May 24, 1960 J. W. O'BRIEN 2,937,821

APPARATUS FOR COILING STRIP MATERIAL

Filed Sept. 12, 1955 4 Sheets-Sheet 1

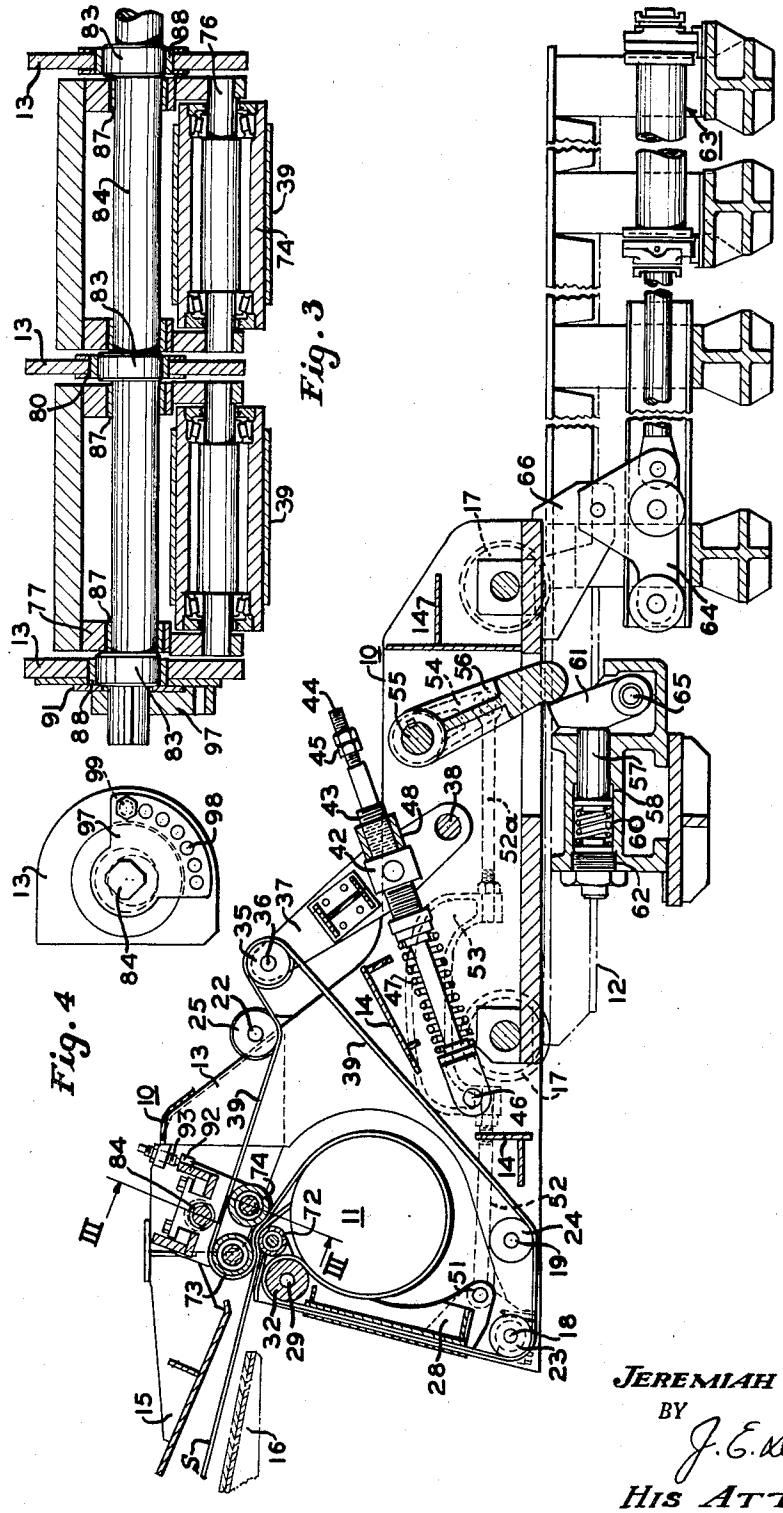


Fig. 1

Fig. 3

Fig. 4

INVENTOR.
JEREMIAH W. O'BRIEN
BY J. E. Dickinson
HIS ATTORNEY

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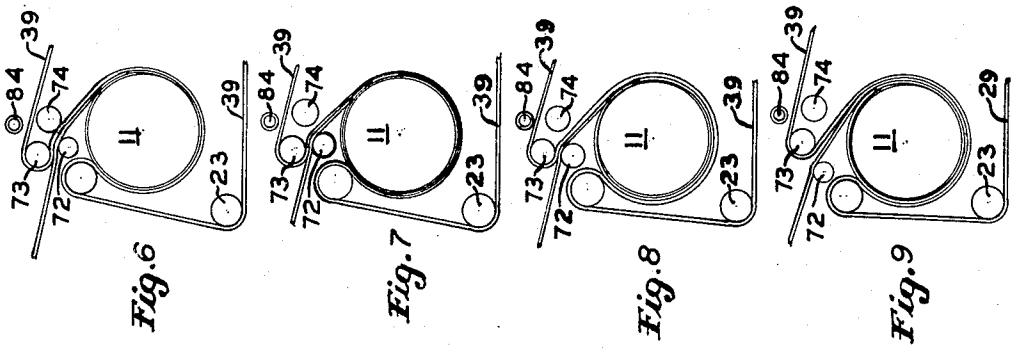


