Dec. 31, 1957 E. T. LORIG 2,817,940

SELF-CENTERING ROLL

Filed Oct. 18, 1955 2 Sheets-Sheet 1

FIG. 1.

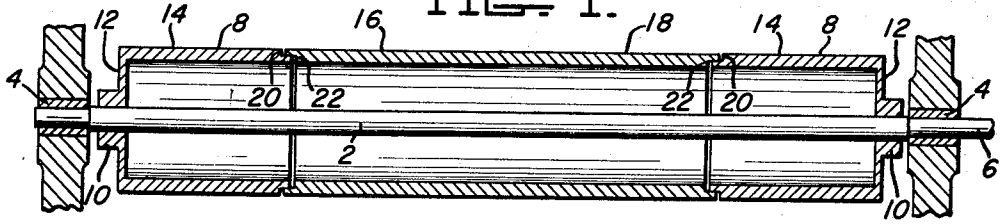


FIG. 2.

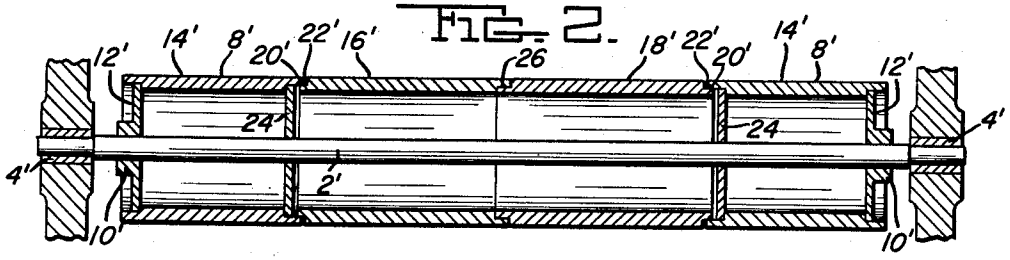


FIG. 3.

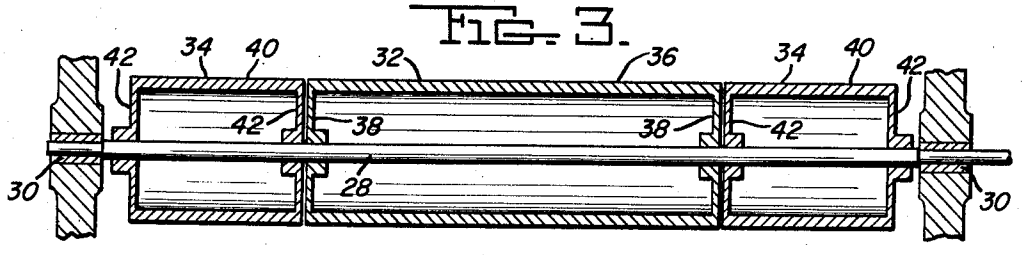


FIG. 4.

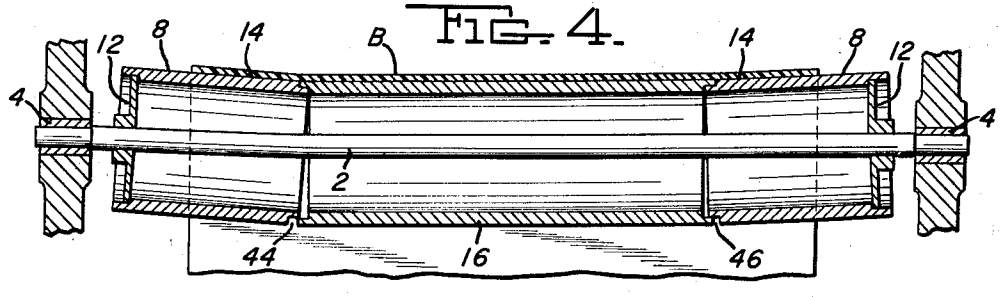
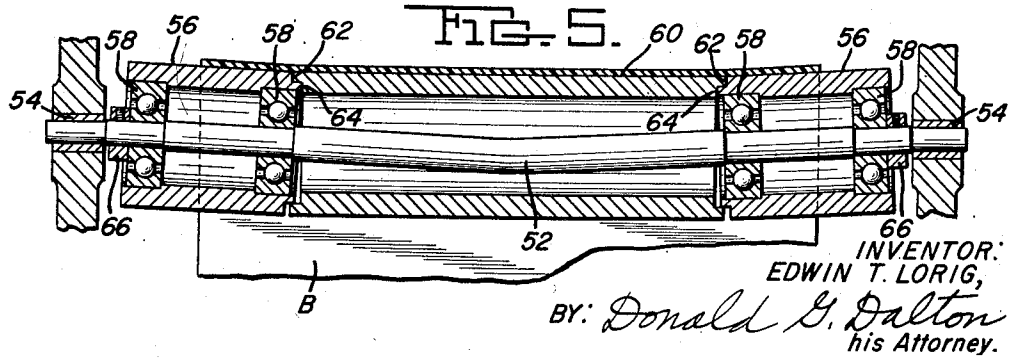


