Jan. 2, 1968 W. J. HILL ET AL 3,360,842

APPARATUS FOR COLLECTING AND DIVIDING ROD INTO BUNDLES

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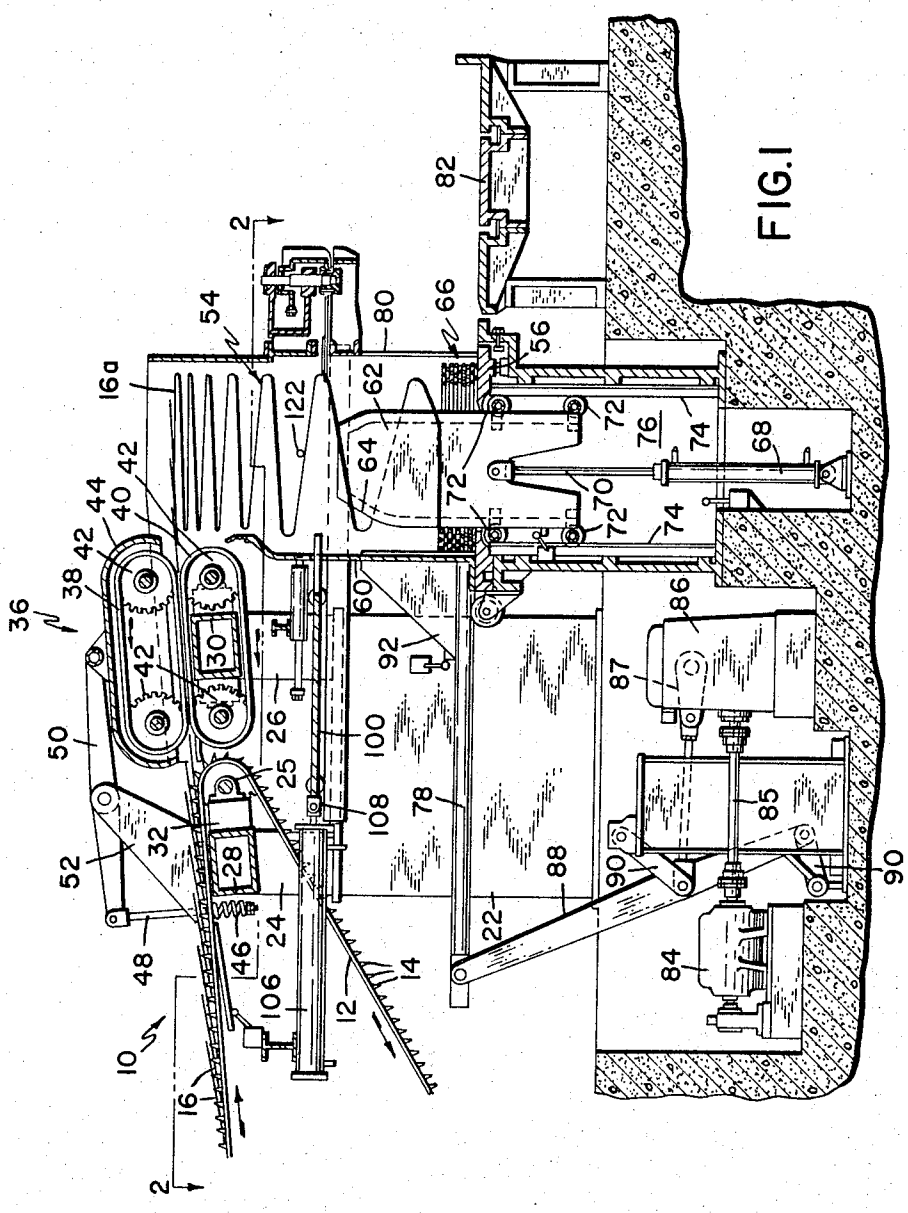

