United States Patent

[11] 3,572,570

[72] Inventor **Peder Mortensen**
Skoobrynet 1, Bagsvard, Denmark

[21] Appl. No. **839,145**
[22] Filed **June 12, 1969**
[45] Patented **Mar. 30, 1971**
[32] Priority **Aug. 2, 1968**
[33] **Denmark**
[31] **3736**

[54] **ROLL WITH CONTROLLABLE DEFLECTION**
4 Claims, 6 Drawing Figs.

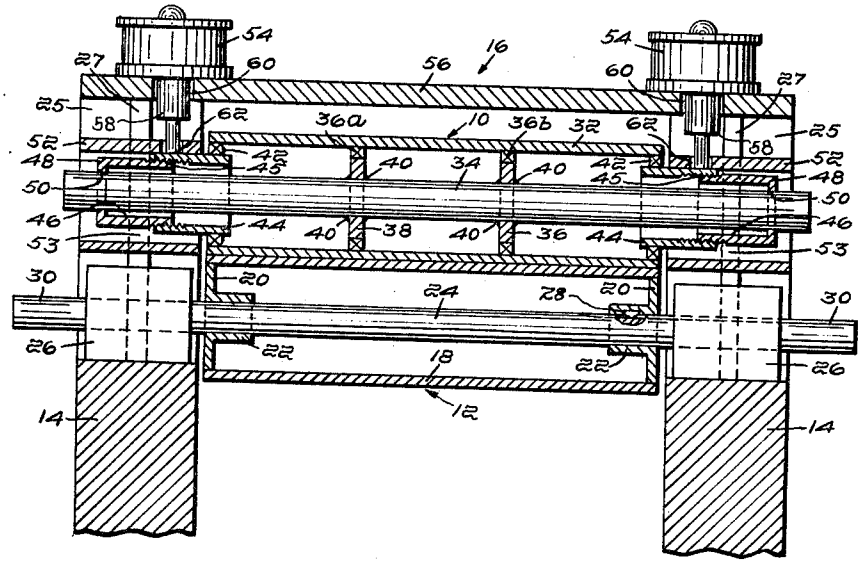
[52] **U.S. Cl.** **226/177,** 100/170
[51] **Int. Cl.** **B65h 17/20**
[50] **Field of Search** ..... 226/176, 177, 190, 194; 100/169—171

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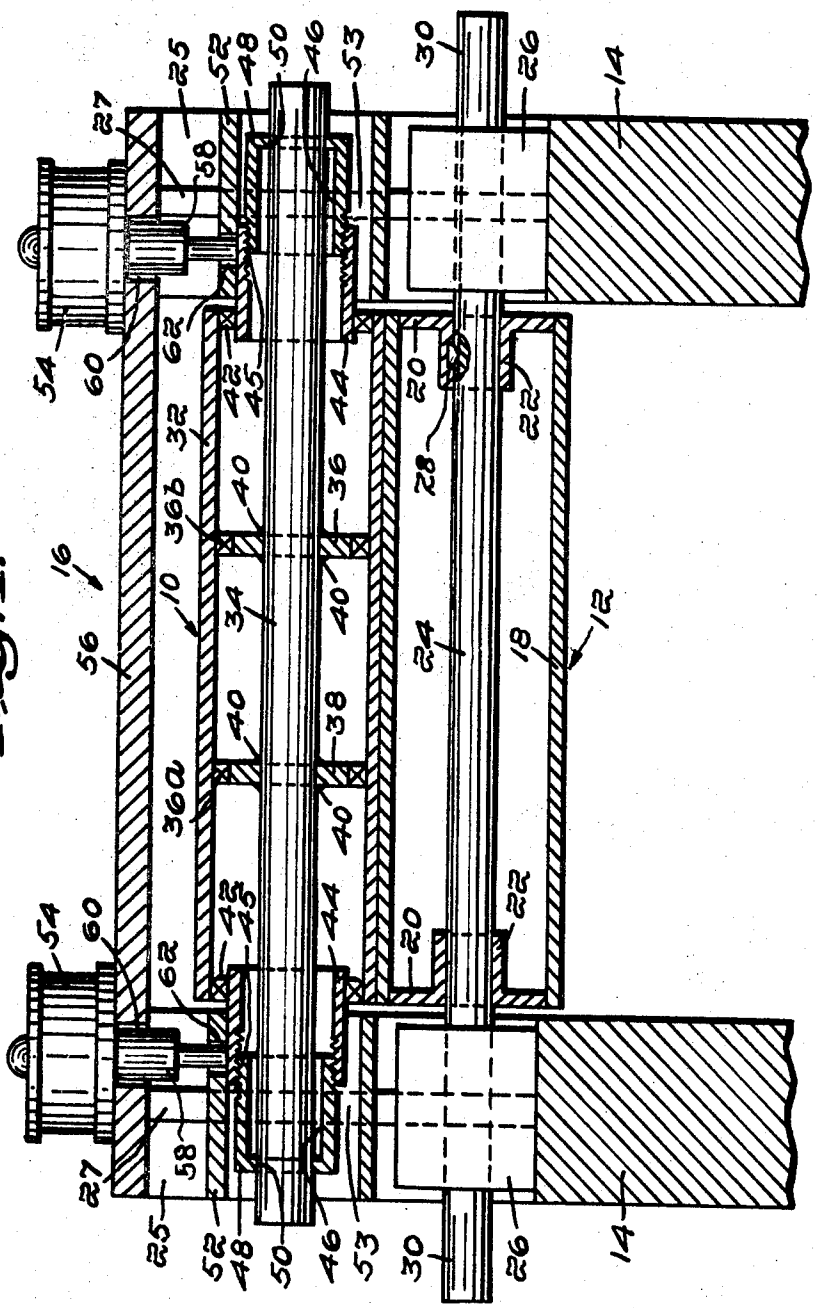
Primary Examiner—Richard A. Schacher

