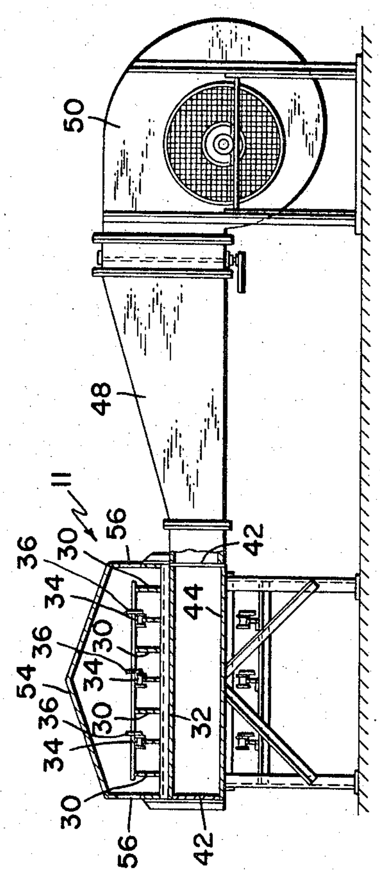

FIG. 8

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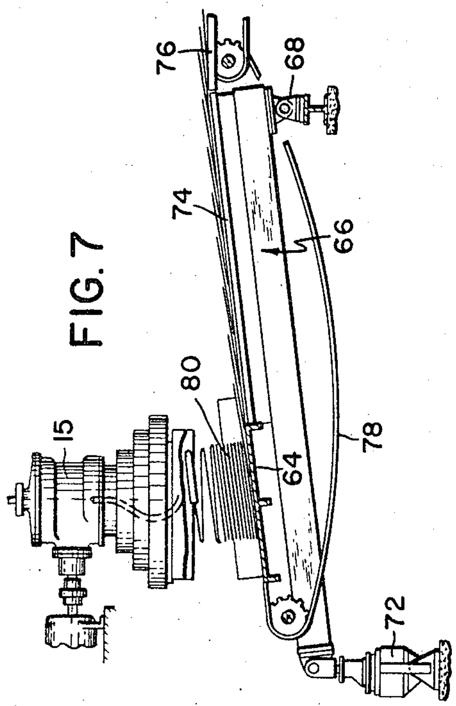