Fig. 6 Fig. 7 Fig. 8 Fig. 9

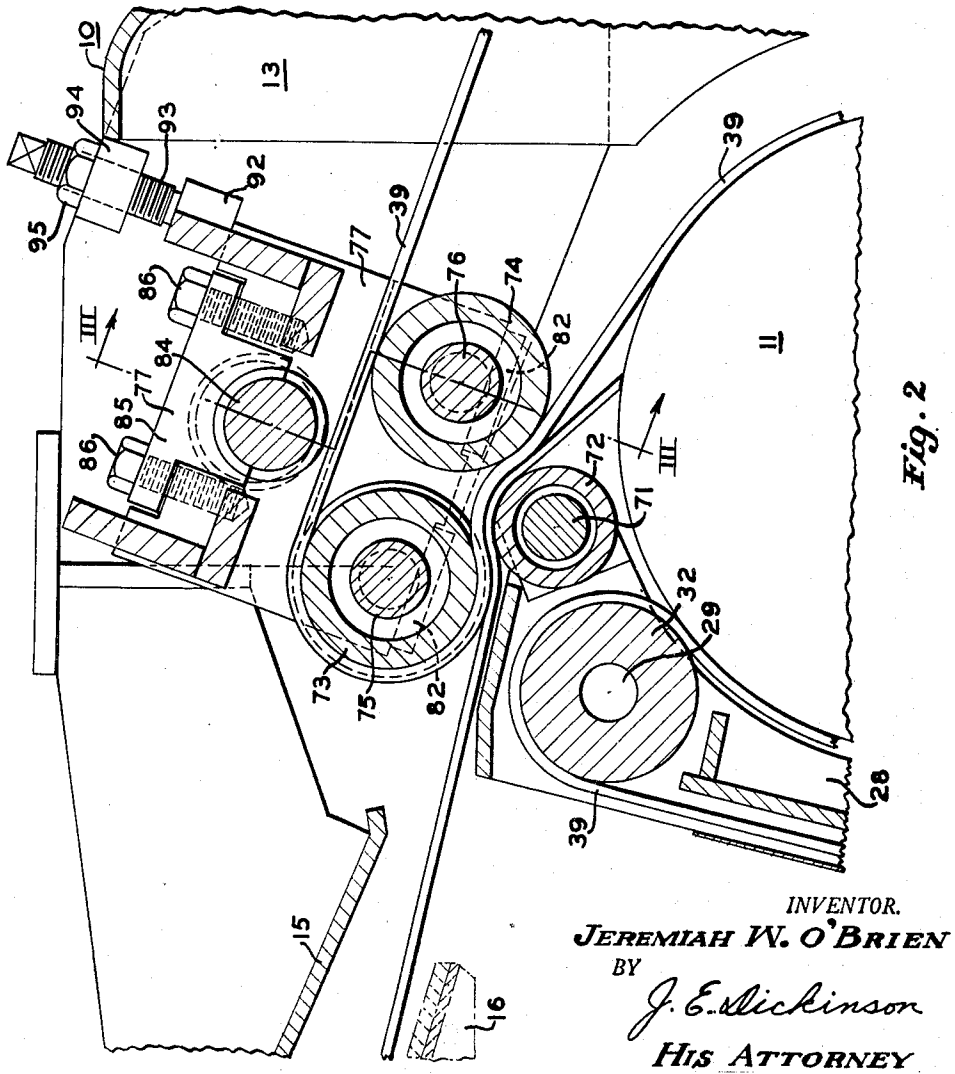


Fig. 2

INVENTOR.
JEREMIAH W. O'BRIEN
BY
J. E. Dickinson
HIS ATTORNEY

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