FIG. 1

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APPARATUS FOR COLLECTING AND DIVIDING ROD INTO BUNDLES

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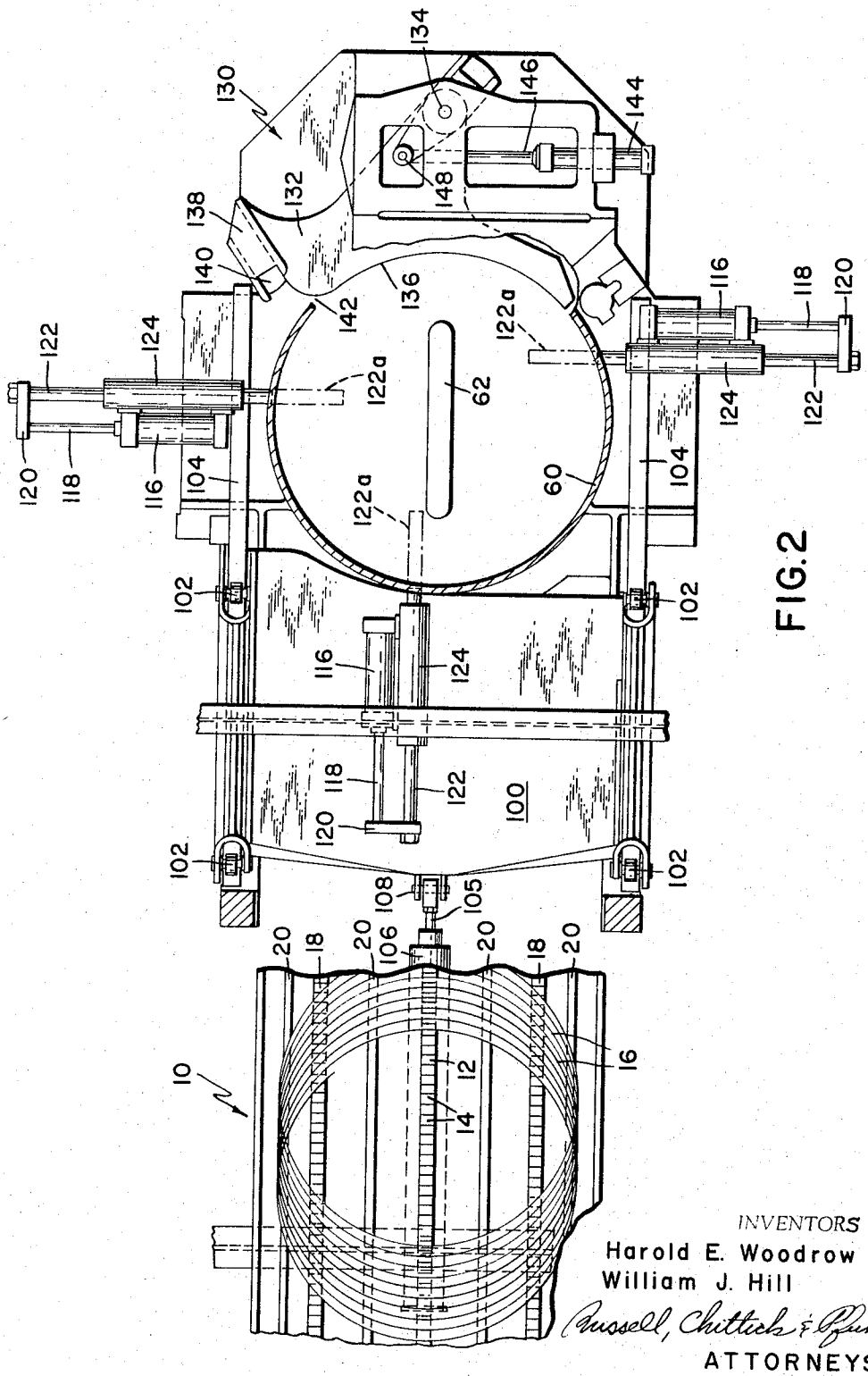

FIG.2

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APPARATUS FOR COLLECTING AND DIVIDING ROD INTO BUNDLES

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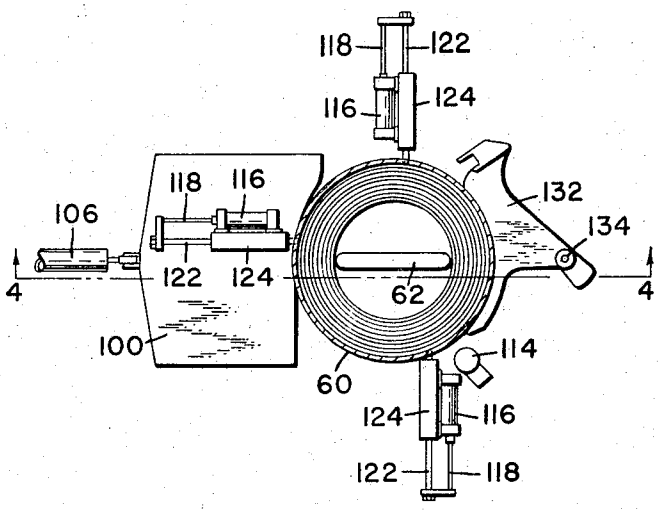