FIG. 7

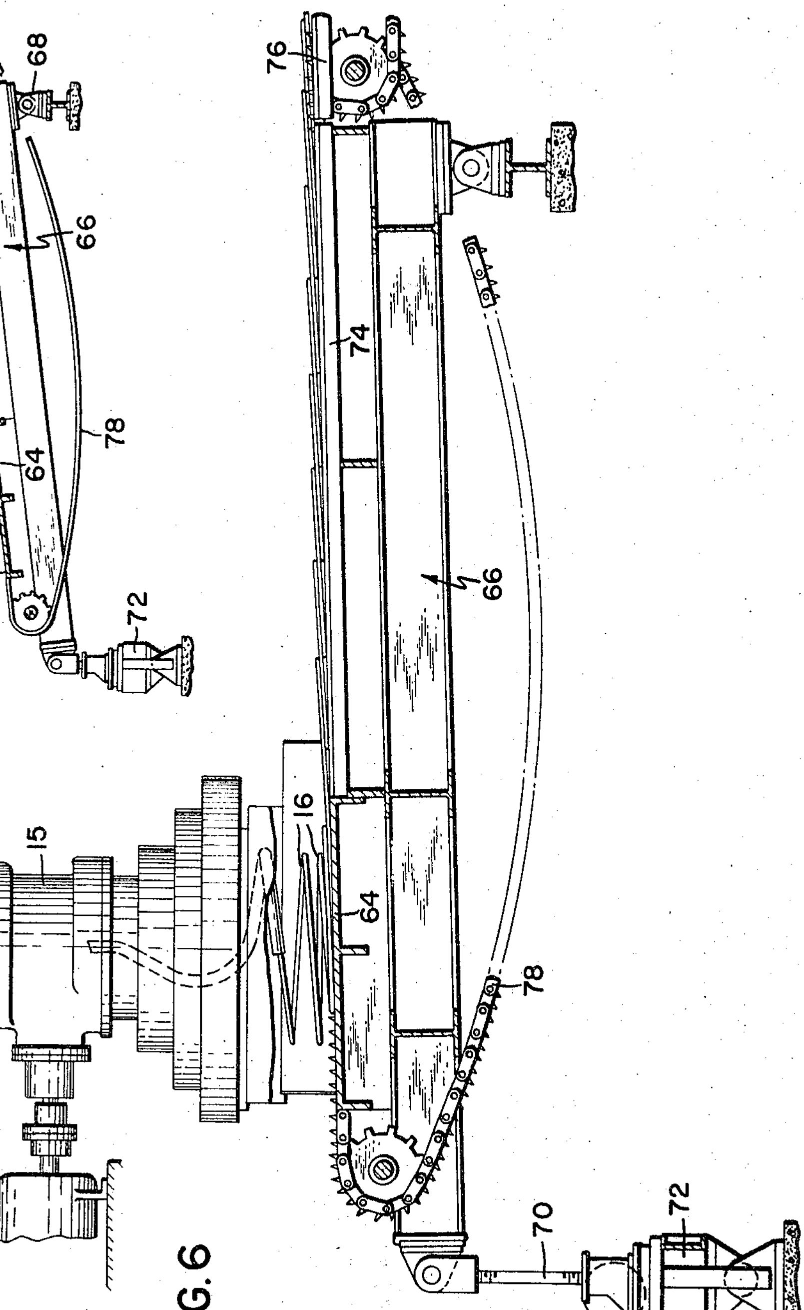

FIG. 6

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APPARATUS FOR DEPOSITING AND CONVEYING ROD RINGS IN SEQUENCE WITH ROD FORMING MEANS

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U.S. Cl. 140—2 9 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for forming, depositing and conveying rod rings in direct sequence wth the rod rolling operation. A laying head forms the hot rolled rod into a continuous series of rings which are deposited on an underlying substantially continuous stationary support surface. A chain conveyor continuously traverses the support surface and laterally moves each ring successively deposited thereon onto the receiving end of an adjacent cooling conveyor.

This invention relates to the metal working industry and more particularly to an improved apparatus operable in direct sequence with rod forming means such as a rolling mill for preparing hot rolled steel rod for subsequent cold working operations such as wire drawing.

Recent technological advances in the art of rolling steel rod have successfully demonstrated that substantial benefits may be gained by uniformly quenching hot rolled steel rod at a controlled rate in direct sequence with the rolling operation. A preferred embodiment of this inventive process is described in patent application of the present inventors, U.S. Ser. No. 402,495, now U.S. Patent No. 3,231,432, the teachings of which are incorporated herein by reference. By this process, a billet of steel is first rolled by conventional means into a length of rod. As the rod leaves the final finishing stand of the mill, it is passed through a delivery pipe equipped with water quenching nozzles which operate to cool the rod from the high temperatures maintained during rolling down to about 1450° F. Following this initial water quenching step, the rod is then directed into a laying head where it is formed into a continuous series of rings. The rings fall from the laying head under the influence of gravity directly onto an open moving conveyor, the surface of which is made up laterally spaced support tracks and conveyor chains. The continuous motion of the conveyor causes the rings being deposited thereon to assume a non-concentric overlapping relationship. While moving along the conveyor, the rings are cooled through the transformation range defined by the isothermal transformation diagram for the particular grade of steel being processed at a rate appropriate to achieve substantially complete allotropic transformation of the austenite in a manner which will enable the rod to be subsequently cold worked without an intervening patenting step. Thereafter, the rings are collected from the conveyor into bundles ready for further processing steps such as descaling and wire drawing.

Experience has indicated that by cooling the rod in a controlled manner as described above in direct sequence with the rolling operation, uniform metallurgical properties are developed along the entire length of the rod, which properties are at least equal to and in many instances better than the properties developed by conventional air patenting. The need for a separate patenting step prior to cold working is thus eliminated, making it possible to realize substantial savings in production costs. Moreover, it has been found that by cooling the rod in the aforementioned manner, a thin uniform friable surface scale is formed which scale may be removed easily with a

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minimum resulting metal loss while the rod remains in bundle form.

