United States Patent [19]

Avery et al.

[11] **3,784,076**

[45] **Jan. 8, 1974**

[54] **WEB GUIDING APPARATUS**

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[21] Appl. No.: **329,223**

[52] **U.S. Cl.** **226/179,** 226/19, 226/190

[51] **Int. Cl.** **B65h 17/22**

[58] **Field of Search** 226/15, 18–23, 226/179, 190

[56] **References Cited**

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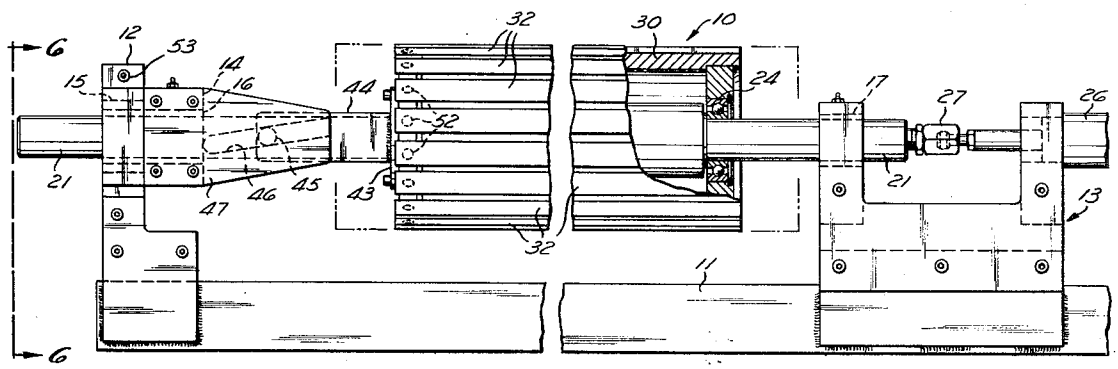
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Assistant Examiner—Gene A. Church
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[57] **ABSTRACT**

A web guide roll is bodily translated in a direction parallel to its axis to one or the other side of an intermediate bodily position and in opposition to lateral shifting of the web. At the same time, the steering action of the roll on the web is varied as a function of the translation of the web to one side or the other of such intermediate bodily position while maintaining the roll axis normal to the desired direction of web travel.

