Oct. 15, 1963 H. R. RICHARDS ETAL 3,107,036

SELF-ADJUSTING WEB GUIDING APPARATUS

Filed Sept. 14, 1961 3 Sheets-Sheet 1

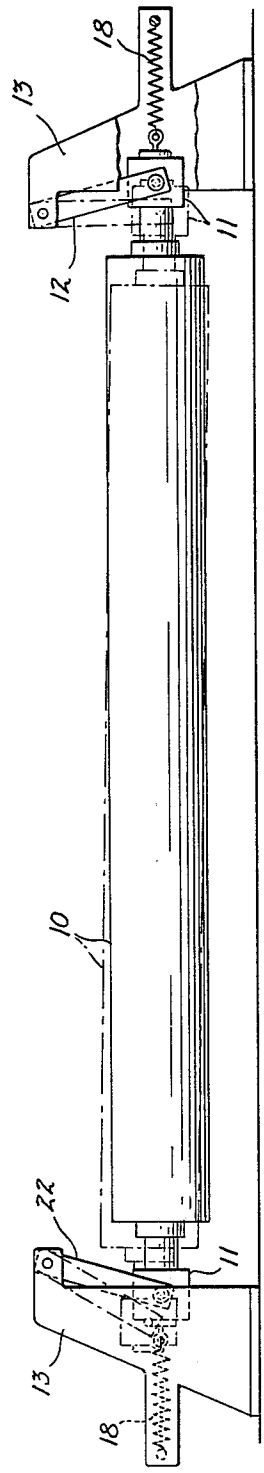



Fig. 1

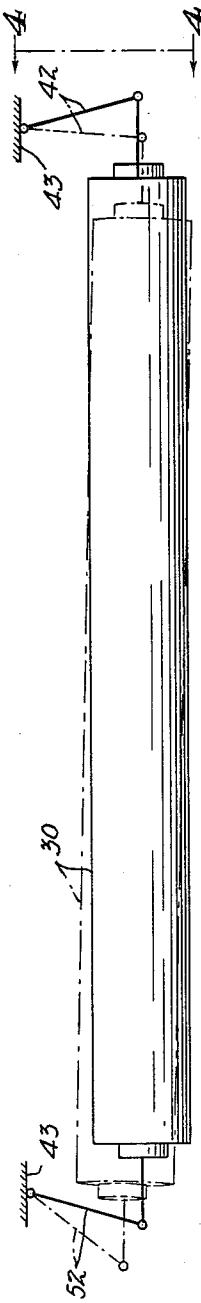



Fig. 3

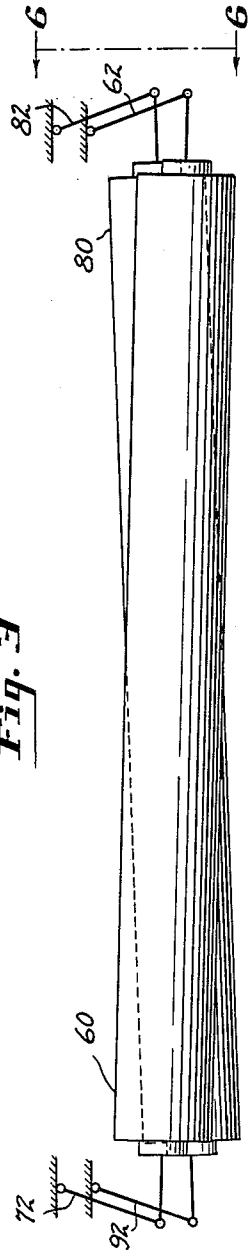



Fig. 5

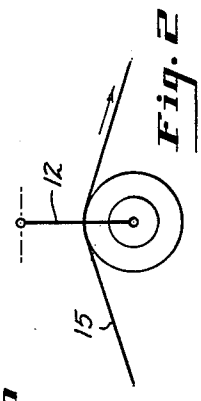



Fig. 2

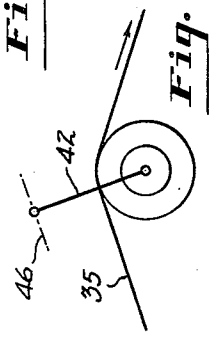



Fig. 4

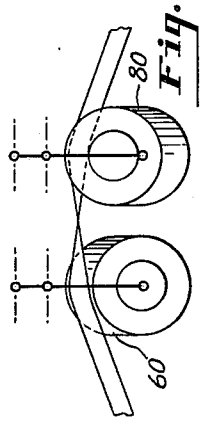



Fig. 6

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SELF-ADJUSTING WEB GUIDING APPARATUS