FIG.3

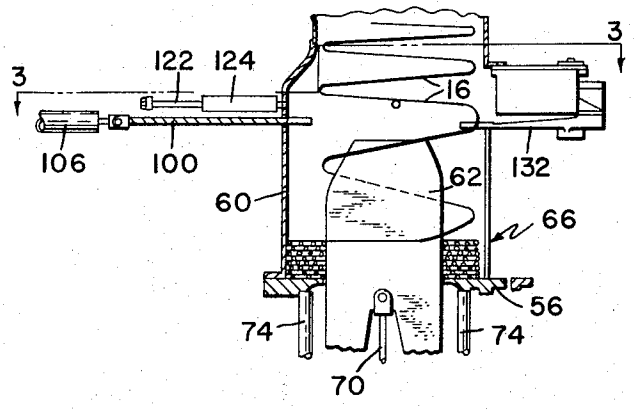

FIG.4

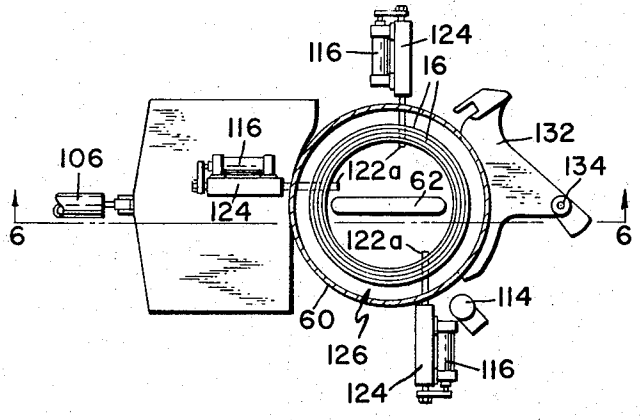

FIG.5

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APPARATUS FOR COLLECTING AND DIVIDING ROD INTO BUNDLES

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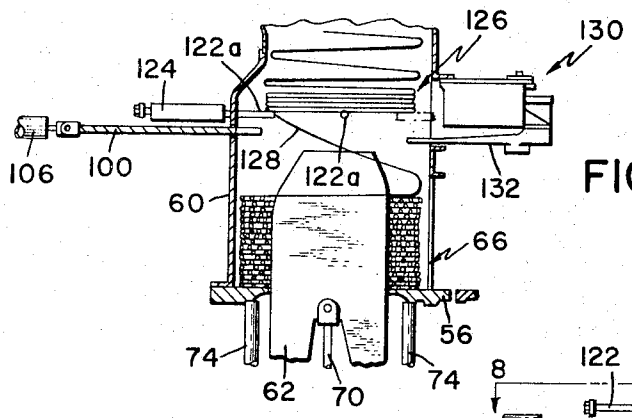