ABSTRACT: Apparatus for controlling the deflection of a tubular nip roll. The roll is supported internally at its ends by annular bearings which are in turn carried by sleeves. A nonrotatable shaft extends axially through the roll and the sleeves, the shaft having at least one additional bearing radially supporting the roll at a point intermediate its ends. The sleeves are carried on adjustable members which are movable axially on the shaft. By applying a force to the sleeves, which force is opposite to the nip separating force and by properly positioning the adjustable members on the shaft, the shaft and the roll are deflected in opposite directions, the deflection of the roll being in the same direction and approximately of the same magnitude as that of the other mating nip roll.



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Inventor:
Peder Mortensen,
By Cheatham Pfund Birch Samuels & Gauthier
Attorneys

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Fig. 2.

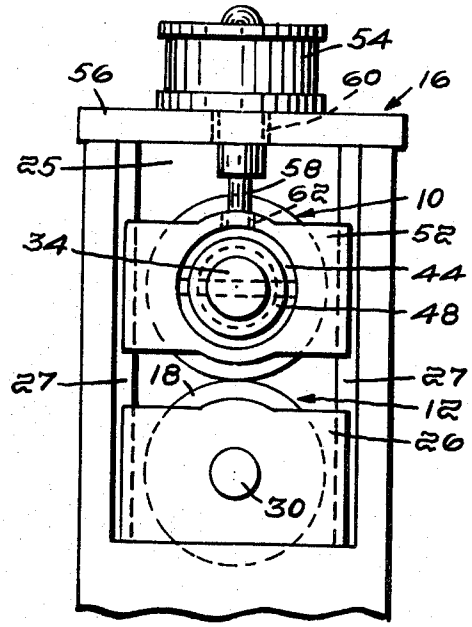


Fig. 3.