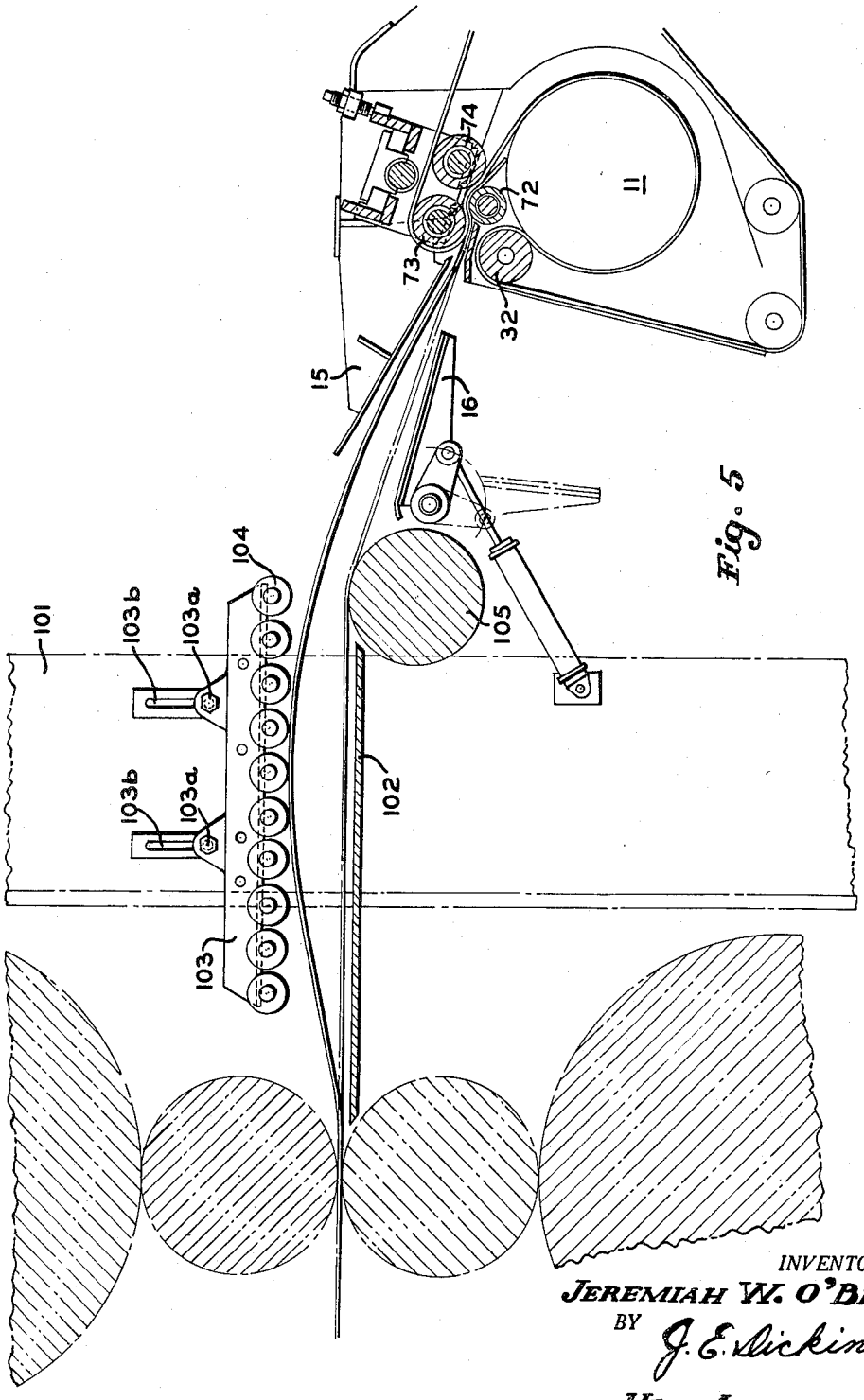


Fig. 5

INVENTOR.
JEREMIAH W. O'BRIEN
BY J. E. Dickinson
HIS ATTORNEY

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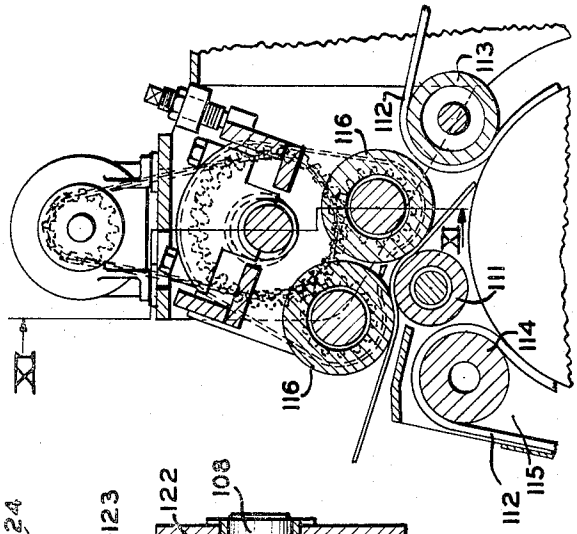