Although the above-described apparatus and process for cooling rod in direct sequence with the rolling operation will operate satisfactorily under most conditions, there is a possibility of difficulties arising as a result of depositing the rod rings formed by the laying head directly onto the laterally spaced tracks and chains of the conveyor. One such difficulty might be caused by the leading end of an oncoming rod length passing downwardly between the tracks and chains to thereafter form a loose hanging end which could catch or snag at some downstream point on the conveyor. Should this occur with rod continuing to issue from the final finishing stand at mill delivery speeds as high as 6000 f.p.m. or more, rod rings will immediately begin piling up on the conveyor, thus causing a malfunction of the apparatus. In addition, when depositing relatively small diameter rod directly onto the conveyor at elevated temperatures of approximately 1450° F., the momentum of the rings as they descend from the laying head combined with their lack of rigidity at these elevated temperatures may cause the rings to sag when they initially contact the spaced conveyor tracks and chains. Any such sagging or deformation would of course be objectionable in that it would complicate subsequent handling of the rings.

These problems have now been overcome by the present invention, one object of which is to provide a flat substantially continuous ring receiving surface onto which the rod rings formed by the laying head are initially deposited. Rod engaging means to be hereinafter described in greater detail continuously traverse the ring receiving surface to transport rings successively deposited thereon out onto the open conveyor. By depositing the rings on a substantially continuous surface, the problem of a leading end initially passing between or under laterally spaced tracks and chains is completely overcome. Moreover, the ring receiving surface provides a greater area for absorbing the dynamic forces developed by the rod rings as they drop from the laying head, thus avoiding any problem of initial sagging. Where necessary, the ring receiving surface also may be made of sufficient length to provide continuous support for the rings until the rod has had an opportunity to cool down to a temperature at which its strength is sufficient to withstand sagging on the spaced tracks of the conveyor. However, in most instances, the spacing of the conveyor tracks and chains will be such that adequate support for the rings is provided as soon as the descent of the rings has been effectively arrested by the flat ring receiving surface.

These and other objects of the present invention will become more apparent as the description proceeds with the aid of the accompanying drawings in which:

FIG. 1 is a somewhat schematic view in side elevation with parts in section of a rod quenching apparatus embodying the concepts of the present invention;

FIG. 2 is a plan view taken along line 2—2 of FIG. 1;

FIG. 3 is an enlarged side view partly in section of the laying head with one embodiment of the substantially continuous ring receiving surface position thereunder;

FIG. 4 is a plan view of the ring receiving surface taken along line 4—4 of FIG. 3;

FIG. 5 is a sectional view on an enlarged scale taken along line 5—5 of FIG. 3;

FIG. 6 is a side view similar to FIG. 3 showing an alternate embodiment of the ring receiving surface;

FIG. 7 is a view similar to FIG. 6 on a reduced scale showing the ring receiving surface adjusted to its lowered position;

FIG. 8 is a sectional view on an enlarged scale taken along line 8—8 of FIG. 2; and

FIG. 9 is a plan view of a portion of the upper conveyor floor.

Referring initially to FIGS. 1 and 2, an apparatus for quenching hot rolled steel rod in direct sequence with a rod mill is shown comprising a delivery pipe **10** which includes a plurality of water spray nozzles **11**, extending from the final finishing stand **12** of the rolling mill to a chain guide assembly **14** of known construction overlying a laying head **15**. Hot rolled rod **8** issuing from finishing stand **12** at mill delivery speeds enters pipe **10** where it is immediately subjected to the quenching action of the water spray nozzles **11**. The temperature of the rod as it leaves finishing stand **12** is approximately 1800° F. and as it emerges from delivery pipe **10**, it is down to about 1450° F. It is important to note, however, that at this point the rod temperature is still above that at which allotropic transformation of austenite begins.

After being subjected to this initial water quenching step, the rod is directed downwardly through an angle of approximately 90° by chain guide assembly **14** into laying head **15** where it is formed into a continuous series of rod rings indicated typically by the reference numeral **16**. As each ring is formed, it drops under the influence of gravity directly onto a substantially continuous ring receiving surface indicated generally at **18**, one embodiment of which can be best seen by additional reference to FIGS. 3 to 5. Surface **18** is positioned immediately adjacent the receiving end of an elongated upwardly inclined conveyor **19**, a more complete description of which will presently be provided. Ring receiving surface **18** is comprised basically of flat elongated apron plates **20** spaced laterally to provide channels **22** therebetween. Endless chains **24** run continuously as indicated in FIG. 3 along tracks **25** in channels **22** between sprockets **26***a* and **26***b*. The chains are provided with a series of teeth **28** which protrude upwardly beyond the substantially continuous surface **18** formed by apron plates **20**. The space between tracks **25** and the adjacent edges of apron plates **20** are completely enclosed by intermediate webs **27**.