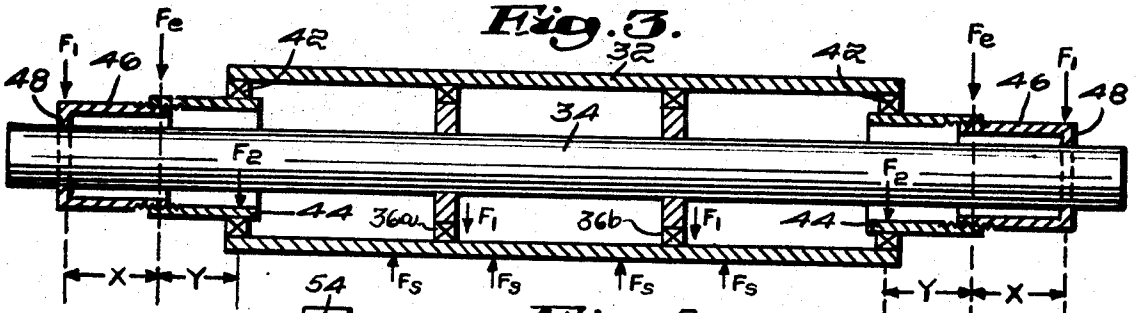


Fig. 5.

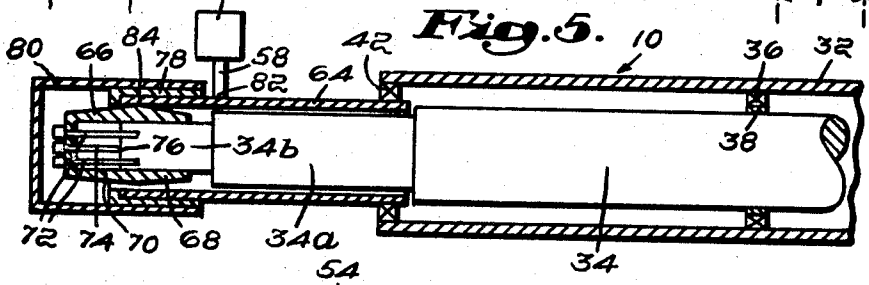
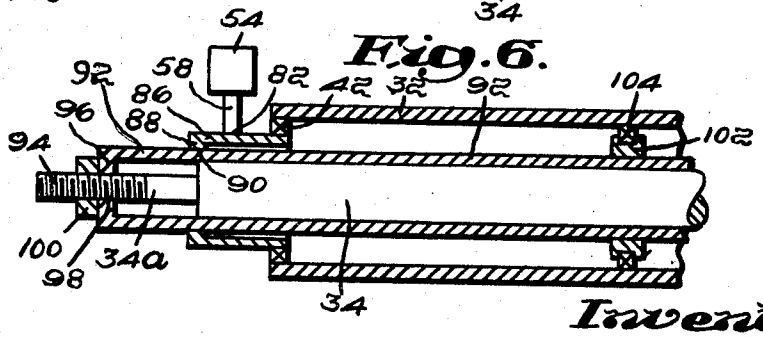


Fig. 6.



Inventor:
Peder Mortensen,
By Cutlick Pfund Birch Samuels & Gauthier
Attorneys

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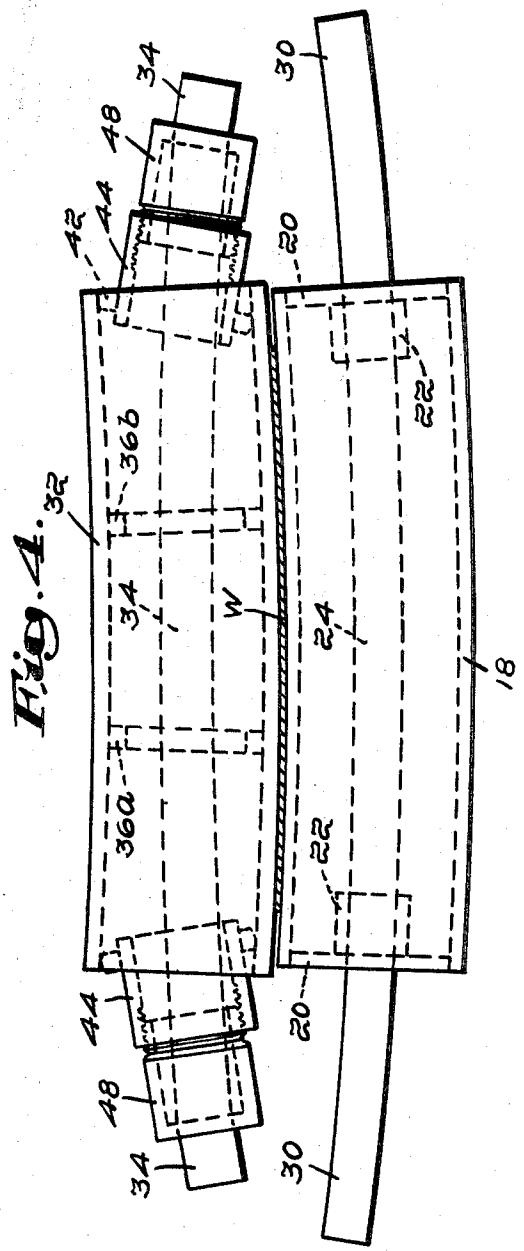