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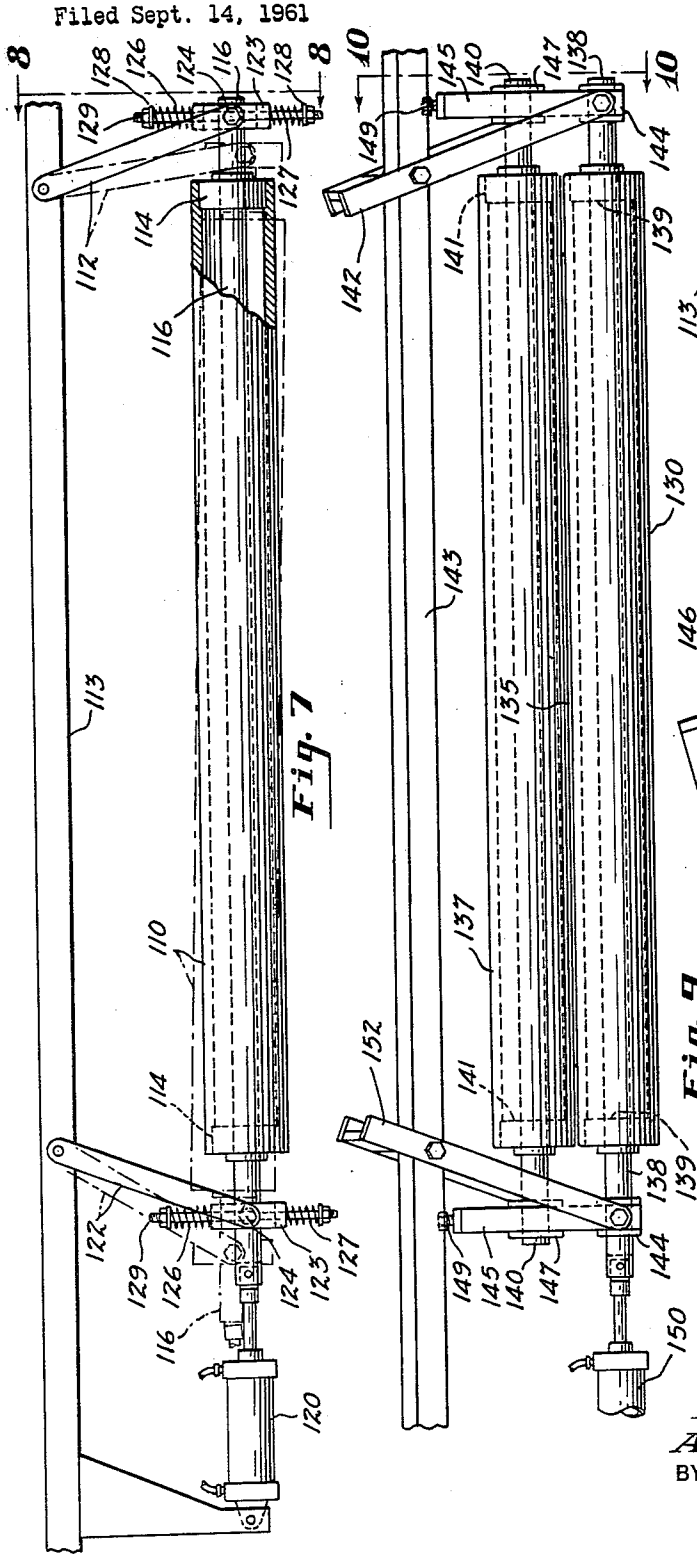