With this arrangement, each rod ring **16** which drops onto surface **18** from the overlying laying head **15** will immediately be engaged and moved towards the adjacent end of conveyor **19** by the upwardly protruding teeth **28** of chains **24**. This continuous movement of each successively deposited ring will produce the non-concentric overlapping formation shown in the drawings. The degree of overlap between each successively deposited ring will of course depend on the operation speed of the chains **24** in relation to that of laying head **15**.

As is best seen in FIGS. 1, 2 and 8, conveyor **19** is comprised basically of a plurality of laterally spaced support tracks **30**, the upper edges of which reside in a plane common to the substantially continuous surface **18**. Between tracks **30** are conveyor chains **34** provided with upwardly extending teeth **36** similar to the teeth **28** on the chains **34** running across ring receiving surface **18**. Chains **34** run between conveyor sprockets **38***a* and **38***b*, the former being positioned on the same shaft **40** as sprockets **26***b*. The operating speed of chains **34** is the same as that of chains **24**, thus providing a means for continuously transporting the rod rings **16** from ring receiving surface **18** along the entire length of conveyor **19**. The tracks **30** are supported by a longitudinally extending conveyor floor **32** which in the preferred embodiment herein disclosed, cooperates with side walls **42**, a bottom wall **44** and intermediate partitions **46** to define a series of plenum chambers A, B and C. The plenum chambers, which make up the "cooling section" of the conveyor, are each connected by means of horizontally extending ducts **48** to powerful fans **50** driven by variable speed motors **52**. Operation of fans **50** will result in a continuous supply of cooling air being forced into each of the plenum chambers A, B and C. Transverse slots collectively referred to by the reference numeral **33** in the conveyor floor **32** provide a means for allowing the cooling air to pass upwardly from the plenum chambers through floor **32** into contact with the exposed surfaces of the non-concentric overlapping rod rings being carried along the conveyor tracks **30** by the chains **34**. Thereafter, the cooling air is deflected by an overlying hood **54** to outlets **56** along the side of the conveyor. As can best be seen in FIG. 9, the arrangement of transverse slots **33** is such that full width slots **33***a* are spaced by pairs of shorter slots **33***b*, which slots are in turn spaced by still shorter slots **33***c*. This arrangement provides a greater concentration of slotted area per increment of conveyor width and thus a greater flow of air near the edges of the conveyor, where the mass flow rate of steel rod is at a maximum due to the overlapping non-concentric formation of the rod rings **16**. The net result is thus to obtain substantially uniform application of the cooling medium to all exposed surfaces of the rod.

The cooling section of conveyor **19**, which extends from the beginning of plenum chamber A to the end of plenum chamber C, encompasses the positions on the conveyor at which transformation of the austenite of all parts of the rod rings **16** will occur during cooling. In addition, the area of contact between the rod rings **16** and the support tracks **30** and the conveyor chains **34** is such as to have a negligible effect on the cooling rate of the rod as it passes over the cooling section. The cooling rate is selected with regard to the isothermal transformation diagram for the particular grade of steel being processed so as to provide the desired metallurgical properties required for subsequent cold working without an intervening patenting step. This cooling rate must be sufficiently slow to avoid the formation of quench hardened areas such as areas that contain martensite, yet sufficiently rapid to avoid the growth of undue amounts of coarse pearlite.

It will be understood that the number and size of the plenum chambers A, B, and C, the arrangement and configuration of slots **33** in upper floor **32**, and the size and capacity of the fans **50** may be varied at will to produce the desired volume of air that is to be passed over the moving rod rings as they travel continuously along conveyor **19**. It should also be understood that a cooling medium other than air may be used, and that the cooling medium may be delivered at selected temperatures above or below atmospheric temperature.

After cooling through the transformation range, the rod rings leaves the delivery end of conveyor **19** to be collected into bundles **58** by a coil collecting apparatus **60**. The bundles **58** are then transported by means of a second conventional conveyor **62** to a compacting and strapping apparatus (not shown).