Fig. 4.

Inventor:
Peder Mortensen,
by Cuttick Pfund Birch Samuels & Gauthier
Attorneys

ROLL WITH CONTROLLABLE DEFLECTION

DESCRIPTION OF THE INVENTION

This invention relates generally to tubular rolls of the type employed to process open width material, such as for example cloth or paper webs, and more particularly to means for controlling the deflection of at least one roll in a roll nip so as to achieve approximately uniform nip pressure across the width of the material being processed.

It is well known that the roll separating forces exerted by material passing through a roll nip tend to deflect the rolls in opposite directions, thereby producing a nonuniform nip pressure across the width of the material being processed. A number of attempts at minimizing or eliminating this problem have been made in the past, but these attempts have generally failed to adequately meet the demands of those skilled in the art. Experience has indicated that these failures have been due either to the employment of complicated mechanisms which are difficult to maintain and which in many cases are incapable of extended trouble-free operation, or because these mechanisms cannot be readily adjusted to accommodate the various running conditions encountered in commercial operations.

These difficulties have now been overcome in a novel manner by the present invention, a general object of which is to provide an apparatus for controlling the deflection of a tubular nip roll, which apparatus may be readily adjusted to accommodate various conditions normally encountered in commercial operations.

Another object of the present invention is to provide an apparatus of the aforementioned type which is both simple in construction and capable of extended trouble-free operation.

These and other objects and advantages 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 sectional view through a roll frame showing a pair of nip rolls, one of which is constructed in accordance with one embodiment of the present invention;

FIG. 2 is an end view of the roll frame shown in FIG. 1;

FIG. 3 is a sectional view of the upper roll shown in FIGS. 1 and 2 with the forces acting thereon diagrammatically illustrated;

FIG. 4 is a schematic view of the upper and lower rolls shown in FIGS. 1 and 2 with the resulting deflection of each roll and its respective shaft greatly exaggerated for illustrative purposes; and,

FIGS. 5 and 6 are sectional views showing alternate embodiments of rolls constructed in accordance with the present invention.

Referring initially to FIGS. 1 and 2, there is shown upper and lower roll assemblies 10 and 12 supported between two upstanding frame members 14 of a roll frame generally indicated at 16. Lower roll assembly 12 may be of any conventional construction, such as that illustrated wherein a tubular roll 18 is enclosed at its ends by circular plates 20 having hubs 22 integral therewith. The hubs are centrally apertured to accommodate an axially extending shaft 24 which is journaled for rotation between bearings 26 supported on the frame members 14. Roll 18 may be keyed to shaft 24 as at 28, the latter being driven by conventional means connected to the shaft end 30 exterior of the roll frame 16. The bearings 26 are slidably lowered into the housing windows 25 on tracks 27.

The upper roll assembly 10 is constructed in accordance with one embodiment of the present invention. Roll assembly 10 is provided with a tubular roll body 32 having a nonrotatable shaft 34 extending axially therethrough. As herein illustrated, the roll 32 is rotatably supported on shaft 34 at two points intermediate its ends by means of annular bearing assemblies 36*a* and 36*b*, the latter in turn being supported on annular spacer members 38 which are fixed to the shaft 34 as by welding at 40.

Roll 32 is additionally rotatably supported at its ends by means of annular bearing assemblies 42, each of which is carried on one end of a cylindrical sleeve 44. Each sleeve 44 is threadably engaged at its other end as at 45 to a second sleeve member 46, the latter having an inwardly disposed radial shoulder 48 contacting shaft 34 as at 50.