7 Claims, 6 Drawing Figures



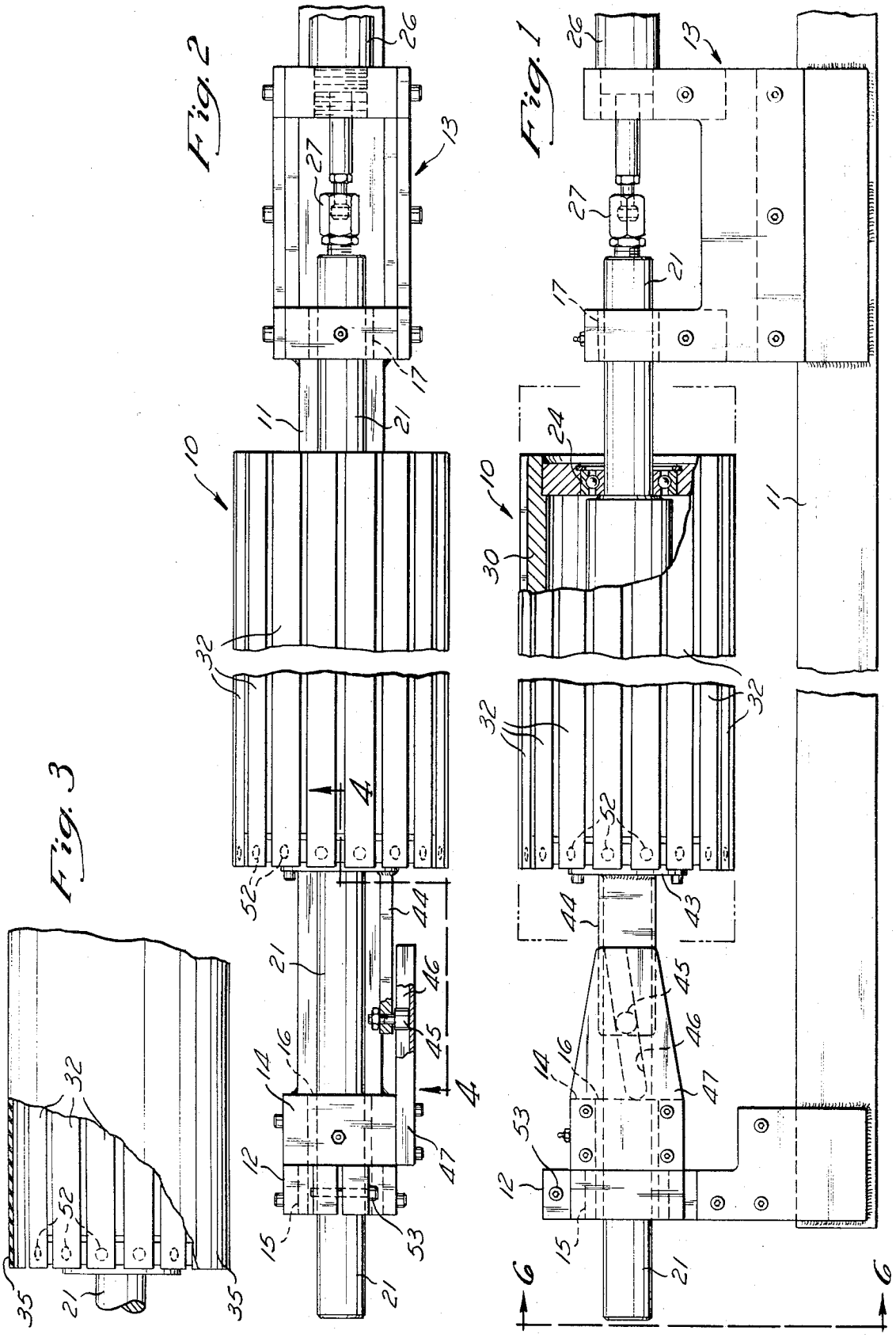
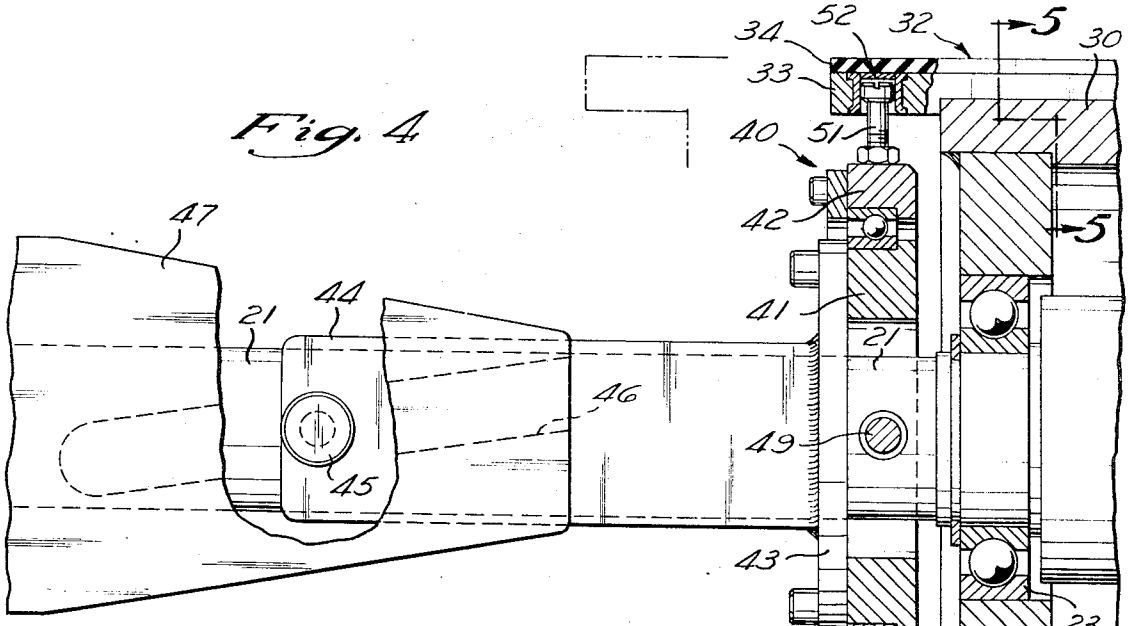