Fig. 7

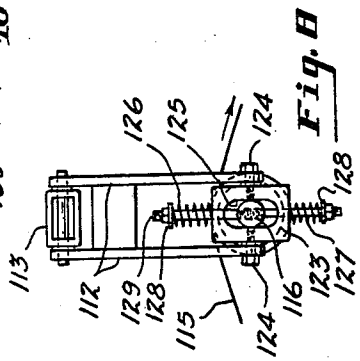


Fig. 8

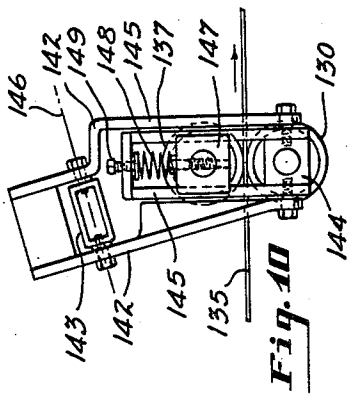


Fig. 10



Fig. 9

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SELF-ADJUSTING WEB GUIDING APPARATUS

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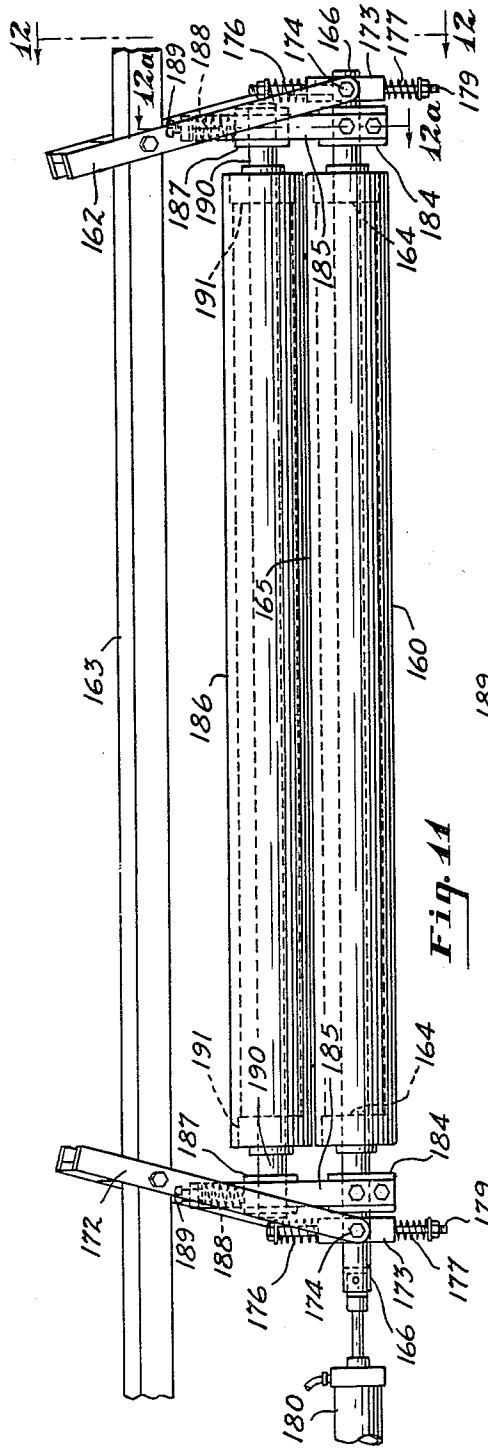