FIG.6

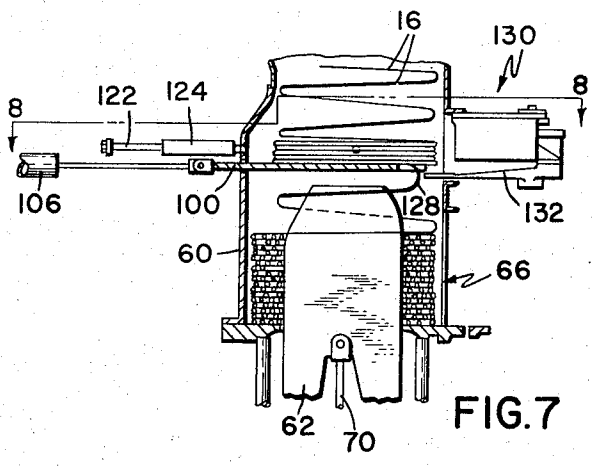

FIG.7

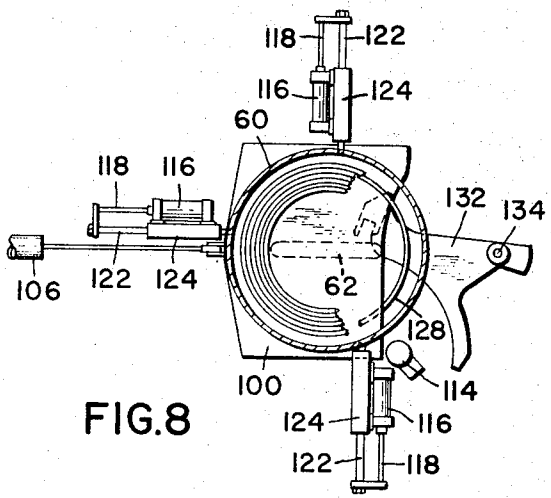

FIG.8

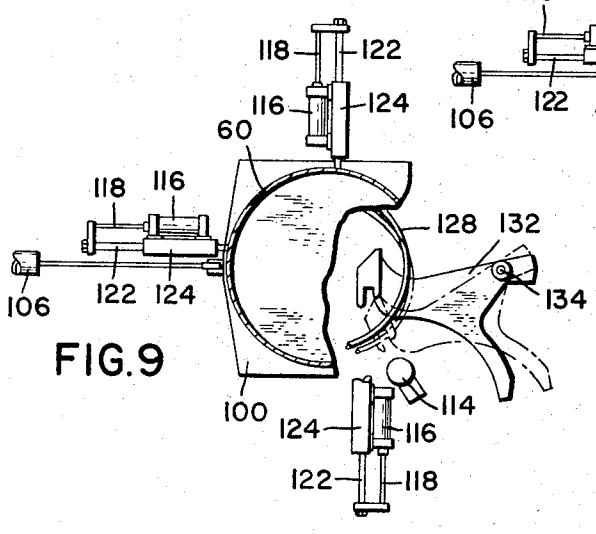

FIG.9

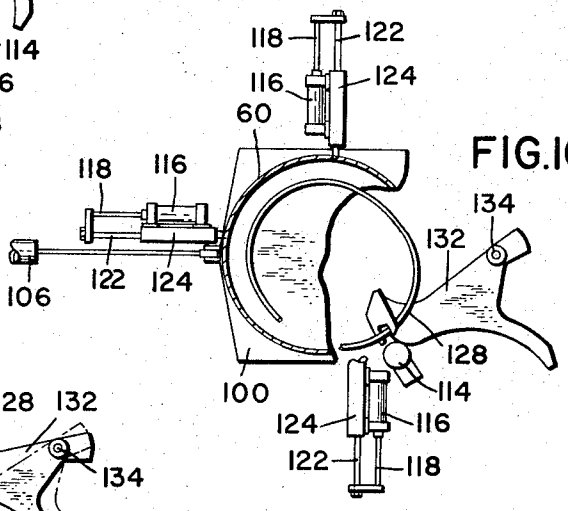

FIG.10

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APPARATUS FOR COLLECTING AND DIVIDING ROD INTO BUNDLES

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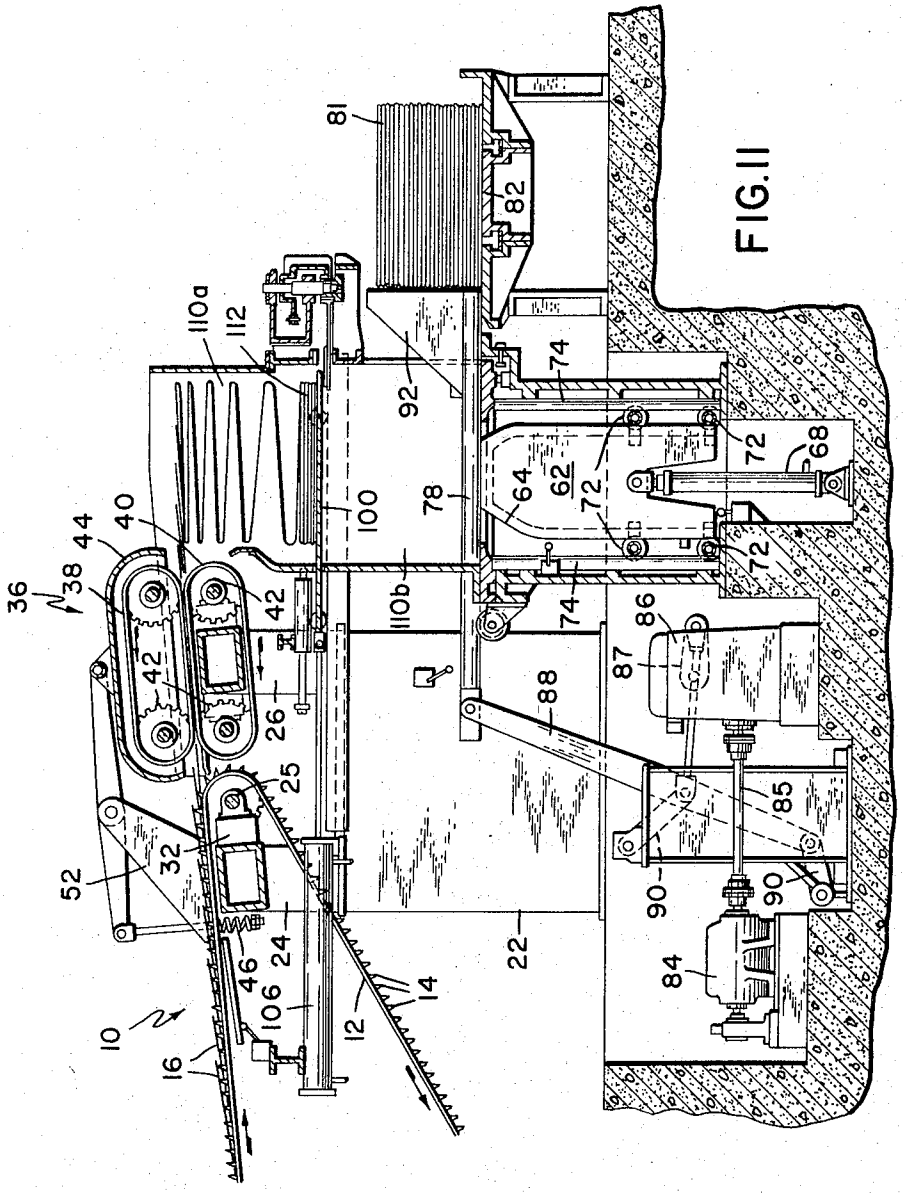
FIG. 11



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United States Patent Office 3,360,842 Patented Jan. 2, 1968

3,360,842

APPARATUS FOR COLLECTING AND DIVIDING ROD INTO BUNDLES

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Filed Sept. 29, 1965, Ser. No. 491,369
8 Claims. (Cl. 29—200)

This invention relates generally to the metal working industry and more particularly to an improved apparatus for collecting and dividing hot rolled steel rod into bundles or coils.

Recent developments in the art of rolling steel rod have shown that significant advantages may be obtained by cooling the rod at a controlled rate in direct sequence with the rolling operation prior to forming the rod into coils. The concept is fully disclosed in U.S. patent application Ser. No. 402,495, now Patent No. 3,231,432, granted Jan. 25, 1966, wherein it is shown that the rod may be initially deposited on a moving conveyor in a continuous series of overlapping non-concentric rings. The conveyor is suitably designed to permit rod cooling at a controlled rate to achieve substantially uniform predetermined metallurgical properties over the entire length of the rod. Once the rod has been cooled in the desired manner, it is taken from the delivery end of the conveyor and thereafter formed into coils of preselected weight.

A coil forming apparatus which has heretofore been designed to receive cooled rod from a conveyor of the above mentioned type is described in U.S. Patent No. 3,176,385. The construction of this apparatus is such that after one coil had been formed on an underlying collecting table, the initial rings of the next coil will be collected for a short time by a temporary support plate which is adapted to be advanced to an operative position overlying the completed coil. As soon as the collecting table has been cleared of the first completed coil, the temporary support plate is withdrawn, thus permitting the rings accumulated thereon to fall by gravity to the collecting table where the coiling operation is continued.

Although the above-described apparatus had proved generally satisfactory in operation, experience now indicates that under certain circumstances where the support plate must of necessity be made of a heavier construction, it may not be possible due to increased inertia to advance the plate to its operative position overlying the completed coil with sufficient speed to avoid damaging contact with the descending rod rings of the next coil. This is primarily because a heavier support plate cannot undergo rapid acceleration followed by sudden deceleration without damaging other components such as the cylinders used to advance and retract the plate. It is therefore an object of the present invention to provide means for temporarily arresting the downward descent of rod rings for a brief period during which the support plate may be advanced at a slower rate to its operative position overlying the completed coil.