Fig. 1
Fig. 2
Fig. 3
4
4
6
6

Fig. 4



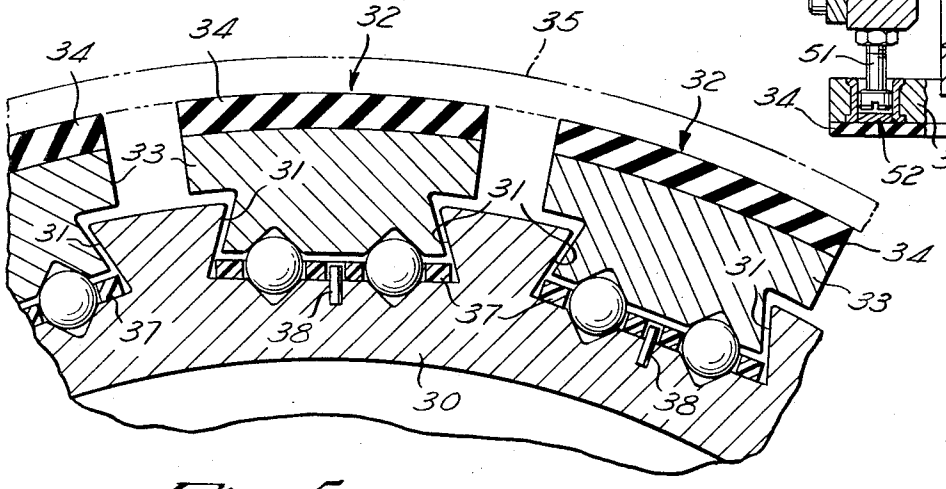


Fig. 5

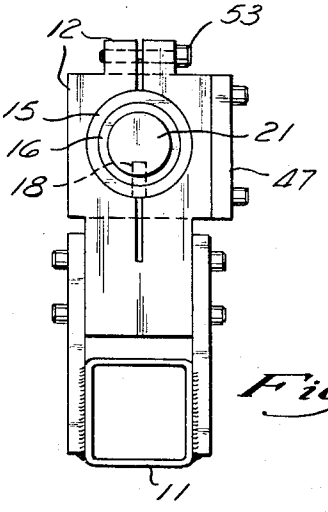


Fig. 6

WEB GUIDING APPARATUS

FIELD OF THE INVENTION

This invention relates to web guiding apparatus, and particularly to a web guide roll.

PRIOR ART REFERENCES

Prior art references include the following U.S. Pat. Nos.:

479,501	2,689,392
678,121	2,713,191
1,068,005	2,722,415
1,738,700	2,735,156
2,289,796	2,735,630
2,340,242	2,752,151
2,461,084	2,786,675
2,562,026	2,797,091
2,643,116	3,052,395
2,682,094	3,095,131

and the following British patents:

2,062 of 1881

11,654 of 1906

SUMMARY OF THE INVENTION

The invention makes it possible to achieve an excellent trade-off between cost of guide roll apparatus and quality of performance of the apparatus, particularly with respect to quality of guiding action, but also with respect to adaptability to varying conditions and varying degrees of wrap. The guiding action of apparatus incorporating the invention is excellent. In some applications performance is believed to be outstanding. Such belief is based on applicants' lack of knowledge of the existence of other guide roll apparatus, regardless of cost, having similar capabilities. For example, the invention can provide for good guiding action by a single guide roll on a continuous non-closed-loop web (to be distinguished from a closed-loop web such as an endless conveyor belt) around a full 180° wrap. Applicants know of no other roll with such a capability. However the advantages of the invention's novel guiding action are substantial regardless of the degree of wrap, and in many applications the invention may be used with only a small degree of wrap.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of web guiding apparatus embodying the invention, with the middle portion broken out to save sapce in the illustration, and with one end partly broken away.

FIG. 2 is a plan view of FIG. 1.

FIG. 3 shows a portion of the roll seen in FIGS. 1 and 2 with an elastomeric cover included and part of the cover broken away. The roll as shown in the first two figures does not include a cover.

FIG. 4 is a view on an enlarged scale taken from the planes of line 4—4 in FIG. 2.