Fig. 11

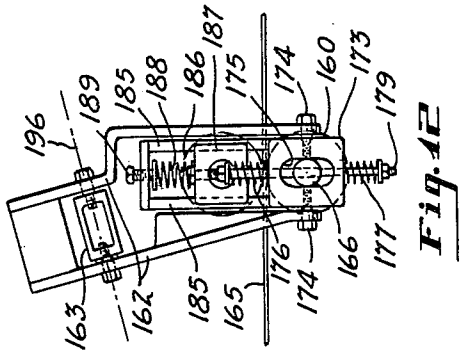



Fig. 12

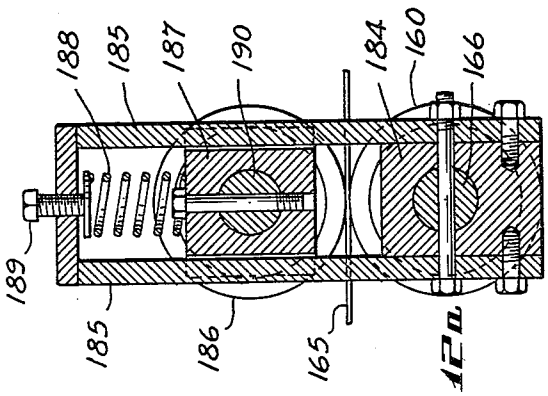



Fig. 12a

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3,107,036

# SELF-ADJUSTING WEB GUIDING APPARATUS

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15 Claims. (Cl. 226—198)

This invention relates to apparatus for guiding and centering traveling webs of paper, fabric, film, metal and the like.

Various types of guide rolls and the like have been provided for longitudinally shifting the unwind faces of web carrying rolls or for longitudinally shifting intermediate guide rolls, the latter being shown in U.S. Patents 2,722,415 and 2,797,091

In prior proposals for longitudinally shifting the rolls, there has been involved the use of means responsive to lateral deviation of the web for directing the roll journaling means. Such responsive means has comprised edge sensing means which through control linkages actuate the roll journaling means to swivel the roll to provide a corrective guiding action and for simultaneously shifting the roll (laterally with respect to the web, longitudinally with respect to the roll itself) in the proper direction to accomplish quick-correct transverse translation of the web.

The present invention accomplishes both (1) quick-correct lateral translation of the web and (2) corrective adjustment of the guide action of the roll and accomplishes both these functions in a manner which is inherent in the mounting of the roll means without the necessity for an error responsive means and a directing means controlled by the error responsive means, although these may be employed where necessary or desirable in specific applications.

It is appreciated that numerous rolls of the "self-centering" type have been heretofore provided which do not inherently require auxiliary error sensing and directing apparatus. However such self-centering rolls have not accomplished the bodily lateral quick-correct action contemplated by the present invention. Devices which have accomplished such quick-correct lateral translation of the roll have inherently required powered linkages controlled by edge sensing devices.

One important object of the present invention is to accomplish web control, including bodily lateral translation of the roll in a quick-correct action, by means which is relatively simple in the structural sense. In this aspect, in some applications the invention may be advantageously employed with powered control linkage and edge sensing devices.

Another aspect of the invention contemplates the provision of biased lost-motion linkages whereby a given amount of web misalignment occasions a relatively low degree of corrective guide roll displacement, but reactive forces for applying the corrective action are maintained in that loading of the biasing means accompanies the reduction in the degree of guide roll displacement.

Another feature of the invention is that it opens the way for the provision of a guide roll or centering roll means to which all the above remarks apply and which may also advantageously be arranged to provide compound swiveling movements or adjustments of the web guiding attitude of the roll whereby the roll and web relationship is varied both with respect to increasing or decreasing the height of either end of the roll with respect to the web and also with respect to increasing or decreasing the degree by which one or the other end of the roll extends in the approach direction of the web.

Another feature of the invention is the possibility of providing a plurality of rolls which are successively engaged by passing web and which are mounted according



to the general concepts of the invention but in such a way that a pair of the rolls function together as an operative unit for centering and crowding action on a web being guided thereover.

These and other objects and advantages of the invention will become more fully apparent from the following description of examples of the invention together with the accompanying drawings, in which:

FIGURE 1 is an elevational view of a roll embodying the invention.

FIGURE 2 is a diagrammatic end view of the roll shown in FIGURE 1, with a web on the roll.

FIGURE 3 is a diagrammatic view similar to FIGURE 1 showing an alternative guide roll means.

FIGURE 4 is a diagrammatic end view of the roll shown in FIGURE 3, with a web on the roll.

FIGURE 5 is a diagrammatic elevational view showing a guide roll scheme employing a pair of rolls similar to those illustrated in FIGURE 1 but mounted in a slightly different manner.

FIGURE 6 is a diagrammatic side elevation of the apparatus shown in FIGURE 5, with a web on the rolls.