FIG. 5.



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FIG. 6.

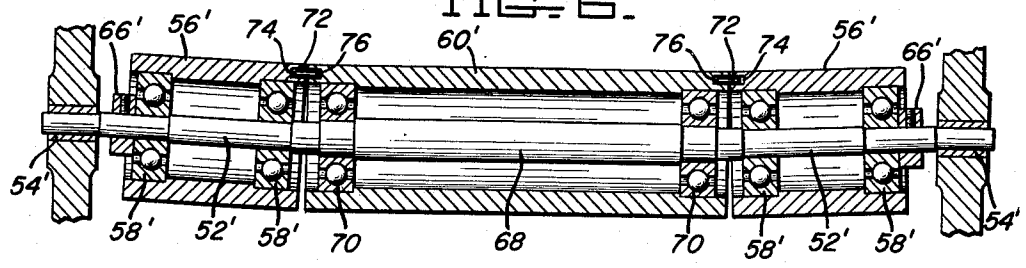


FIG. 7.

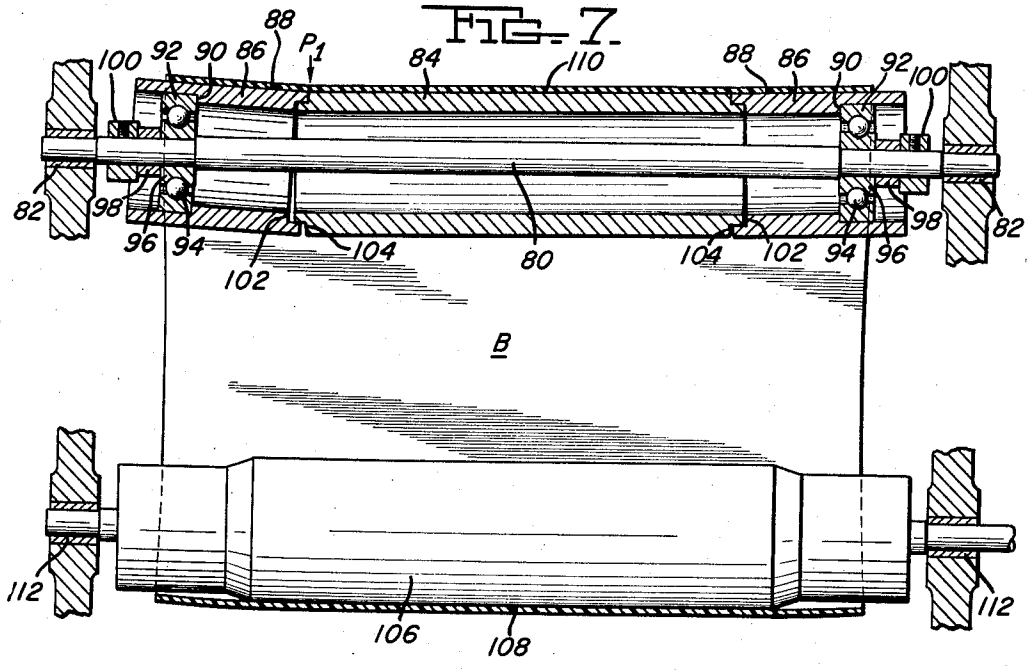
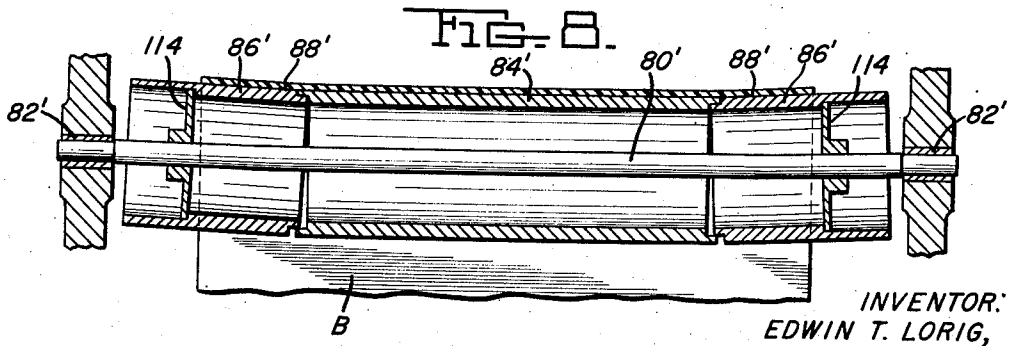