Fig. 10

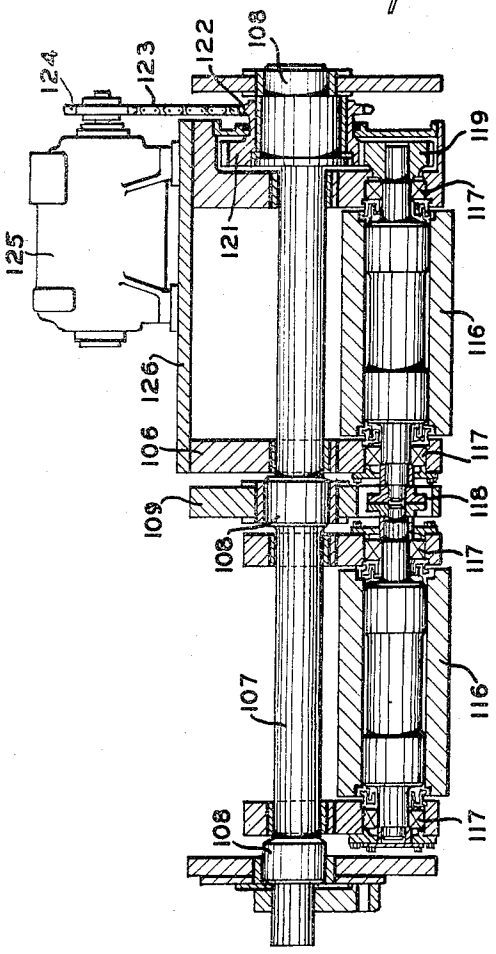


Fig. 11

INVENTOR.
JEREMIAH W. O'BRIEN
BY J. E. Dickinson
HIS ATTORNEY

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2,937,821

APPARATUS FOR COILING STRIP MATERIAL

Jeremiah W. O'Brien, Pleasant Hills, Pa., assignor to United Engineering and Foundry Company, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Sept. 12, 1955, Ser. No. 533,709

7 Claims. (Cl. 242—78.5)

This invention relates to apparatus for coiling strip material and in particular to an improvement in belt wrapping apparatus adapted to be employed in combination with a reel for coiling metallic strip such as steel or aluminum having a relatively heavy gauge.

Belt wrapping apparatus employed presently for coiling metallic strip is adapted to be brought into cooperative relationship with a driven reel whereby one or more of the continuous flexible belts carried thereby encompass a considerable arc of the periphery of the reel so that material fed between the belt wrapper and the reel is restrained to pass around and wrap itself upon the reel. As soon as the strip has lapped itself one or more times upon the reel, the belt wrapper is no longer necessary for coiling and it is withdrawn to its inoperative position. The use of such a coiling arrangement has proved itself to be satisfactory in the coiling of thin gauge strip of the order of from .008 to .085 inch. However, when heavier gauge strip is to be coiled, it is soon discovered that a belt wrapper as normally employed can not perform the coiling operation since the belts do not have sufficient rigidity to bend the leading end of the strip to permit the strip to be coiled upon the reel.

It is, therefore, an object of this present invention to provide a belt wrapper and reel combination in which means are included in the form of a plurality of bending rolls arranged in cooperative relationship with the belts of the strip coiling device to effectively coil heavy gauge strip material upon the reel.

It is another object of this invention to provide means for pre-bending the end of the strip as it is fed to the reel and immediately prior to its making contact with the belts of the belt wrapper.

It is a still further object of this invention to provide an improved belt wrapper including a set of strip bending rolls positioned to receive the leading end of a strip being fed to a reel for coiling thereon which are adapted to pre-bend the strip for a portion of its length at the leading end in an arc of substantially the same diameter of the reel whereby the belts will guide the strip around the reel for effective coiling of the material thereon.

It is another object of this invention to provide means for adjusting the working zone of the bending rolls and also to provide an efficient, positive means for bringing the rollers into and out of their operative nested relationship.