FIGURE 7 is an elevational view similar to FIGURE 1 showing another roll guide means.

FIGURE 8 is an end elevation of the apparatus shown in FIGURE 7.

FIGURE 9 is an elevational view showing a roll arrangement similar to FIGURE 3 but provided with a second roll which constitutes a nip roll.

FIGURE 10 is an end elevation of the apparatus shown in FIGURE 9.

FIGURE 11 is an elevational view showing a roll arrangement combining certain features of the structures of FIGURES 7 and 9.

FIGURE 12 is an end elevation of the apparatus shown in FIGURE 11.

FIGURE 12*a* is an enlarged sectional view taken from the plane of line **12***a*—**12***a* in FIGURE 11.

Shown in FIGURE 1 is a roll **10** over which passes a web **15** (FIGURE 2). The roll is provided with journaling means which in the embodiment includes a pair of journal boxes **11** each located at its own end of the roll **10**. A first hanging link **12** is provided at one end of the roll **10** and is suspended from a supporting frame **13** and is connected to the journal box **11**. It will be noted that the point at which the link **12** is suspended from the supporting frame **13** is located upwardly and laterally inwardly of the point at which the link **12** is connected to the journal **11**. The term "upwardly" as here used refers to the given direction from the central axis of the roll in which lies the arc of contact between the passing web and the roll, and particularly the center of the arc of contact. The point at which the link **12** is suspended from the supporting frame **13** thus will be seen to lie (with respect to the point of support of the journal **11**) along a direction having a vector in such "up" or given direction and in this particular case coinciding with such given direction.

At the opposite end of the roll **10** is provided a hanging link **22** which is suspended from another portion of the supporting frame **13** and is connected to the journal **11** at the associated end of the roll **10**. Again it will be seen that the point at which this hanging link **22** is suspended from the supporting frame means **13** is located upwardly and laterally inwardly of the point at which it is connected to the journal **11**.

If the passing web **15** is properly centered on the roll **10**, the roll will adopt the neutral position shown in solid line in FIGURE 1. If the web then passes off-center to the right as viewed in FIGURE 1, there will be an increased fabric load toward the right end of the roll, and the resultant forces on the roll will be such as to cause the roll to cant and to shift toward the dotted line posi-

tion shown in FIGURE 1. The web therefore will be quickly shifted in a corrective direction toward the left and at the same time will have a tendency to climb to the left toward what becomes the high end of the roll. Thus both a quick-correct bodily lateral translation of the web and a corrective adjustment of the guiding relationship between the roll and the web both are accomplished without any auxiliary edge sensing and control means. It will be understood that the linkage shown in FIGURE 1 may be centered other than by gravity and the tension on the web, as with the springs **18** to resiliently urge the roll **10** toward the neutral position. If the apparatus is, for example, inverted from the position shown in FIGURE 1 so that the links in fact extend in the "down" direction (using "down" in its usual sense) and with the web passing under the roll, the same guiding action will be accomplished as in the operation described above. In this attitude, "up" for the purposes of the present discussion will again be understood to mean the direction from the central axis of the roll in which lies the arc of contact between the passing web and the roll.

Shown in FIGURE 3 is a roll **30** over which passes a web **35**. End links **42** and **52** are provided which are generally similar to the end links **12** and **22** except that they are pivotally connected to the frame means **43** about axes which are inclined to the horizontal, that is, are other than normal to the given direction from the central axis of the roll in which lies the center of the arc of the contact between the passing web and the roll. Thus, as shown in FIGURE 4, the link **42** pivots about the imaginary axis **46** and the link **52** pivots about another imaginary axis which lies directly behind the imaginary axis **46** as viewed in FIGURE 4. It will be seen that the point at which the link **42** is suspended from the supporting frame **43** is located upwardly and laterally inwardly of the point at which the link **42** is connected to the journaling means for the roll **30**. That is, the point of suspension lies (with respect to the point of journal support) along a direction having a vector in the above-mentioned given direction, although not in this case coinciding with such given direction. The result is that as an end of the roll moves downwardly from the normal position shown in FIGURE 3, it also moves in the approach direction of the passing web. Conversely, the opposite end which moves upwardly also moves in the departing direction of the passing web. This skewing of the roll with respect to the passing web is in a direction which amplifies the corrective guiding action.