The sleeves 44 and 46 are surrounded by guide members 52 which are also slidably lowered into the housing windows 25 on the tracks 27. A space 53 is provided between guide member 52 and the bottoms of sleeve members 44 and 46. In effect, the guide members 52 act as means for laterally locating the ends of the roll axle 34 in the housing windows 25, it being understood that in the absence of material running through the roll nip, the upper roll 32 is supported on the lower roll 18 as shown in FIG. 1.

The frame members 14 are joined by an upper housing plate 56 on which is mounted a pair of piston-cylinder assemblies 54. Each assembly 54 is provided with an extensible piston rod 58 which extends downwardly through an opening 60 in the housing plate 56 and another opening 62 in the guide member 52 to contact the underlying cylindrical sleeve 44.

It will be understood that the separating force which results from feeding open width material through the roll nip tends to deflect or bow the lower roll 18 downwardly, while at the same time bowing or deflecting the upper roll 32 upwardly in the opposite direction. Unless some compensating action is taken, this will result in a nonuniform nip pressure across the width of the material being processed. As is schematically illustrated in FIG. 3, a compensating action is effected with regard to the upper roll 32 by actuating cylinder assemblies 54 to apply an external force F_e through the piston rods 58 to the sleeve members 44 in a direction opposite to the separating forces F_s being exerted on the roll at the roll nip. The tubular assemblies made up of sleeves 44 and 46 serve as levers which distribute portions F_1 of the externally applied forces F_e through the radial shoulders 48 on sleeves 46 to the ends of the shaft 34. The partial forces F_1 are in turn transmitted through the shaft 34 and bearings 36*a* and 36*b* to the roll 32 at points intermediate its ends. The remaining portions F_2 of the externally applied forces F_e are transmitted through the end bearings 42 directly to the ends of the roll 32.

The proportion between the partial forces F_1 and F_2 may be altered by screwing the tubular sleeves 46 into or out of the sleeves 44, thereby varying the distances X between F_e and F_1, it being understood that the distances Y between F_e and F_2 remains constant. The positions of sleeves 46 relative to the sleeves 44 are adjusted such that the forces F_1 at bearings 36*a* and 36*b* exceed the forces F_2 at bearing 44, thereby causing roll 32 to bow or deflect in the same direction as roll 18. This condition is schematically illustrated at FIG. 4 wherein dimensions and degrees of deflection have been greatly exaggerated for purposes of illustration and wherein the bowing of both the upper and lower rolls 32 and 18 is in the same direction with the result that the open-width material W passing therebetween is subjected to a substantially uniform nip pressure. In this regard, it will be understood that the space 53 at each roll end between the sleeve members 44 and 46 and their respective guide member 52 accommodates deflection of axle 34 in a direction opposite to that being experienced by roll 32.

An alternate embodiment of the present invention is shown in FIG. 5 wherein it can be seen that the upper roll 32 is again supported at points intermediate its ends (it being understood that both ends of the roll are constructed identically) by bearings 36, the latter being in turn supported on shaft 34 by means of intermediate spacers 38. Shaft 34 is provided at its ends with concentric reduced diameter sections 34*a* and 34*b*.

The roll 32 is radially supported at each end by a bearing 42 which is in turn mounted on one end of a tubular sleeve member 64. A cup-shaped member 66 is mounted on the reduced diameter section 34*b* of the shaft 34. Cup-shaped member 66 is provided with a short tapered outer surface 68 and another longer tapered surface 70. The closed end of the cup shaped member 66 is fastened to the shaft 34 by means of screws 72, there being additionally provided a pressure screw 74 bearing against the end of shaft 34 as at 76. By loosening

screws 72 and tightening screw 74, the cup shaped member 70 may be displaced axially away from the end of shaft 34. Adjustment in the opposite direction may be accomplished in a similar manner by loosening screw 74 and tightening screws 72.