These objects, as well as the various other novel features and advantages of the invention disclosed herein, will become apparent from the following description and accompanying drawings of which:

Fig. 1 is a sectional elevation view showing a belt wrapper, incorporating the features of the invention herein defined, in its reel-engaging coiling position;

Fig. 2 is an enlarged view, partially in section, of the bending roller assembly as shown in Fig. 1;

Fig. 3 is a partial sectional view taken on lines III—III of Fig. 2;

Fig. 4 is an end view of the mechanism for locking in position the rollers shown in Fig. 3;

Fig. 5 is a partial sectional view of a mill and strip wrapper-reel combination including guides for directing the strip from the mill into the strip wrapper;

Figs. 6, 7, 8 and 9 represent a series of schematic views showing the relative movement of the bending rollers as they are retracted from their operative to their inoperative positions;

Fig. 10 is a partial sectional view of a modified form of apparatus embodying the features of the invention;

Fig. 11 is a sectional view taken on the lines XI—XI of Fig. 10.

With reference, in particular, to apparatus embodying the features of the present invention as shown in the Fig. 1, there is a belt wrapper assembly **10** shown in engagement with a reel **11** for assisting in coiling a strip S thereon. As is the practice where a belt wrapper is employed in combination with a reel, the reel is driven by a motor connected thereto which may be an electric motor or the like as is customarily used for the purpose. The belt wrapper assembly is mounted upon a pair of parallel tracks **12** to permit movement of the assembly into and out of its reel engaging position.

The belt wrapper consists of four vertically disposed parallel side frames **13**, having a C-shaped throat at one end, firmly secured together by necessary traverse cross-supports **14** to form a unitary structure and to the bottom portion of the frames there are secured two pairs of spaced flanged wheels **17** adapted to be moved along the tracks **12**. Guides **15** and **16** are attached to the frames and extend forward toward a mill or other feeding device to direct the strip S along a restricted path for engagement with the belt wrapper and coiling on the reel. Secured between the frames **13** there is a plurality of split stationary shafts **18**, **19** and **22** on which there is rotatably mounted a plurality of split rollers **23**, **24** and **25**, the rollers and shafts being divided in three adjacent sections for accommodating three separate continuous belts. Pivotally mounted at the ends of the shaft **18** there is an arm **28** which carries at its outward end a shaft **29** having rotatably mounted thereon a split roller **32**. A similar roller **35** is rotatably mounted on a shaft **36** secured to the end of symmetrical arms **37** which are pivotally mounted at their opposite ends on a shaft **38** supported in the frames **13**.

For engaging the strip and leading it around and for wrapping onto the reel there are three continuous belts **39** which are passed over the supporting rollers **23**, **24**, **25**, **32** and **35**. Intermediate the ends of and pivotally mounted between the arms **37** there are three pairs of trunnion nuts **42** which are threadably engaged by hollow sleeves **43** through which pass corresponding pairs of threaded rods **44** having adjusting nuts **45** at their outer ends and pivotally mounted at their lower ends upon a common shaft **46** supported between the side frames **13**. A plurality of compression springs **47** encircle the rods **44** and are interposed between the pivot point of rods **44** and the threaded sleeves **43**. The purpose of the springs is constantly to urge the pivoted arms **37** to the right for maintaining the belts taut. Lock nuts **48** are threadably engaged with the sleeves **43** at their outer ends and are adapted to be tightened against the trunnion nuts **42** after the sleeves **43** have been adjusted to attain the desired compression in the springs.

Adjacent to the pivoted lowered ends of the arms **28** there are inwardly extending projections **51** to which the outer ends of rods **52** are pinned. The rods **52**, at their opposite ends, are secured to a C-shaped element **53** so formed as to avoid interfering with the forward wheels **17**. Rods **52***a*, similar to rods **52**, are connected to the

C-shaped elements 53 and to the lower end of downwardly extending arms 54 which are keyed to a shaft 55 supported in suitable bearings in side frames 13. Intermediate the arms 54, there is a member 56 which is keyed to the shaft 55 and extends in a downward direction parallel to the arms 54. Beneath the belt wrapper there is a spring-biased plunger 57, slidably mounted in a receptable 58 containing a spring 60 having an adjusting plug 62, which engages with a vertical dog 61 pivotally mounted upon a shaft 65.

For moving the belt wrapper assembly 10 to the left or to the right, there is a piston-cylinder assembly 63 provided therefor mounted in suitable supporting members located beneath the assembly. The end of the piston rod is pivotally connected to a carriage 64 to which there is secured at its upper portion a bracket 66 secured to and extending downward from the belt wrapper assembly. For actuating the piston-cylinder assembly fluid is supplied from a suitable source, not shown.