Shown in FIGURES 5 and 6 is a web guiding roll assembly comprising a pair of rolls **60** and **80** similar to the rolls **10** and **30**. The rolls **60** and **80** are shown in FIGURE 5 in the positions which they assume when no web is being supported on them. The roll **60** is provided with end links **62** and **72** and the roll **80** is provided with end links **82** and **92**. The pairs of end links **62** and **72**, and also **82** and **92**, are in general similar to the end links **12** and **22**. It will be seen that the end link **82** is pivoted to the frame structure at a point somewhat above that at which the end link **92** is pivoted to the frame structure; and that conversely the end link **72** is pivoted to the frame structure at a point somewhat above that at which the end link **62** is pivoted to the frame structure. Other equivalent arrangements to accomplish sloping of the rolls in the unloaded condition may be employed, as for example, hanging the links from a common level on the supporting frame structure but making the links **62** and **92** relatively longer than, respectively, the links **72** and **82**.

The center of the arc of contact of the passing web with the rolls **60** and **80** will be seen to be respectively slightly to the left and right of these rolls as they are viewed in FIGURE 6. Thus the center of the arc of contact for the roll **60** is along a first given direction to one side of the axis of roll **60** which given direction extends upwardly and slightly to the left as viewed in FIGURE 6.



The center of the arc of contact for the roll **80** is along a second given direction to one side of the axis of roll **80** which given direction extends upwardly and slightly to the right as viewed in FIGURE 6.

The links **62** and **82** are on the same side of the web, and the links **72** and **92** are on the opposite side of the web. Both in the positions shown in FIGURE 5 and in the normal running condition of the apparatus, the point at which the links **62** and **72** support the journaling means of the roll **60** will be seen to be displaced from each other—with respect to such first (or second) given direction—in the same sense respectively as are the links **92** and **82**. Thus the journal supporting point associated with the link **62** is below that of the link **72** and the journal supporting point of the link **92** is below that of the link **82**.

When a web is carried on the rolls **60** and **80**, the high left side of the roll **60** and the high right side of the roll **80** as viewed in FIGURE 5 will be loaded in such a way as to cause each of the rolls to both (1) shift toward the center of the apparatus and (2) lower their high ends. This occurs even if the web is perfectly centered. This condition is the normal condition of the assembly when the web is running. The movement of each of the rolls from its position shown in FIGURE 5 to such normal running position does not exhaust the range of movement of each roll. This may be most clearly demonstrated by the fact that this adjustment to "normal" running condition will be progressively greater as progressively wider webs are placed on the apparatus. When the apparatus, loaded with the web, is running in such normal condition, the left end of the roll **60** and the right end of the roll **80** will each still be slightly high.

If now the web shifts to the right as shown in FIGURE 5, the roll **80** will be caused to increase its shift toward the left and to further lower its high right end to thereby correct the web misalignment. The converse will happen (shifting of the roll **60** to the right and further lowering of its high left end) if the web moves to the left of the apparatus. If the web remains centered but varies in width, increasing width will cause further inward shifting of both the rolls **60** and **80** to thereby cause the web to "crowd" toward its centerline.

It will be noted that all this may be accomplished where appropriate without auxiliary edge sensing apparatus and power control means.

Shown in FIGURE 7 is a roll **110** over which passes a web **115** (FIGURE 8). The roll is provided with journaling means which in this embodiment comprises cartridge bearings **114** together with a non-rotating shaft **116** on which the cartridge bearings are supported and on which the outer races thereof rotate. A first hanging link **112** is provided at one end of the roll **110** and is suspended from a supporting beam **113** at a point which is located upwardly and laterally inwardly of the point at which the link **112** is joined to the non-rotating shaft **116** which comprises part of the journal means for the roll **110**. Again the term "upwardly" as here used refers to the given direction from the central axis of the roll in which lies the arc of contact between the passing web and the roll, and particularly the center of the arc of contact. The point at which the link **112** is suspended from the supporting member **113** thus will be seen to lie (with respect to the point of support of the journal means comprising the non-rotating shaft **116** and cartridge bearings **114**) along a direction having a vector in such "up" or given direction and, in the particular case illustrated in FIGURE 7, coinciding with such given direction.