This is accomplished by providing a plurality of relatively small diameter fast-acting retaining pins arranged in a radially disposed manner surrounding the path of descent of the rod rings at a level slightly above that of the support plate. When advanced to their inwardly extending operative positions, the pins prevent further descent of rod rings across the path of the support plate, thus permitting the plate to be advanced to its operative position at a slower rate. Because of the fast operation of the pins which is in turn made possible by their relatively light-weight construction, any damage to the descending rod rings which might otherwsie be caused by contact

with the slower moving heavy support plate is effectively obviated. Moreover, by advancing the support plate at a slower rate, damage to the means utilized for advancing and retracting the plate is prevented by avoiding rapid deceleration. With the support plate safely advanced, the retaining pins are immediately withdrawn to allow rod rings of the next coil to temporarily accumulate thereon while the underlying coil collecting table is cleared of the completed coil.

It should also be noted that under certain operating conditions where the weight of a billet originally introduced into the mill exceeds that of the coils being formed, provisions must also be made for separating each completed coil from the continuous length of rod being rolled. For example, if rod is being rolled from a 1200 pound billet, it might be desirable to collect the rolled rod into four coils of 300 pounds each. Under such conditions, after the support plate had been advanced to its operative position, the underlying completed coil will be connected to the rings of the next coil being temporarily deposited on the plate by a single strand. Means must therefore be provided for shearing this strand prior to clearing the completed coil from the coil collecting table. It is heretofore been proposed that this strand be carried into the operative range of a suitably positioned shear by the forward edge of the support plate. It is a further object of the present invention to improve this arrangement by providing additional means operating in conjunction with the forward edge of the support plate for positively carrying the rod strand directly into the jaws of the shear. In this manner, effective separation of the completed coil on the coil collecting table from the rings of the next coil being collected on the support plate will always be assured prior to removal of the completed coil from the apparatus.

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 vertical sectional view of a coil collecting and dividing apparatus embodying the concepts of the present invention;

FIG. 2 is a horizontal sectional view on an enlarged scale taken along line 2—2 of FIG. 1;

FIG. 3 is a schematic illustration similar to FIG. 2 on a reduced scale taken along line 3—3 of FIG. 4 showing the support plate and retaining pins withdrawn and rod rings descending onto the underlying coil collecting table;

FIG. 4 is a vertical sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a view similar to FIG. 3 with the retaining pins advanced to their operative position;

FIG. 6 is a vertical sectional view taken along line 6—6 of FIG. 5;

FIG. 7 is a vertical sectional view similar to FIG. 6 showing the support plate fully advanced and the retaining pins withdrawn;

FIG. 8 is a horizontal sectional view taken along line 8—8 of FIG. 7 showing the strand positioning arm being pivotally advanced beneath the support plate;

FIG. 9 is a view similar to FIG. 8 showing the movement of the strand positioning arm in relation to the rod strand connecting the completed coil on the coil collecting table to the rod rings temporarily being accumulated on the support table;

FIG. 10 is a view similar to FIGS. 8 and 9 showing the connecting strand being carried into the jaws of an appropriately positioned shear; and,

FIG. 11 is a view similar to FIG. 1 showing the support plate advanced to interrupt further descent of rod rings onto the coil collecting table and the pusher mecha-

nism activated to move the completed coil onto an adjacent conveyor.

Referring initially to FIGS. 1 and 2 wherein are best shown general features of the invention, there is provided a steadily moving conveyor generally indicated at **10** comprising a driven chain **12** having a series of upwardly extending teeth **14** of such height that they will effectively engage non-concentric overlapping rod rings **16** being carried by the conveyor. It is to be understood that the rod rings **16** have previously been deposited on the opposite end of the conveyor by a laying head (not shown). The rod rings receive support from conveying chains **18** and stationary tracks **20** with together provide adequate support for the rings so that sagging will be prevented without adversely affecting the desired exposure of the rings to the cooling medium.

A supporting structure generally indicated at **22** includes suitably spaced uprights **24** and **26** on either side of the conveyor **10**, which uprights in turn carry transverse beams **28** and **30**. Beam **28** has secured thereto a bearing support **32** carrying a transverse shaft to which are affixed sprockets **25** for chains **12** and **18**. In addition, transverse beams **28** and **30** support a tractor chain assembly generally indicated by the reference numeral **36**. The tractor chain assembly includes two endless chains **38** and **40** carried by sprockets **42** beneath a protective hood **44**. The lower chain **40** is driven by conventional means (not shown) and the upper chain **38** is urged downwardly into contact with the lower chain **40** by means of springs **46** on either side of the conveyor **10**. The springs **46** act through rods **48** and pivotal arms **50** mounted on upstanding supports **52** extending upwardly from transverse beam **28**.

As the rod rings leave conveyor **10**, they are gripped between tractor chains **38** and **42** which in the usual case are driven at a speed slightly greater than that of the conveyor. This results in the rings being accelerated while being held in substantially horizontal plane until finally released from engagement by the tractor chain unit **36** as indicated by rings **16***a*. Thereafter as gravity becomes effective, the falling rings **16** stretch into a helical arrangement as indicatde generally at **54** in FIG. 1 until they are deposited at random on an underlying coil collecting table **56**.