With reference to Fig. 2, there is shown thereon at the outer extremity of the free end of the arm 28, adjacent to the roller 32, a split stationary shaft 71 upon which there is rotatably mounted a split relatively small diameter bending roll 72. For cooperating with the roll 72 there is provided a pair of rolls 73 and 74 rotatably mounted upon stationary shafts 75 and 76 affixed within suitable cradles 77 mounted between the frame sections at the top end of the C-shaped throat of the belt wrapper 10. These rolls 73 and 74 as shown are relatively larger in diameter than the roll 72 and are so constructed and arranged that the roll 72 is adapted to be placed between and closely adjacent to or in a nested relationship with respect to the two larger diameter rolls 73 and 74 as shown in the drawing . Depending upon the thickness of the strip to be coiled upon a reel with which a belt wrapper is employed having the features of the invention disclosed herein, it has been found that if the small diameter roll has a diameter of the order of 3⅞ inches and the larger rolls 73 and 74 a diameter of the order of 5½ inches, highly satisfactory results are obtainable in coiling steel strip having a width of 60 inches and a thickness of 0.220 inch.

Although suitable means may be employed for driving the rolls over which the belt passes, particularly, those which constitute the bending rolls of this combination, as is shown in the modified form of invention, one of the features of the preferred form of this invention is that the power for driving the bending rolls is provided by the belts which, in turn, are driven by the driven reel when the belts engage the reel for coiling a strip thereon.

For maintaining the shafts 75 and 76 in their working positions, keeper plates 82 are provided for the purpose and are affixed to the cradles 77. Openings 80 are provided in the side members of the cradles and within which there are positioned the eccentric portions 83 of a transversely extending shaft 84 mounted at its ends in the frame 13 and secured at the eccentric portions to the cradles by bearing caps 85 affixed to the top of the cradles 77 by studs 86. Bushings 87 are secured within the frames 13 and bushings 88 affixed within the cradles 77 for supporting the shaft 84 within the frame and cradle members. A thrust plate 91 prevents the shaft from moving axially within the frame and cradle. The upwardly extending frame portions of the cradles are provided with a lug 92 which makes contact with an adjustable stop 93 mounted in a lug 94 projecting inward from and secured to the belt wrapper frame. A suitable lock nut 95 is provided for securing the stop 93 in its desired position. By reason of the eccentric mounting of the shaft 84, the space between the larger diameter rolls 73 and 74 and the smaller diameter roller 72, when in their working position as shown in Fig. 2, is adjustable simply by turning the shaft 84 by means of a hand wrench to attain the desired result. The pressure between the nested rolls is dependent upon the spacing between the rolls, the thickness of the belts and the thickness and metallurgical characteristics of the strip being coiled.

One end of the eccentric shaft 84 projects out from the end frame 13 and there is mounted thereon a segmental plate 97 having therein a series of equally spaced apertures 98. A threaded bolt 99 is inserted in one of the apertures which will be in alignment with a similar opening in the frame 13 after adjustment of the shaft 84 has been accomplished to effect the required clearance between the small diameter roll 72 and the upper larger diameter rolls 73 and 74. The spacing of the apertures 98 serves as a scale so that when a particular aperture is in alignment for receiving the bolt 99, the extent of the clearance between the rollers will be readily apparent.

In Fig. 5, there is shown a four-high mill 101 having attached to the housing posts thereof on the delivery side a lower guide or apron 102 and an upper guide 103 employing a plurality of idler rollers 104 along its length which extend transversely across the width of the mill, and a deflector roll 105 which is rotatably mounted in suitable bearings between the apron 102 and the guide member 16. The upper guide 103 is so mounted that it may be adjusted vertically by loosening the bolts 103*a* and sliding the bolts along slots 103*b* provided in the housing so as to attain the proper clearance between the guide 103 and the apron 102 for a purpose to be hereinafter defined.

The modified form of invention employs an independent drive for rotating the strip bending rolls as is shown in Figures 10 and 11. The bending roll assembly is mounted upon a cradle 106, which by means of the rotatably adjustable shaft 107 having eccentrics 108 mounted thereon in the main belt wrapper frame 109, is moved toward and away from the small bending roll 111 to provide the necessary clearance between the rolls. The endless belt 112 of the belt wrapper assembly does not make contact with the bending rolls, as is the case in the preferred form of the invention, but is passed around a roll 113 which is closely adjacent to the bending roll assembly and mounted on the wrapper frame, over a roll 114 mounted on the belt wrapper arm 115 and over the remaining rolls of the wrapper assembly which, since similar to and mounted in the same fashion as those of the belt wrapper assembly shown in Figure 1, are not specifically illustrated in the drawings of the modified form of invention.