A first lost-motion connecting means is provided between the link **112** and the journaling means at the end of the roll associated with the link **112**. The lost-motion connecting means in the embodiment illustrated comprises a slotted block **123** to which the link **112** is pivotally attached by the pins **124**. As may be seen most clearly in FIGURE 8, the shaft **116** is slidingly received in a slot

125 formed in the block 123. The shaft 116 may move back and forth along the slot 125 through the neutral position which is illustrated in FIGURE 8. The lost motion will be seen to be in a direction having a vector extending in the "up" or given direction as defined above.

Biasing means is provided between the link 112 and the journaling means. The biasing means comprises a pair of compression springs 126 and 127 each of which bears on an end washer 128 tied to a vertical (i.e., transverse to the shaft 116) rod 129 which is fixed to the shaft 116 near the end thereof. In the particular embodiment, the springs 126 and 127 respectively resist displacement of the shaft 116 downwardly and upwardly from the neutral position shown in FIGURE 8.

At the opposite end of the roll 110, there is provided a hanging link 122 which is suspended from another portion of the supporting member 113 and is connected to the journaling means at the associated end of the roll 110. Again, it will be seen that the point at which the hanging link 122 is suspended from the supporting frame means is located upwardly and laterally inwardly of the point at which it is connected to the journal means comprising the cartridge bearings 114 and non-rotating shaft 116.

At the end of the roll associated with the link 122 are provided second lost-motion connecting means, generally similar to the means described above, and providing a lost-motion connection between the link 122 and the journaling means at the associated end of the roll. The elements of this lost-motion connection are generally similar to those previously described and are indicated with like reference numerals. The spring 126 at the end of the roll associated with the link 122 resists displacement of the shaft 116 in the downward direction, and the spring 127 resists displacement thereof in the upward direction.

The roll shown in the particular embodiment illustrated can be allowed to function as a self-adjusting roll without auxiliary edge sensing and power link means. However in the illustration, a power linkage means is shown comprising a hydraulic cylinder 120, pivotally attached to the mounting frame structure and linked for reciprocating actuation of the non-rotating shaft 116. The plunger 120 may be advanced or retracted from the neutral position illustrated by suitable control means (not shown) associated with a suitable edge senser device (not shown), a variety of which are known to the art.

If the passing web 115 is precisely centered on the roll 110, the roll will remain at the neutral position shown in FIGURE 7. If the web then passes off center to the right, as viewed in FIGURE 7, there will be an increased fabric load toward the right end of the roll, and the resultant forces will be such as to cause the roll to cant and to shift toward the dotted line position shown in FIGURE 7. If an edge senser means and the power linkage comprising the hydraulic cylinder 120 is provided, the roll will be positively actuated toward the dotted line position shown in FIGURE 7. In either case, the web will be quickly shifted in a corrective direction toward the left and at the same time will have a tendency to climb to the left toward what becomes the high end of the roll. Thus both a quick-correct bodily lateral translation of the web and a corrective adjustment of the guide relationship between the roll and the web both are effectively accomplished.

The provision of the lost-motion linkage greatly reduces the distortion of the passing web attendant upon corrective shifting motion of the roll back and forth through its neutral position. Some web material, as for example sheet steel, can be distorted only through extremely narrow tolerances. At the same time the nature of such material is such that very small displacements are accompanied by relatively high corrective forces. By the provision of the described lost-motion connections, these characteristics of web material such as sheet steel are accommodated. But it will be understood that the basic functioning of the apparatus has much in common with the functioning of the apparatus of FIGURE 1. With the lost-motion connection provided as in the apparatus of FIGURE 7, there may be much less progressive guide roll displacement (vertical motion of the roll ends) as the roll structure progressively shifts from neutral position, as compared with the roll displacement (vertical motion of the roll ends) of the apparatus of FIGURE 1. How much less displacement there may be depends upon factors such as the "give" of the web material and the spring rate of the springs 126 and 127.