FIG. 5 is a fragmentary sectional view on a further enlarged scale taken from the planes of line 5—5 in FIG. 4.

FIG. 6 is an end view taken from the plane of line 6—6 in FIG. 1.

DESCRIPTION OF AN EMBODIMENT

The roll body generally indicated at 10 is carried on a frame which includes a cross beam 11, an upstanding split block 12 rigidly mounted on the cross beam 11, and an upstanding rigid sub-frame 13 also rigidly mounted on the cross beam 11.

The shaft bearing block 14, provided with a boss 15, is received in a bore in the split block 12. A bushing sleeve 16 extends through the shaft bearing block 14 and boss 15. Another bushing sleeve 17 is supported at the inboard end of the sub-frame 13. The bushings 16 and 17 support a shaft 21 for sliding movement. The shaft 21 is adapted for sliding movement in the bushings 16 and 17, but is held against rotation relative to the shaft bearing block 14 by a key 18 (shown only in FIG. 6).

The roll 10 is carried on the shaft 21 and is supported thereon for rotary motion by bearings 23 (FIG. 4) and 24 (FIG. 1). The shaft 21 does not itself rotate during operation of the guide roll 10. However the shaft 21 is adapted to be translated in the axial direction to one side or the other of its illustrated neutral position by a hydraulic actuating cylinder 26 carried by the sub-frame 13 and operably connected to the shaft 21 by the cylinder rod shaft coupling 27 which has the capability of accommodating slight misalignments. The limits of bodily translation of the roll 10 to one side or the other of its illustrated intermediate position are illustrated in phantom lines in FIG. 1, and one limit is also similarly illustrated in FIG. 4.

The roll proper comprises a tubular beam 30 rotatably supported on the bearings 23 and 24. The beam 30 is provided with a plurality of slideways 31 (FIG. 5) each formed along the entire length of the tube 30. The slideways 31 are provided around the entire annular extent of the tube 30. Slats 32 are received and keyed within the slideways 31 as shown in FIG. 5. The main body 33 of each slat 32 may be formed of aluminum, and the tube 30 may also be formed of aluminum. An elastomeric face 34 may be adhered to each body portion 33 so that the tops of the slats will present a surface of elastomeric material rather than metal.

When a continuous roll surface is desired, or when it is desired to enclose the slat array for purposes of dirt protection, a sheath or sleeve 35 (FIG. 3) may be provided in surrounding grouping relationship with the entire array of slats 32. This sleeve 35 aids in retaining the slats 32 in the slideways 31, and where such a sleeve is not provided, encircling elastic bands (not shown) or the like may be provided around each end of the array of slats to similarly aid in slat retention.

The slat body portions 33 and the bottoms of the slideways 31 are provided with appropriate grooves (FIG. 5) which receive ball bearings. The ball bearings are held in spaced relationship along the lengths of the slats by retainers 37 (FIG. 5) which are simply plastic strips with pairs of holes punched at regular intervals along the strip lengths to receive the ball bearings. At one end of each slideway 31 an anti-drift pin 38 is provided (FIG. 5) which is received in a slot in the retainer 37 that extends a short distance along the length of the retainer. This arrangement allows each retainer 37 to move longitudinally with the shifting movement of its associated slat 32, but prevents the retainer from drifting out one end or the other of the slideway 31.

As most clearly seen in FIG. 4, the slats 32 overhang the tubular beam 30 at one end. These overhanging slat ends surround a camming pin assembly generally indicated at 40. This assembly includes an inner non-rotating bearing block 41 and an outer rotating bearing block 42. A plate 43 fixed to the non-rotating bearing block 41 is in turn fixed to an arm 44 which carries a cam follower 45. A cam track 46 is formed in a stationary cam member 47 which is bolted to the shaft bearing block 14.

The non-rotating bearing block 41 surrounds the shaft 21 in spaced relationship therewith and is pivoted to the shaft 21 on a cross pin 49 (FIG. 4) which extends from each side of the shaft.

A number of camming ins 51 are provided around the periphery of the rotating bearing block 42 in one-to-one association with the slats 32. The camming pins are provided with heads which are received in lined sockets within the ends of the slats, to provide pin-and-socket connections generally indicated at 52. Provision may be made for adjusting the degree of extension of the pins 51 in the manner illustrated.