In order that the rings **16** may be properly guided in their downward travel to coil collecting table **56**, the aparauts is further provided with a generally cylindrical wall member **60** and a vertically movable interior guide member **62**. The purpose of guide member **62** is to cooperate with wall **60** in controlling the random deposit of rings **16** on table **56** so as to provide a completed coil of the desired dimension. More particularly, as each ring drops, it will be engaged by one edge **64** of guide member **62**. By properly controlling the distance between edge **64** and the adjacent inner cylindrical surface of wall member **60**, the radial thickness of the coil being produced will be controlled.

Guide member **62** is actuated by a double acting cylinder **68** which acts to drive piston **70** down and up as required. Member **62** is guided during this vertical travel by grooved rollers **72** which roll on fixed vertical guide posts **74**. When the coil **66** accumulating on coil collecting table **56** has achieved the proper size, it is cleared from the apparatus by first lowering guide member **62** into well **76** through suitable actuation of cylinder **68**. As soon as the guide members **62** are below the level of table **56**, a pusher arm **78** is operated to slide the completed coil horizontally out through an opening **80** in wall **60** to a position indicated at **81** (see FIG. 11) on conveyor **82**. The pusher arm **78** is actuated by means of a motor **84** acting through a shaft **85** and gear box **86** to cause a single revolution of crank arm **87**. This in turn results in the lever **88** mounted on swing links **90** being pulled from the position of FIG. 1 to that of FIG. 11. Lever **88** is connected to pusher arm **78**, the latter having on its end a vertical plate **92** which moves through a slot in wall

member **60** to contact and move completed coils on coil collecting table **56** out through opening **80** onto conveyor **82**. Once this has been accomplished, the pusher arm is retracted and the guide member **62** raised to its operative position. The apparatus is then again ready to resume formation of another coil on coil collecting table **56**.

An intermediate support plate is shown at **100** lying in a plane spaced vertically above the top of guide member **62**. The support plate is provided with wheels **102** arranged to run along horizontal support tracks **104** extending in parallel relationship along opposite side of cylindrical wall member **60**. The piston rod **105** of a double acting cylinder **106** is pivotally attached to the rear edge of plate **100** as at **108** to thus provide a means of advancing plate **100** along tracks **104** to an operative position as shown in FIG. 11 overlying coil collecting table **56** and thereafter, to withdraw the plate back to its inoperative position as shown in FIGS. 1 and 2.

As can be best seen in FIG. 11, advancement of the support plate **100** to its operative position overlying coil collecting table **56** will result in the interior of cylindrical wall member **60** being divided into upper and lower chambers **110***a* and **110***b*. Once this has been accomplished, any rod rings subsequently issuing from tractor chain assembly **36** will be temporarily collected in chamber **110***a* on the upper surface of the plate as at **112**, thus allowing sufficient time for the lower chamber **110***b* to be cleared of the completed coil.

As previously mentioned during normal operation of the apparatus there are two different circumstances which will require advancement of plate **100** to its operative position. First, there is the situation where the weight of the coil being formed is equal to that of the billet being rolled by the mill. Where this is the case, support plate **100** will be advanced after all of the rod rings formed from one billet have been deposited in coil form on coil collecting table **56** and prior to the arrival of rings from the next billet. This is by far the simplest situation since the normal interval between billets provides ample time for the plate to be advanced to its operative position without contacting a continuous series of descending rings. Moreover, since all of the rings from one billet are formed into a single coil, there is no need for a shearing operation prior to removing the completed coil from the apparatus.

The second and more complicated circumstance during which use of support plate **100** is required occurs when the completed coil on coil collecting table **56** weighs less than the billet originally introduced into the mill. Where this is the case, the completed coil must first be divided from the rod continuing to issue from the mill by advancement of support plate **100**. Once this has been accomplished, a shearing operation is then carried out to separate the coil from rings piling up on the plate. However, if the weight of plate **100** precludes fast movement across the path of the continuously descending rings, several rings may be pushed into the jaws of the shear **114** located on one side of wall member **60**. Should this occur, the shear may be jammed.

To avoid this difficulty, the present invention contemplates the positioning of a plurality of fast acting cylinders **116** spaced around the circumference of wall member **60** at a level slightly above that of the intermediate support plate **100**. Each cylinder **116** is provided with a piston rod **118** connected by means of a laterally extending bracket **120** to a relatively small diameter retaining pin **122** which is in turn slidably contained within an adjacent cylindrical housing **124**. By extending piston rods **118**, the pins **122** will be placed in the retracted position as indicated in FIG. 2. However, by retracting piston rods **118**, each pin **122** will be axially advanced through appropriately positioned apertures in wall member **60** to operative positions indicated at **122***a* extending across the path of the descending rod rings **16**. In this manner, further descent of rod rings across the path of advancing plate **100** will be temporarily prevented and the danger

of the plate engaging a number of rings thus avoided.