A cap 78 is attached to the other end of tubular sleeve 64. A second cap 80 is attached to the outside of cap 78. The piston rod 58 of a piston and cylinder assembly 54 bears against sleeve 64 as at 82. A portion of the external force exerted by piston rod 58 is transmitted through sleeve member 64 and bearing 42 to the end of the roll 32, while the remaining external force is transmitted to the roll through sleeve 64, cup shaped member 66, shaft 34 and bearing 36. The point of transmission between sleeve member 64 and cup-shaped member 66 is at the shoulder 84 formed where the two tapered outer surfaces 68 and 70 meet. Adjustment of the screws 72 and 74 result in axial movement of the cup-shaped member 66 on the reduced diameter end section 34*b* of the shaft, with the result that the relative position of the shoulder 84 relative to the point of application 82 of the external force exerted by piston and cylinder assembly 54 is varied. This produces essentially the same result as that achieved by screwing sleeve 46 into or out of sleeve 44 in the embodiment described above in connection with FIGS. 1 to 4.

Another alternate embodiment of the invention is shown in FIG. 6 wherein it can be seen that the roll 32 is again provided at either end with a bearing 42 which is in turn supported on one end of a tubular sleeve 86. The other end of sleeve 86 has an inwardly projecting flange 88 which is supported as at 90 on a sleeve 92, the latter being axially movable on a nonrotatable shaft 34 extending axially through the roll 32. Shaft 34 is provided with a reduced diameter section 34*a* threaded as at 94. Sleeve 90 has inwardly extending flange 96 which threadably engages shaft 34 as at 98. A retaining nut 100 is also threaded on shaft 34 exterior of flange 96.

Sleeve 92 is further provided with at least one annular spacer 102 on which is mounted a bearing 104, the latter providing radial support for the roll 32 at a point intermediate its ends. The piston rod 58 of a cylinder assembly 54 applies an external force to the sleeve 86 as at 82.

This embodiment may be made to operate in a manner similar to those previously described in connection with FIGS. 1—5 by dividing the sleeve 86 into two parts as shown in FIGS. 1 and 2. Moreover, this embodiment entails the possibility of axially displacing bearing 104 relative to roll 32 by screwing sleeve 92 on shaft extension 34*a* along with appropriate adjustments to nut 100.

Each of the above-described embodiments makes it possible to compensate for the deflection of one nip roll by deflecting the other roll in the same direction, thereby subjecting the material passing therebetween to a substantially uniform nip pressure. Moreover, the adjustability of the foregoing arrangements makes it possible to control deflection without varying the externally applied load.

It is my intention to cover all changes and modifications to the embodiments herein disclosed which do not depart from the spirit and scope of the invention.

I claim:

1. Apparatus for controlling the deflection of a tubular nip roll, said apparatus comprising: a nonrotatable shaft extending axially through the roll; annular bearings radially supporting the ends of said roll, each said bearings in turn being mounted on a tubular assembly, the said tubular assemblies in turn being in contact with and supported by said shaft at locations outside of the roll ends; at least one additional bearing mounted on said shaft, said bearing providing radial support for the roll at points intermediate its ends; means for applying an external force to each said tubular assemblies in a direction opposite to the separating force exerted on the roll at the roll nip; and means for varying the distance between the points of application of said external forces to said tubular assemblies and the locations at which the said tubular assemblies are in contact with said shaft.

2. The apparatus as set forth in claim 1 wherein each said tubular assemblies is comprised of a first sleeve member threadably engaged to a second sleeve member.

3. The apparatus as set forth in claim 1 wherein each said tubular assemblies is comprised of a first sleeve member slidable relative to the second sleeve member, and means associated with the ends of said shaft for axially displacing said first sleeve members relative to said shaft and said second sleeve members.

4. Apparatus for controlling the deflection of a tubular nip roll, said apparatus comprising: bearings rotatably supporting the ends of said roll, said bearings each being mounted on cylindrical sleeve members; a nonrotatable shaft extending axially through said roll and said sleeve members, said shaft carrying at least one additional bearing which provides radial support for the roll at a location intermediate its ends, the said sleeve members in turn being mounted on adjustable members which are movable axially on said shaft; and, means for applying an external force to said sleeve members in a direction opposite to that of the separating force being exerted on the roll at the roll nip, whereby axial adjustment of said adjustable members on said shaft will result in said externally applied force being distributed between said bearings in a manner such that the deflection of said roll will be in the same direction and approximately of the same magnitude as that of the other nip roll.