FIG. 8.



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2,817,940

SELF-CENTERING ROLL

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14 Claims. (Cl. 271—2.6)

This invention relates to a self-centering roll and more particularly to such a roll for use with wide short belts and wide strip. My prior Patents Nos. 2,593,157, 2,592,581 and 2,593,158 disclose self-centering rolls which are suitable for most applications. However, when handling wide short belts and wide strip, especially when the material is of light gauge, there is a tendency for the strip and belt to gutter or gather at the longitudinal center because of the toeing-in action of the broad area of roll contact toward the transverse center of the roll.

It is therefore an object of my invention to provide a self-centering roll for handling wide light material without any substantial guttering or gathering of the material.

Another object is to provide a roll assembly utilizing such a self-centering roll.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

Figure 1 is a cross sectional view showing one embodiment of my invention under no load static conditions;

Figure 2 is a sectional view showing a slight modification of the roll of Figure 1;

Figure 3 is a sectional view, similar to Figure 1, showing a further modification;

Figure 4 is a view of the roll of Figures 1 and 2 with a belt or strip wrapped therearound and showing in an exaggerated manner the deformation of the roll;

Figure 5 is a sectional view of a self-centering roll of the bent shaft type;

Figure 6 is a view, similar to Figure 5, showing a modification thereof;

Figure 7 is a view, partly in section, showing a roll assembly including a self-centering roll of a modified type; and

Figure 8 is a sectional view showing a modified roll similar to the self-centering roll of Figure 7.

Referring more particularly to Figure 1 of the drawings, reference numeral 2 indicates a shaft which is rotatably mounted on spaced apart bearings 4. The shaft 2 may be supplied with an extension 6 beyond one of the bearings 4 so that the roll may be driven if desired. Keyed or otherwise attached to the shaft 2 adjacent each of the bearings 4 is a roll section 8. Each of the roll sections 8 consists of a hub 10, web 12 and an object supporting rim 14. A center roll section 16 is provided between the roll sections 8. The object supporting surfaces 14 may be either cylindrical, frustoconical in either direction, or slightly concave. However, when the large diameter end is adjacent the free end of rim 14 the amount of taper must be very slight. In any case the variance in diameter is only a matter of a few thousandths of an inch so that the strip supporting surface is relatively cylindrical. Object supporting surface 18 of the section 16 may be either cylindrical or slightly concave. The unsupported end of each of the roll sections 8 has a reduced diameter portion 20 for receiving a closely fitted counterbored portion 22 of the center section 16. Under load the close fitting portions

20 and 22 will cause the center section 16 to rotate in unison with the outer sections 8.

The roll of Figure 2 has a construction similar to that of Figure 1 and is particularly suitable where the roll is extremely long with respect to its diameter. Like parts are indicated by priming the reference numerals shown in Figure 1. The roll of Figure 2 differs from that of Figure 1 in that each of the end sections 8' is provided with a web 24 at its inner end extending radially inwardly to within a few thousandths of an inch of shaft 2'. Also, the end 20' of each section 8' is counterbored for receiving reduced diameter portion 22' of section 16', this arrangement being preferred for this type of roll. Another difference between this roll and that of Figure 1 is that the web 12' is not attached to its rim 14' although in either type roll the web 12 may or may not be attached to its rim. The center strip supporting member 16' may be in two parts as shown with a connection 26 therebetween or unitary as in Figure 1. Under load the webs 24 contact the shaft 2' causing it to deflect. Otherwise the roll functions in the manner described below.