To further illustrate the above, reference will now be made to FIGS. 3 to 7 wherein this sequence of operation is illustrated diagrammatically. In FIGS. 3 and 4, the intermediate support plate **100** and the retaining pins **122** are in the withdrawn position, thus allowing rod rings **16** to descend in a helical fashion over guide member **62** where they are eventually collected in a growing coil **66** on table **56**. When coil **66** has attained the desired weight, cylinders **116** are actuated to retract piston rods **118** and thus advance retaining pins **122** to operative positions extending across the path of the descending rings **16** as indicated at **122***a* in FIGS. 5 and 6. Thereafter, rings begin to accumulate on the advanced pins as at **126**. Moreover, as can be best seen in FIG. 6, the rings at **126** are now connected to the completed coil **66** by a single strand **128** which spirals downwardly across the path of support plate **100**. Support plate **100** is then advanced to its operative position as shown in FIG. 7 by actuation of cylinder **106**, thus carrying strand **128** to the right towards the general vicinity of shear **114**. Once this has been accomplished, the cylinders **116** are again actuated to retract retaining pins **122** and thus allow the rings temporarily supported thereon at **126** to drop onto plate **100** where they will remain until the completed coil **66** has been cleared from coil collecting table **56**. It can therefore be seen that by temporarily withholding the rings at **126** above the path of the advancing plate **100**, inadvertent engagement of a plurality of rings by the forward edge of the plate is avoided, in spite of the fact that the plate may be advancing at a relatively slow rate due to limitations imposed by its inherent inertia.

Following advancement of plate **100** to its operative position and retraction of pins **122**, the connecting strand **128** must then be severed prior to clearing the completed coil **66** from the apparatus. To this end, a strand positioning device generally indicated by the reference numeral **130** is provided to positively carry strand **128** directly into the jaws of shear **114**. As can be best seen in FIG. 2, strand positioning device **130** is comprised of a positioning arm **132** mounted for pivotal movement about point **134**. The positioning arm is provided with a curved edge **136** corresponding to the curvature of wall member **60** which edge terminates at one end in a somewhat hook-shaped attachment **138** which is provided with a strand retaining recess as at **140**.

The positioning arm **132** is positioned adjacent a slot **142** in wall member **60** which slot is substantially closed by curved edge **136** when the arm is in its inoperative position as shown in FIG. 2. In this manner, the possibility of a rod leading end becoming inadvertently lodged in slot **142** as rod is fed into the apparatus is effectively avoided. Positioning arm **132** is pivoted about point **134** by means of a double acting cylinder **144** provided with a piston rod **146** which is pivotally connected to the arm as at **148**.

The sequence of operation followed in severing strand **128** will now be described with particular reference to FIGS. 8 to 10. Following advancement of support plate **100** to its operative position as indicated diagrammatically in FIG. 7, cylinder **144** is actuated to retract piston rod **146** and thus cause arm **132** to pivot about point **134** in a counterclockwise direction. As illustrated in FIG. 8, as arm **132** begins to pivot about point **134**, hook-shaped attachment **138** will pass beneath strand **128**, the strand now being engaged by curved edge **136**. As shown in FIG. 9, continued pivotal movement of arm **132** in a counterclockwise direction about point **134** will cause strand **128** to slide along curved edge **136** until it is engaged by the hooked shaped attachment **138**. At this point, the strand is positively engaged and as shown in FIG. 9, carried into the jaws of shear **134** where it is severed in a conventional manner.

Following the shearing operation cylinder **144** is again actuated to extend piston rod **146** and thus pivot arm **132** in a clockwise direction about point **134** to its inoperative position as shown in FIG. 2. In so doing, the curved edge **136** of arm **132** will again close slot **142** and thus effectively eject any rod portion which might have been drawn into the slot during the shearing operation. With strand **128** sheared, the completed coil **66** is then cleared from the coil collecting table **56** in the manner previously described by lowering guide member **62** and actuating pusher arm **78**. Following the coil clearing operation, support plate **100** is withdrawn, thus depositing the rings temporarily collected thereon on the collecting table **56**.

Having thus described the invention from both a structural and operational standpoint, the novel and inventive features incorporated therein will now be briefly reviewed.

By providing means above the path of advancing plate **100** in the form of fast acting retractable retaining pins **122**, it is now possible to utilize a heavier support plate without regard for the problems which might otherwise be present as a result of its increased inertia. As soon as the retaining pins are advanced, further descent of rod rings is immediately interrupted, thus providing an opportunity for the support plate to be advanced at a relatively slow rate while carrying a single connecting strand **128** into the operative range of strand positioning arm **132**. The pins may then be retracted to deposit the few rings collected thereon onto the plate. In this manner, the danger of the forward edge of plate **100** contacting more than one descending ring is avoided without decreasing the effectiveness of the apparatus.

In addition to the above, by providing means in the form of pivotal strand positioning arm **132** for positively carrying strand **128** directly into the jaws of shear **114**, the dependability of the shearing operation is markedly increased. This two step operation which initially entails carrying strand **128** into the general operative range of arm **132** by advancing plate **100** and thereafter actuating the strand positioning device **130** to carry strand **128** directly into the jaws of shear **114** obviates any chance of a malfunction which would prevent subsequent clearing of the completed coil **66** from the apparatus.

It is our intention to cover all changes and modifications of the embodiment herein chosen for purposes of disclosure which do not depart from the spirit and scope of the invention.

We claim:

1. For use with a conveyor carrying a continuous succession of non-concentric overlaping rod rings, means for collecting said rings into coils of predetermined weight comprising: a coil forming device adjacent the delivery end of said conveyor, said device including an underlying collecting table onto which said rings are accumulated in coil form as they drop from said conveyor; a shear located adjacent the path of said descending rings between the collecting table and the delivery end of said conveyor; dividing means for temporarily interrupting the further descent of rod rings onto said collecting table when a completed coil has been formed thereon, whereby subsequent rings dropping from said conveyor will be temporarily supported by said dividing means above said collecting table with the lowermost ring on said dividing means being connected to the last deposited ring of said completed coil by a single strand, the said dividing means also being operative to locate said strand in an area adjacent to said shear; strand positioning means for mechanically engaging and carrying said strand into the operative range of said shear, whereby subsequent actuation of said shear will cause the strand to be severed, thus separating the rings temporarily being collected on said dividing means from the coil on said collecting table; and, means for removing said coil from said collecting table, whereby the rings which had previously been accumulated on said dividing means may thereafter be allowed to fall to said collecting table for continued assembly of the next coil.