It should now be apparent that several significant advantages are gained by initially depositing the rod rings **16** formed by laying head **15** onto a substantially continuous surface **18**, rather than directly onto the spaced tracks **30** of conveyor **19**. To begin with, with the present arrangement there are no open spaces for a leading rod end emerging from the laying head to pass through. Although the adjacent apron plates **20** are spaced by channels **22**, these channels are substantially filled by continuously moving chains **24**. Moreover, the bottom of each channel is fully enclosed by webs **27** abutting each side of the tracks **25**. Thus, the leading end is initially deprived of any opportunity to pass downwardly through surface **18**.

The adjacent apron plates **20** also cooperate in providing a wide area of support for the descending rings. This feature is important, particularly with the smaller diameter rods, in that it provides a means of effectively absorbing dynamic forces without the danger of individual rings sagging between widely spaced track. By the time the rings have been transported by chains **24** from their point of deposit on surface **18** to the receiving end of conveyor **19**, they have been formed correctly so that the continued support offered by the spaced tracks **30** and conveyor chains **34** will be sufficient to avoid sagging.

An alternate embodiment of the invention is shown in FIGS. 6 and 7 wherein it can be seen that a substantially continuous ring receiving surface **64** similar to that shown in detail in FIGS. 3–5 is included as an integral part of a unitized frame structure **66** pivotally supported at one end for movement about a transverse shaft **68**. The other end of frame structure **66** is supported on the vertically extensible screw **70** of a conventional power operated jack mechanism **72**. Frame structure **66** further includes spaced support tracks **74** which extend from ring receiving surface **64** to the continuing tracks **76** of the cooling conveyor. During normal operation of the mill, rod rings **16** are continuousy deposited from laying head **15** directly onto the ring receiving surface **64**, and from this point the rings are carried by means of chains **78** onto the spaced support tracks **74** and **76**. To this point, this embodiment operates much the same as the embodiment discussed earlier. However, should a malfunction occur at some point downstream from the laying head, as for example on the cooling conveyor or in the coil forming apparatus at the delivery end of the cooling conveyor, then it may be necessary to temporarily interrupt operation of the conveyor until the source of trouble can be located and remedied. When such is the case, jack mechanism **72** will immediately be activated, either by manual or automatic means, to retract screw **70** and cause frame structure **66** to pivot downwardly about shaft **68** to the position shown in FIG. 7. In this manner the vertical distance between ring receiving surface **64** and the laying head will be increased sufficiently to provide adequate clearance for the rod rings continuing to issue from the laying head as the current length of rod being rolled is completely run through.

With the cooling conveyor temporarily stopped and the frame structure **66** depressed as shown in FIG. 7, the rod rings will simply accumulate in a pile **80** on ring receiving surface **64** without fouling the laying head **15**. After having remedied the trouble which originally necessitated stoppage of the cooling conveyor, the pile **80** of rings which is fully accessible to workmen, can be easily removed and the frame structure **66** again pivoted about shaft **68** to its operative position shown in FIG. 6 in preparation for the next oncoming rod length.

It is our intention to cover all changes and modifications of the embodiments herein chosen for purposes of disclosure which do not depart from the spirit and scope of the invention as defined by the claims appended hereto.

We claim:

1. Apparatus for depositing and conveying rod rings comprising the combination of: a laying head operating in direct sequence with a rod mill to form rod issuing from said mill into a continuous series of rings; a substantially continuous stationary surface positioned beneath said laying head to receive the rings being formed thereby; an open moving conveyor adjacent said surface; and, means continuously traversing said surface for laterally moving each ring successively deposited thereon onto said conveyor, the said lateral movement resulting in the rings assuming an overlapping non-concentric relationship on said conveyor.

2. For use in direct sequence with a rolling mill, apparatus for arranging hot rolled steel rod on an open moving conveyor comprising; a flat substantially continuous stationary surface adjacent the receiving end of said conveyor; a laying head overlying said surface and spaced vertically therefrom, said laying head being operative to deposit rod issuing from said mill on said surface in a continuous succession of rings; and, ring engaging means continuously traversing said surface to move each ring deposited thereon laterally onto said conveyor, the said lateral movement resulting in successively deposited rings assuming a non-concentric overlapping relationship on said conveyor.