The roll of Figure 3 consists of a slender shaft 28 mounted for rotation in bearings 30, a center roll section 32 and end roll sections 34. The section 32 consists of a cylindrical rim 36 and two webs 38 which are keyed or otherwise attached to the shaft 28. Each of the sections 34 consists of a cylindrical rim 40 and web sections 42 keyed or otherwise attached to the shaft 28. The operation of this roll depends upon deflection in the shaft 28 which is made relatively slender for that purpose. The sections 34 and 36 are spaced apart slightly so that the part in contact with the strip passing thereover can move toward each other.

Figure 4 shows the operation of the roll of Figure 1 when a belt or strip B passes beneath the roll and then up around the roll, the length of wrap being between 90 and 180°. Contact of strip B with the sections 8 causes each of the rims 14 to deflect so that its axis of rotation extends at an angle from the transverse center of the roll away from the direction of approach of the belt B. Assuming that the belt or strip B is cambered with its left edge shorter than its right edge the load resisting pressure due to tension is greater on the left hand bearing 4 than on the right hand bearing so that deflection of shaft 2, webs 12 and rims 14 is greater at the left end of section 16 than at the right end. Thus, for cambered belts or strip center section 16 can never rotate with its planes parallel to the theoretical transverse center of the roll nor in parallelism with the rotating planes of end sections 8. Also, the maximum opening at point 44 is greater than at point 46 and the deflection of left hand section 8 will be greater than the deflection of right hand section 8. The unit force exerted by the left hand section 8 tending to move the belt to the right is greater than the unit force exerted by the right hand section 8 tending to move the belt to the left. It should also be noted that the forces exerted by the center section 16 on the belt also tends to move the belt to the left but with the unit force being less than the unit force exerted by the right hand section 8. Thus it is seen that the center roll section 16 is a rotating, tilting, balancing link between end sections 8 which permits greater deflection on one end section than on the other as demanded by unequal belt or strip pressures applied to the roll. The total lateral forces exerted by right hand section 8 and center section 16 will be equal to the total lateral forces exerted by the left hand section 8 so that the belt B will be centered on the roll. The belt B must be of greater width than center section 16 and of sufficient magnitude that one end section 8 can provide axial forces toward the transverse center sufficient to balance opposing forces in the other end section and in the center section. Ob-

viously if the conditions are reversed with the greater pressure being applied to the right hand section 8, the deflections in the roll assembly and the resulting lateral forces will also reverse themselves. The roll provides uniformity of strip pressure across the roll assembly to the greatest extent possible so that there is no concentrated loadings which cause fibre straining, longitudinal guttering or gathering of the strip material across its width under the strip tensions necessary to secure good automatic centering and aligning. When the roll sections 8 and 16 have object supporting surfaces made of like material it is preferred to have the width of section 16 approximately twice that of each end section 8. However, this relationship may be varied, especially if the end sections are covered with rubber or other high frictional materials and the center section has a highly polished low frictional material surface, in which case the center section may be much longer. The operation of the rolls of Figures 2 and 3 are essentially the same as that of Figure 1.

The roll of Figure 5 utilizes a stationary bent shaft 52 supported in bearings 54. The shaft 52 is bent in such a manner that it diverges from its transverse center away from the direction of strip approach. A section 56 is provided at each end of the shaft 52 and is rotatably supported on bearings 58 carried on the shaft 52. A center section 60 is provided between end sections 56. The sections 56 are provided with a reduced diameter portion 62 adjacent their inner ends for receiving counterbored portion 64 of section 60. A retainer collar 66 is provided at each end of the shaft 52 to hold the sections 56 and 60 in assembled position with sufficient pressure between the portions 62 and 64 to cause the sections 56 and 60 to rotate in unison. The operation of this roll is much the same as that of the roll of Figures 1 and 2 except that pure deflection is not depended upon to secure the required planar action in end sections 56. However, some deflection is secured under load because of the position of bearings 58 with respect to the bearings or supports 54.

The roll of Figure 6 is similar to that of Figure 5 and like parts will be indicated by priming reference numerals of Figure 5. Bent shaft 52′ is provided with a center section 68 which is in a plane normal to the desired path of travel of the belt passing over the roll. The center section 60 is supported on internal bearings 70 carried by the shaft section 68. In order to cause the sections 56′ and 60′ to rotate in unison pins 72 extend between sections 56′ and 60′ into holes 74 and 76 in the respective section. The strip or object supporting surface of sections 56′ and 60′ have the same contour as the corresponding sections of Figures 1 and 2. The functioning of this embodiment is essentially the same as that of Figure 5 and is used for extremely high rotative speeds.