2. The apparatus as set forth in claim **1** wherein said

dividing means includes a plurality of retaining pins having actuating means connected thereto to advance said pins into operative positions extending across the path of said descending rod rings.

3. The apparatus as set forth in claim 2 further characterized by said dividing means including an intermediate support plate lying in a substantially horizontal plane below the level of said retaining pins, and actuating means for advancing said plate to an operative position overlying said coil collecting table following the advancement of said retaining pins, the forward edge of said plate being in contract with said strand to locate said strand adjacent said shear, whereby said pins may thereafter be retracted to allow the rings held thereby and any subsequent rings coming from said conveyor to fall to a temporarily supported position on said plate.

4. Apparatus for collecting and subdividing a continuous series of descending rod rings into coils of predetermined weight comprising: a coil collecting table onto which said rings are accumulated in coil form; a shear positioned adjacent the path of said descending rings and above said collecting table; dividing means above said shear for temporarily interrupting the further descent of rod rings onto said collecting table when a completed coil has been formed thereon, whereby subsequent rings are being accumulated by said dividing means will be connected to the completed coil on said coil collecting table by a single strand, the said dividing means also being operative to locate said strand in an area adjacent said shear; strand positioning means cooperating with said dividing means to mechanically engage and carry said strand into the operative range of said shear, whereby subsequent actuation of said shear will cause said strand to be severed, thus separating the rings temporarily being accumulated by said dividing means from the coil on said collecting table; and, means for removing said coil from said collecting table, whereby the rings which had previously been accumulated by said dividing means may thereafter be allowed to fall to said collecting table for continued assembly of the next coil.

5. The apparatus as claimed in claim 4 further characterized by said strand positioning means comprising a pivotal arm provided at one end with a generally hook-shaped attachment forming a strand retaining recess into which said strand is located during pivotal movement of said arm relative to said dividing means, the said attachment being suitably adapted to locate said strand within the operative range of said shear.

6. For use with a conveyor carrying a continuous succession of non-concentric overlapping rod rings, means for collecting said rings into completed coils comprising: a coil forming device adjacent the delivery end of said conveyor, said device including an underlying collecting table onto which said rings are accumulated in coil form as they drop from said conveyor; a shear located adjacent the path of said descending rings between the collecting table and the delivery end of said conveyor; dividing means for temporarily interrupting the further descent of rod rings onto said collecting table when a coil of predetermined weight has been formed thereon, said dividing means including a plurality of retaining pins having actuating means connected thereto to advance the pins into operative positions extending across the path of said descending rod rings, and an intermediate support plate lying in a substantially horizontal plane below the level of said retaining pins, said support plate being adapted for advancement to an operative position overlying said coil collecting table following the advancement of said retaining pins, whereby said pins may thereafter be retracted to allow the rings held thereby and any subsequent rings coming from said conveyor to fall to a temporarily supported position on said plate, the rings on said plate being connected to the last deposited ring of the completed coil on said coil collecting table by a single strand which strand is supported by the forward edge of said support plate; strand positioning means including a pivotal arm operating in a substantially horizontal plane below said plate to positively engage and carry said connecting strand into the operative range of said shear, whereby subsequent actuation of said shear will cause said strand to be severed, thus separating the rings temporarily being accumulated by said dividing means from the completed coil on said coil collecting table; and means for removing said coil from said coil collecting table, whereby subsequent retraction of said support plate will cause the rings temporarily supported thereon to fall to said collecting table for continued assembly of the next coil.

7. Apparatus for collecting and subdividing a continuous series of descending rod rings into coils comprising: a coil collecting table onto which said rings descend to accumulate in coil form; dividing means above said table for temporarily interrupting the further descent of rod rings onto said table when a completed coil has been formed thereon, said dividing means including a plurality of retaining pins having actuating means connected thereto to advance said pins to operative positions extending across the path of said descending rod rings; an intermediate support plate lying in a substantially horizontal plane below the level of said retaining pins, said support plate being adapted for advancement to an operative position overlying said coil collecting table following the advancement of said retaining pins, whereby said pins may thereafter be retracted to allow the rings held thereon and any subsequent descending rings to fall to a temporarily supported position on said plate; and means for removing the completed coil from said coil collecting table while said support plate remains operatively positioned, whereby subsequent retraction of said support plate will cause the rings temporarily supported thereon to fall to said collecting table for continued assembly of the next coil.

8. The apparatus as set forth in claim 7 further characterized by a shear located adjacent to the path of said descending rings at the approximate level of said intermediate support plate, whereby any rod portion contacted by said support plate during the advancement thereof will be pushed to an area adjacent said shear; and strand positioning means for mechanically engaging and carrying said strand portion into the operative range of said shear, whereby subsequet actuation of said shear will cause said strand to be severed, thus separating the ring temporarily being accumulated on said support plate from the coil on said coil collecting table.

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THOMAS H. EAGER, *Primary Examiner.*