There are two pairs of bending rolls 116 which are positioned adjacent to the smaller diameter bending roll 113 and the rolls of each pair are mounted in bearings 117 and connected together by a coupling 118. At the outer end of the shaft of each pair of rolls 116 there is secured a gear 119 which meshes with a gear 121 rotatably mounted upon the shaft 107. Upon the hub of the gear 121 there is secured a sprocket 122 over which passes a chain 123 engaged with a driving sprocket 124 secured to the shaft of a motor 125 mounted upon a platform 126 provided at the top of the cradle 106. As in the preferred form of invention, the cradle 106 is mounted upon the main belt wrapper frame and is withdrawn from its operative position when the belt wrapper assembly is retracted. By reason of the fact that the bending rolls are independently driven, so that the belt does not make contact with the strip either during or immediately prior to the strip's being deformed to assume the approximate curvature of the reel, there is less possibility of the belt being damaged by the leading end of the strip.

The operation of the present invention may be briefly summarized as follows: The piston-cylinder assembly 63 is actuated to bring the belt wrapper 10 into engagement with the reel 11 for coiling a strip of metal on the reel as shown in Fig. 1. As the belt wrapper is moved toward the reel, the arms 56 will engage the pivotal dogs 61 thereby to cause the arm 28 to pivot upward and thus cause the belts to encircle a large arc of the reel.

The small diameter bending roll **72** will first make contact with the underneath portion of the upper bending roll **73** causing the roll assembly and cradle to pivot about the axis of the eccentric shaft **84** to permit the small roll **72** to position itself between and closely adjacent to or in a nested relationship with respect to the rolls **73** and **74**. Once the small roll **72** is in the strip engaging position, the pull of the belts on roll **73** will pivot the roll **73** downward and the other roll **74** upward until the lug **92** strikes the stop **94**, the stop **94** having been previously adjusted to limit the pivotal movement of the rolls in one direction to such a position as to effect the desired bending of the leading end portion of the strip to an extent sufficient to permit the strip to move forward and to make close contact with the surface of and for coiling upon the reel. As will be noted in Figs. 1 and 2, the bending rolls when in their strip engaging position are located closely adjacent to the surface of the reel **11**. Rotation of the reel **11** by actuation of the motor connected thereto supplies the power for driving the belts **39** as well as the bending rolls **73** and **74**.

Prior to coiling a strip the roller guide **103** is adjusted vertically with respect to apron **102** and the shaft **84** is adjusted to such a position as to give the spacing desired between the rolls when they are adjacent to one another and in their strip end engaging position. The guides **15** and **16** will direct the leading end of the strip to the three rolls **72**, **73** and **74** as shown in Figs. 2 and 5 so that the strip will pass above the roll **72** and make contact with the belt **39** which engages the two rolls **73** and **74** from beneath. In order to assist in positively inserting the leading end of the strip between the bending rolls **72**, **73** and **74**, should the strip leading end not readily enter the rolls when brought adjacent thereto, the oncoming strip will tend to loop upward thereby causing the upper surface thereof to strike against the rollers **104** of the guide **103** to prevent further upward deflection and thereby to lend stiffness to the strip. With the strip thus confined, the mill **101** continues to feed the strip forward thereby serving effectively as a sticker for driving the leading end of the strip between the bending rolls, assuring positive feeding of the strip to the reel for wrapping thereon. Once the strip end has passed beyond the bending rolls, the strip portion adjacent to the delivery side of the mill will then drop downward and make contact with the deflector roll **105** for passage thereover.

The strip end in passing between the bending rolls will be deformed since it is subjected to forces sufficient to stress the strip beyond its elastic limit and on being delivered therefrom will be directed downward toward the reel, having had imposed thereon a curvature or "set" substantially the same as that of the curvature of the reel. The rotating reel will assist in directing the leading end of the strip forward so as to cause the strip to be engaged tightly between the reel and the belts. The strip will continue on its travel around the reel and build itself up as a coil thereon. As one or more wraps of the coil upon the reel are completed, the added diameter at the reel tends to cause the arm **28** to pivot away from the reel but this movement is resisted by the spring biased plunger **57**. As the small diameter roll **72** is forced outward toward the larger diameter roll **73**, the roll **73** will pivot upward and the roll **74** pivot downward without affecting the working relationship of the rolls and the strip will continue to pass therebetween.