In the embodiment of Figure 7 a straight shaft 80 is supported in bearings 82 and a cylindrical center roll section 84 is supported between end sections 86. The end sections 86 each have a cylindrical belt or strip supporting surface 88. The internal surface of the section 86 is provided with a shoulder 90 for receiving in abutting relationship an outer race 92 for ball bearings 94. Inner race 96 surrounds the shaft 80 and is held from outward movement on the shaft by means of collar 98 and a retainer 100. The inner end of roll section 86 is counterbored at 102 for receiving a reduced diameter portion 104 of cylindrical center roll section 84. The roller bearing 94 with its inner and outer race functions in a manner similar to that of the webs of the outer section shown in the other embodiments. The belt B passes around the self-centering roll and around a narrow-bodied cylindrical roll 106. The roll 106 has a cylindrical strip supporting surface 108 of less width than the belt B and is somewhat wider than the cylindrical strip supporting surface 110 of roll section 84. The roller bearings 94 are mounted inwardly from the outer end of the roll section 86 a distance approximately between one-fourth and one-third of the total length of the roll section 86. The parts are assembled in such a manner that the end sections 86 will be held tightly against the center section 84 when the roll is under load. In other words as the belt B passes around the roll it causes deflection of end sections 86 as shown so that there will be a pinching of the sections 86 and 88 where contacted by the belt B. This causes the sections 86 and 88 to rotate in unison. As shown, the shaft 80 is stationary but it may be rotatable. The narrow bodied roll 106 is shown as rotatably mounted in bearings 112. When the left side of belt B is shorter than the right side a pressure P1 is applied as shown and the outer end of left hand roll section 86 will elevate slightly to a somewhat greater amount than the outer end of the right hand roll section 86. This increases the tension somewhat in the left hand edge of belt B as it moves to the left which action will cause quicker center restoration of the belt B than with the embodiments described above. The particular arrangement of self-centering roll and narrow-bodied roll shown functions to correctly and quickly restore the belt on center since the maximum tension of the belt will be at the abutting rims of roll sections 84 and 86. This arrangement also permits proper deflection of the sections of the belt overhanging the belt supporting surface 108.

The roll of Figure 8 is similar to that of Figure 7 except that a flexible web 114 is substituted for the bearings and races 92, 94 and 96 and shaft 80′ must be rotatable. The remaining parts and function of this roll are essentially the same as that of Figure 7 and like parts are indicated by priming the numerals of Figure 7.

Each of the rolls described above is preferably used with a narrow-bodied roll or rolls as shown in Figure 7. When used with elongated strip rather than strip in the form of a belt, it is preferred to use a narrow-bodied roll on both exit and entry sides of the self-centering roll.

In any of the embodiments of self-centering rolls shown and described a slightly raised diameter portion may be provided at the outer ends of the end sections of the rolls. The connection between the end and center sections may vary somewhat from those shown without changing the operation thereof. In case it is desired to handle strip narrower than the center roll section, that section may be split with the connection therebetween being the same as the connection between the end and center sections.

While several embodiments of my invention have been shown and described it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. A roll for centering and aligning a strip comprising a first strip supporting section at one end of the roll, a second strip supporting section at the other end of the roll, mechanism for supporting said sections so that under load they rotate on axes that diverge away from the direction of strip approach, said mechanism including a shaft section at each end of the roll, means for supporting said shaft sections in fixed relationship with each other and a relatively non-compressible generally radial support on each shaft section for the outer end of the associated strip supporting section, and strip supporting means extending between said first and second sections.

2. A roll for centering and aligning strip comprising a shaft, a pair of spaced apart end sections mounted on said shaft, each of said end sections having a rim and a relatively flexible web for supporting the outer end of said rim on said shaft, said web being relatively non-compressible in a radial direction and the inner end of said rim being free to deflect toward said shaft so that said sections under load rotate on axes that diverge away from the direction of strip approach, and an intermediate rotatable rim section extending between and supported by the rims of said end sections.

3. A roll for centering and aligning strip comprising

a shaft, a pair of spaced apart end sections mounted on said shaft, each of said end sections having a rim and a relatively flexible web for supporting said rim intermediate its ends, said web being relatively non-compressible in a radial direction, said web being positioned nearer to the outer end of said rim than to the inner end, said web being supported on said shaft and the inner end of said rim being free to deflect toward said shaft so that said sections under load rotate on axes that diverge away from the direction of strip approach, and an intermediate rotatable rim section extending between and supported by the rims of said end sections.