3. The apparatus as set forth in claim **2** wherein said ring engaging means is comprised of endless chains continuously moving across said surface towards said conveyor, each said chains having spaced teeth protruding above said surface to thus provide a means of engaging and moving rings being successively deposited thereon by said laying head.

4. The apparatus as set forth in claim **3** further characterized by said substantially continuous surface being defined by a plurality of flat plate members spaced laterally to provide elongated channels therebetween, tracks in said channels for supporting the endless chains moving across said surface, and web members extending between said tracks and the adjacent edges of said apron plates to completely enclose the bottom of each said channels.

5. Rod handling apparatus operable in direct sequence with a rod mill for arranging hot rolled steel rod in non-concentric overlapping rings on an open moving conveyor, said apparatus comprising: a laying head offset vertically above and in front of the receiving end of said conveyor, said laying head being operative to form rod issuing from said mill into a continuous series of rings; a plurality of flat apron plates forming a substantially continuous ring receiving surface beneath said laying head and directly adjacent the receiving end of said conveyor, said plates being spaced to provide channels therebetween extending across said ring receiving surface in parallel relationship to said conveyor, the width of said plates in relation to the spacing therebetween being sufficient to avoid sagging of the rings being deposited thereon by said laying head; and ring engaging means continuously running through said channels to move each ring successively deposited on said ring receiving surface laterally onto said conveyor, the operative speed of said ring engaging means in relation to that of said laying head being such as to produce the desired overlapping non-concentric arrangement of rings on said conveyor.

6. For use in direct sequence with a rolling mill, apparatus for arranging hot rolled steel rod on an open moving conveyor comprising: a support member forming a substantially continuous surface adjacent the receiving end of said conveyor; a laying head overlying said surface and spaced vertically therefrom, said laying head being operative to deposit rod issuing from said mill onto said surface in a continuous succession of rings; rings engaging means continuously traversing said surface to move each ring deposited thereon laterally onto said conveyor, the said lateral movement resulting in successive rings assuming a non-concentric overlapping relationship on said conveyor; and, elevational means operatively connected to said support member for adjusting the vertical distance between said surface and said laying head.

7. The apparatus as set forth in claim **6** further characterized by said support member being pivotally mounted at one end adjacent the receiving end of said conveyor, the said elevational means being operatively connected to said support member at the opposite end thereof, whereby operation of said elevational means will cause said support member to be pivotally adjusted relative to the said overlying laying head.

8. Apparatus for cooling hot rolled steel rod in direct sequence with a rolling mill comprising the combination of: a laying head; means for directing rod issuing from said mill to said laying head while the rod remains at an elevated temperature above the temperature of transformation of the austenite of said steel, said laying head being operable to form said rod into a continuous series of rings; a flat substantially continuous surface positioned beneath said laying head to receive the rings being formed thereby; an elongated conveyor positioned adjacent said surface, said conveyor having a plurality of laterally spaced supports; means continuously traversing said surface for moving the rings successively deposited thereon by said laying head onto the laterally spaced supports of said conveyor, thus causing the rings to assume a non-concentric overlapping relationship on said conveyor; a cooling section between the ends of said conveyor, said section encompassing the positions on said conveyor at which transformation of the austenite of all parts of said rod rings occurs during cooling, the said supports being so small in the said cooling section with respect to the dimension of contact with said rod rings as to have negligible influence on the cooling rate of said rod due to conduction of heat between said rod and said supports and negligible interference with the uniform application of a fluid coolant to the surface of said rod; means associated with said conveyor for moving said rod rings continuously through said cooling section; means for guiding and controlling the passage of a fluid coolant over substantially all parts of said rod rings while said rings are moving through said cooling section so as to produce a cooling rate in all portions of said rod due to the influence of said coolant, the result of which is to leave the rod suitable for subsequent cold working without an intervening patenting step; and means for collecting said rings into bundle form.

9. The apparatus as set forth in claim **8** further characterized by means for adjusting the vertical distance between said flat substantially continuous surface and said laying head.

References Cited

UNITED STATES PATENTS

1,295,139	2/1919	Edwards	242—79
2,753,982	7/1956	Fredrikson	198—189
3,056,433	10/1962	Haugwitz	140—2
3,103,237	9/1963	Crum	140—2

FOREIGN PATENTS

686,322	5/1964	Canada.
1,214,635	4/1966	Germany.

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U.S. Cl. X.R.

72—66, 147; 198—204; 242—82