The orientation of the cross pin 49 and hence of the pivot axis of the camming pin assembly 40 with respect to the cross beam 11 and other frame members may be adjusted by loosening the bolt 53 associated with the split block 12 and then rotating the shaft bearing block 14 to the desired degree before retightening the bolt 53. Such adjustment causes the shaft 21 to rotate through a corresponding angle because it is keyed to the shaft bearing block 14 by the key 18. The pin 49 extending from the shaft corespondingly rotates through the same angle. This in turn causes the camming pin assembly including the normally non-rotating bearing block 41 to move through a corresponding adjustment and to carry along the arm 44. The stationary cam member 47 also automatically moves through a corresponding adjustment because it is fixed on the shaft bearing block 14.

OPERATION

The illustrated guide roll apparatus may be used with a web having any desired degree of wrap up to 180° or more. Assuming a 90° wrap, the illustrated apparatus may be used to guide a web without the provision of auxiliary rolls. The web location may be sensed by any conventional sensing and control means (not shown) designed to determine the degree and direction of error in web location and to supply a corresponding power signal to actuating cylinder 22 to move the roll assembly in a correcting direction. The sensor or sensors of such sensing and control means may be located closely adjacent the on-feed or off-feed points of tangency of the web with the roll or even at the roll itself when the nature of the sensor means permits monitoring of web location on the roll itself.

Assuming a 90° wrap with the in-feeding web reach on the near side of FIG. 1 and parallel to the plane of the paper in such view, and the off-feeding web reach feeding deeper into FIG. 1 in a plane normal to the plane of the paper, the apparatus will operate at the adjusted position shown in the drawings. However for some web materials steering action may be improved by adjusting the position of the shaft bearing block 14 to thereby shift the angular location of the cross pin axis 49 approximately 10° in a counterclockwise direction as viewed from the left end of FIG. 4 or FIG. 1. Other web materials may require other settings for optimization of guiding action. These angular adjustments are not critical, and for many given web materials and degrees of wrap, the adjustment may be varied widely to either side of an optimum setting, which itself may be approximated by simply varying the adjustment until a setting is found which appears to correlate with the most sensitive guiding action. Care should be taken that the phase relationships necessary for proper guiding action are not inadvertently reversed as by adjusting the position of the pivot axis 49 through a 180° angle to thereby cause the corrective steering action of the apparatus to work in opposition to the corrective bodily translation of the roll assembly.

It will be understood from the foregoing that when the camming pin assembly 40 is tilted to any degree, the slats 32 are forced to reciprocate, with eavh revolution of the roll, along the axial direction of the roll and relatively to the roll body through a complete back and forth cycl to one and then the other side of a central position of zero axial displacement.

The imaginary plane defined by the intersection of the axis 21 and the cross pin axis 49 may be referred to as the neutral plane because each of the slats 32 is in its central position of zero axial displacement when passing through this plane even when the camming pin assembly is tilted and regardless of the degree of tilting. Advantageously, the angular position of the neutral plane of the present apparatus may be adjusted while the apparatus is in operation by loosening the bolt 53, shifting the shaft bearing block 14 to a new setting and retightening the bolt 53.

It will be further understood from the foregoing that when the roll body 10 is in its intermediate bodily position as illustrated in the drawings, the camming pin assembly is not tilted in either direction, and the amplitude of back and forth movement of the slats with each revolution of the roll is zero. As the roll body 10 is shifted to one side or the other of its intermediate bodily position, the cam follower 45 and cam 46 interact to force the camming assembly 40 to tilt in one direction or the other, the degree of tilting depending upon the degree of displacement of the roll body 10 from its intermediate bodily position. The degree of tilting of the camming pin assembly 40 determines the amplitude of reciprocation of the slats with each revolution of the roll body. The direction of tilting of the camming pin assembly determines the direction of initial movement of the slats in each cycle of reciprocation.

It is to be noted that the axis of the shaft 21 remains perpendicular to the desired direction of roll travel at all times. The steering action of the roll asssembly 10 is achieved by the reciprocating movement of the slats 32.

When the sleeve or sheath 35 is employed, the motion of the slats 32 is imparted to the points on the surface of the sleeve so that the surface of the roll crawls back and forth in a reciprocating movement in a manner suggestive of a snakeskin.