4. A roll for centering and aligning strip according to claim 3 in which each of said webs includes ball bearings, an inner race mounted on said shaft for supporting said bearings, and an outer race extending from said bearings to said rim.

5. A strip centering and aligning member comprising a pair of spaced apart end sections, each of said end sections having a rim and means for supporting its outer end, said means being relatively non-compressible in a radial direction, the inner end of each of said rims being unsupported and free to deflect a limited amount away from said strip, and an intermediate rim section extending between and supported by said end sections.

6. An assembly for centering and aligning strip comprising a centering and aligning member, said member including a pair of spaced apart end sections, each of said end sections having a rim and means for supporting its outer end, said means being relatively non-compressible in a radial direction, the inner end of each of said rims being unsupported and free to deflect a limited amount away from said strip and an intermediate rim section extending between and supported by said end sections, and a roll spaced from said member, said roll having a cylindrical strip supporting surface of less width than the width of the strip and a width at least substantially equal to the distance between said end sections.

7. A roll according to claim 1 in which the shaft sections form part of a bent shaft having two axis sections, said axis sections diverging away from the direction of strip approach, and said end sections are mounted for rotation on said shaft one about each axis section.

8. A roll according to claim 1 in which the shaft sections form part of a relatively flexible shaft.

9. An assembly for centering and aligning strip comprising a first roll and a second roll spaced therefrom, said first roll including a first strip supporting section at one end of the roll, a second strip supporting section at the other end of the roll, means for supporting said sections so that under load they rotate on axes that diverge away from the direction of strip approach, said means including a generally radial relatively non-compressible support for the outer end of each of said sections, and strip supporting means extending between said first and second sections, said second roll having a cylindrical strip supporting surface of less width than the width of the strip and of greater width than the distance between said end sections.

10. An assembly for centering and aligning strip comprising a first roll and a second roll spaced therefrom, said first roll including a shaft, a pair of spaced apart end sections mounted on said shaft, each of said end sections having a rim and a relatively flexible web for supporting the outer end of said rim on said shaft, said web being relatively non-compressible in a radial direction and the inner end of said rim being free to deflect toward said shaft so that said sections under load rotate on axes that diverge away from the direction of strip approach, and an intermediate rotatable rim section extending between and supported by the rims of said end sections, said second roll having a cylindrical strip supporting surface of less width than the width of the strip and of greater width than the distance between said end sections.

11. An assembly for centering and aligning strip comprising a first roll and a second roll spaced therefrom, said first roll including a shaft, a pair of spaced apart end sections mounted on said shaft, each of said end sections having a rim and a relatively flexible web for supporting said rim intermediate its ends, said web being relatively non-compressible in a radial direction, said web being positioned nearer to the outer end of said rim than to the inner end, said web being supported on said shaft and the inner end of said rim being free to deflect toward said shaft so that said sections under load rotate on axes that diverge away from the direction of strip approach, and an intermediate rotatable rim section extending between and supported by the rims of said end sections, said second roll having a cylindrical strip supporting surface of less than the width of the strip and of greater width than the distance between said end sections.

12. An assembly for centering and aligning strip according to claim 11 in which each of said webs includes ball bearings, an inner face mounted on said shaft for supporting said bearings, and an outer race extending from said bearings to said rim.

13. An assembly for centering and aligning strip comprising a first roll and a second roll spaced therefrom, said first roll including a bent shaft, a pair of strip supporting end sections mounted for rotation on said shaft on axes that diverge away from the direction of strip approach, the mounting of said end sections including a generally radial relatively non-compressible support for the outer end of each of said sections, and an intermediate strip supporting section mounted for rotation on said shaft between said end sections, and means for causing said sections to rotate substantially in unison, said second roll having a cylindrical strip supporting surface of less width than the width of the strip and of greater width than the distance between said end sections.

14. An assembly for centering and aligning strip comprising a first roll and a second roll spaced therefrom, said first roll including a relatively flexible shaft supported adjacent its ends, a strip supporting section at each end of said shaft, means for mounting said sections on said shaft so that under load they rotate on axes that diverge away from the direction of strip approach, said means including a generally radial relatively non-compressible support for the outer end of each of said sections, and strip supporting means extending between said sections, said second roll having a cylindrical strip supporting surface of less width than the width of the strip and of greater width than the distance between said end sections.

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