After several wraps of strip have been placed upon the reel **11**, the piston-cylinder assembly **63** is actuated to retract the belt wrapper **10** to its inoperative position. Several positions of the bending roller **72** with respect to the larger diameter rolls **73** and **74** are shown in Figs. 8 through 11. As will be noted, clearance for the small diameter roll **72** to permit its being retracted from between the larger rolls **73** and **74** is provided by

the action first of the roll **73** in swinging upward away from the roll **72** and then of the small diameter roll **72** being moved downward as well as outward away from the reel and the two rolls **73** and **74** when the arm **28**, to which the roll **72** is secured, is folded downward by movement of the belt wrapper assembly to the right as viewed in Fig. 1.

In the modified form of the invention, the rolls **116** are so driven that the strip engaged and urged forward thereby will be travelling at the same speed as the belt and the reel when the leading end of the strip is seized between the belt and the reel thereby to prevent interference between the strip, belt and reel during coiling.

Figs. 6, 7, 8 and 9 illustrate the first few positions of the bending roll **72** and the two cooperating larger diameter rolls **73** and **74** attained when the belt wrapper assembly is retracted from the coiling position. Though not shown specifically, further retraction of the assembly will cause the arm **28** to be lowered to a horizontal position so as to permit the arm **28** to pass beneath the reel as the belt wrapper assembly is withdrawn to its final position.

In acordance with the provisions of the patent statutes, I have explained the principle and operation of my invention and have illustrated and described what I consider to represent the best embodiment thereof. However, I desire to have it understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A belt wrapper apparatus for coiling relatively rigid continuous strip upon a reel comprising a frame, a plurality of rolls rotatably mounted upon said frame, a continuous belt in engagement with said rolls and so arranged to encompass a substantial portion of the peripheral surface of said reel when in the strip coiling position, means to advance said frame to and to retract it from the strip coiling position, an arm pivotally connected at one end to said frame, a roll rotatably mounted at the opposite end of said arm, and means operatively connected to and for pivoting said arm to cause said roll to be positioned between and closely adjacent to a pair of said rolls over which said belt passes thereby to define a path between said belt and said roll along which the leading end of the strip is directed and preformed immediately prior to being fed between said belt and said reel for coiling upon said reel.

2. A belt wrapper apparatus for coiling relatively rigid continuous strip upon a reel according to claim 1 in which there are included means for feeding forward and for confining said strip in order to lend stiffness thereto to permit said feeding means to act as a sticker to force the leading end of the strip between and into the path defined by said belt and said roll.

3. A belt wrapper apparatus for coiling relatively rigid continuous strip upon a reel according to claim 1 in which there is included a cradle rotatably supporting said pair of rolls, means pivotally supporting said cradle upon said frame, and means for varying the relative position of said pair of rolls with respect to said roll mounted at the end of said arm.

4. A belt wrapper apparatus for coiling relatively rigid continuous strip upon a reel according to claim 1 in which there is included a cradle, means pivotally supporting said cradle upon said frame, and adjustable stop means operatively arranged to limit the extent to which said cradle may be pivoted in one direction.

5. A belt wrapper apparatus for coiling relatively rigid continuous strip upon a reel comprising a frame, a plurality of rolls rotatably mounted upon said frame at the strip entry end of said wrapper, a continuous belt carried by said frame so arranged to encompass a substantial portion of the peripheral surface of said reel when in the coiling position, an arm pivotally connected at one end to said frame at the strip entry end of said wrapper, a

roll rotatably mounted at the opposite end of said arm, and means operatively connected to and for moving said arm to cause said roll to be positioned between and in a nested relationship with two of said first mentioned rolls thereby to define a path between said roll and said two rolls along which the leading end of the strip is directed and preformed immediately prior to being engaged between said belt and said reel.

6. Apparatus for coiling relatively rigid continuous strip upon a driven reel comprising a frame, a belt wrapper mounted upon said frame adapted to be engaged with a substantial peripheral portion of and driven by said reel for receiving and directing the leading end of a strip around the reel for coiling thereon, a strip bending roll assembly carried by said frame at a position closely adjacent to the strip entry side of said belt wrapper comprising a pair of rolls adjacent to one another and with the axes thereof substantially parallel, an additional roll mounted upon said frame and operatively arranged to be placed closely adjacent to and in a nested relationship with respect to said pair of rolls, means connected to and for rotating said pair of rolls and means for retracting said frame away from said reel and said additional roll away from said pair of rolls.

7. Apparatus for coiling relatively rigid continuous strip according to claim 1 wherein the diameters of the rolls of said pair are relatively large as compared with the diameter of the roll mounted on said arm.

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