Other linkages may be employed to accomplish a similar "snakeskin" action correlated in the same way with bodily translation of the guide roll in axial directions to one side or the other of an intermediate bodily position. For example, guide roll apparatus could be provided whose construction is identical to that of the illustrated roll except for the roll proper which would

be comprised of a series of non-rotating bearing blocks tied to the non-rotating bearing block **41** for pivoting movement therewith about the roll shaft, and a series of rotating bearing blocks associated with such series of non-rotating bearing blocks. The camming pins **51** and the slats **32** and tubular beam **30** and associated members would be eliminated in such a construction, and a rubber sleeve would directly surround the rotating bearing blocks. The snakeskin action of such a construction would be similar to that of the illustrated apparatus, but it would lack the advantages of simplicity and strength, and particularly depth of section, of the tubular beam construction of the illustrated slat roll.

Similarly, a roll consisting of a number of segments such as the roll 19 of U.S. Pat. No. 2,349,242 could be employed with a linkage that would cause the tilting of the individual segments making up the roll **19** of such patent to tilt progressively more in one direction or the other as the roll body comprised of such sections are bodily translated to one side or the other of an intermediate bodily position. However it would not be possible to surround such a roll with a single continuous elastomeric sleeve.

In the accompanying claims, "surface of the guide roll" refers to the web-contacting surface of the roll whether it be an elastomeric sleeve, slat faces, annular bearing block peripheries, tilting segment surfaces, or whatever.

What is claimed is:

1. Web guiding apparatus including a web guide roll mountable transversely to and in arcuately extending contact with a web to be guided in a desired direction of web travel, means to bodily translate said guide roll in axial directions to one side or the other of an intermediate bodily position in response to and in opposition to lateral shifting of the web to be guided, means for shifting the surface of the guide roll in the axial direction as the guide roll turns to thereby provide a steering action of the guide roll on the web while maintaining the roll axis perpendicular to said desired direction of web travel, said last named means changing the intensity and direction of its steering action proportionately to the degree of displacement and direction of displacement of the guide roll from its intermediate bodily position.

2. Web guiding apparatus including a web guide roll mountable transversely to and in arcuately extending contact with a web to be guided, means to bodily translate said guide roll in axial directions to one side or the other of an intermediate bodily position in response to and in opposition to lateral shifting of the web to be guided, points on the surface of the guide roll being reciprocable, with each revolution of the roll, along the axial direction of the roll and relatively to the roll body through a complete back and forth cycle to one and then the other side of a central position of zero axial displacement, the amplitude of such reciprocation being zero when the roll is in its intermediate bodily position, the amplitude varying from zero directly with the displacement of the roll from its intermediate bodily position, the direction of initial movement of the points in each cycle of reciprocation changing according to whether the roll is on one or the other side of its intermediate bodily position.

3. Apparatus as in claim **2** in which the roll comprises a tubular beam portion of a depth of section almost as great as the outside diameter of the roll for strong support against bending load deflections, and a plurality of slats slidingly guided on the tubular beam portion.

4. Apparatus as in claim **3** including camming means for controlling the sliding movement of the slats as a function of the rotation of the roll to provide such reciprocation of points at the surface of the roll.

5. Apparatus as in claim **4** in which the direction and degree of tilt of the camming means is mechanically linked to the direction and degree of said translation of the guide roll to one side or the other of said intermediate bodily position.

6. Apparatus as in claim **3** in which the slats are surrounded and covered by an elastomeric sleeve.

7. Guide roll apparatus including a roll comprising a tubular beam, end bearing means at the ends of the beam, axially extending slideway in the outside surface of the beam, and slats in the slideways, said roll being mountable transversely to and in arcuately extending contact with a web to be guided in a desired direction of web travel, means to bodily translate said roll in axial directions to one side or the other of an intermediate bodily position in response to and in opposition to lateral shifting of the web to be guided, means comprised at least in part of said slats for shifting the surface of the roll in the axial direction as the roll turns to thereby provide a steering action of the guide roll on the web while maintaining the roll axis perpendicular to said desired direction of web travel, said last named means changing the intensity and direction of its steering action proportionately to the degree of the displacement and direction of displacement of the roll from its intermediate bodily position.

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