To the extent that, at a given degree of web misalignment, the corrective guide roll displacement is less than it would be without provision of the lost-motion linkage, then to that extent is the loading of the spring 126 or 127 increased to apply reactive forces for maintaining effective corrective action.

Shown in FIGURE 9 is a roll 130 over which passes a web 135 (FIGURE 10). It is to be noted that the web 135 is not wrapped on the roll 130 and therefore the arc of contact between the web and the roll as referred to above is so small as to approach line contact. However due to the elasticity of the roll and the web, there is always arcuate contact to a small degree and reference therefore still may be made with consistency to the given direction from the central axis of the roll in which lies the center of the arc of contact between the passing web and the roll.

End links or end link assemblies 142 and 152 are provided which are pivotally connected to a frame member 143 about axes which are inclined to the horizontal, that is, are other than normal to the given direction from the central axis of the roll in which lies the center of the arc of contact between the passing web 135 and the roll.

Thus, as shown in FIGURE 10, the link 142 pivots about the imaginary axis 146 and the link 152 pivots about another imaginary axis which lies directly behind the imaginary axis 146 as viewed in FIGURE 10. As an end of the roll moves downwardly from the normal position shown in FIGURE 9, it moves in the approach direction of the passing web. Conversely, the opposite end of the roll which moves upwardly moves in the departure direction of the passing web. This skewing of the roll with respect to the passing web is in a direction which augments the corrective guiding action.

To provide guiding engagement between the roll 130 and the passing web 135 in the absence of wrapping engagement, there is provided a nip roll 137 which comprises a second parallel roll mounted coextensively with the roll 130 for movement bodily with the roll 130. There is provided nip-maintaining biasing means urging the rolls toward initial contact with each other along the center of the arc of contact between the passing web 135 and the roll 130.

In the particular structure illustrated, the roll 130 is mounted on a non-rotating shaft 138 by means of cartridge bearings 139 and the roll 137 is mounted on a non-rotating shaft 140 by means of cartridge bearings 141. The non-rotating shaft 138 is fixed to end blocks 144 which rigidly support upstanding guide bars 145 in which is sliding block 147 is received. The sliding block 147 is downwardly biased by a spring 148 (FIGURE 10) the force of which may be adjusted by an adjustment bolt 149.

The web 135 has been illustrated as having no wrap on the roll 130. However in some applications it may be desirable to have some wrap. The provision of the nip roll may be of advantage even where there is some wrap of the web 135 on the roll 130, particularly where the wrap is very slight.

Shown in FIGURE 11 is a roll 160 over which passes a web 165. The roll is provided with journaling means which comprises cartridge bearings 164 together with a non-rotating shaft 166 on which the cartridge bearings are supported.

A first hanging link 162 is provided at one end of the

roll 160 and is suspended from a supporting frame 163. Again it will be understood that the point at which the link 162 is suspended from the supporting member 163 will be seen to lie along a direction having a vector in the given direction from the central axis of the roll in which lies the arc of contact of the passing web and the roll, and particularly the center of the arc of contact. It will be seen that the web 165 is not wrapped on the roll 160 and it will therefore again be understood that the arc of contact between the web and the roll is so small as to approach line contact but, due to the elasticity of the roll and web, there always remains at least a small degree of arcuate contact.

A first lost-motion connection means is provided between the link 162 and the journaling means at the associated end of the roll. The lost-motion connection means comprises a slotted block 173 to which the link 162 is pivotally attached by the pins 174 (FIGURE 12). The non-rotating shaft 166 is slidingly received in a slot 175 formed in the block 173. The shaft 166 may move back and forth along the slot 175 through the neutral position which is illustrated in FIGURE 12. The lost motion will be seen to be in a direction having a vector extending in the "up" or given direction as defined above.

Biasing means is provided between the link 162 and the journaling means. The biasing means comprise a pair of compression springs 176 and 177 each of which bears on its own associated end washer which in turn is tied to a vertical (i.e., transverse to the shaft 166) rod 179, which is fixed to the shaft 166 near the end thereof. In the particular embodiment, the springs 176 and 177 respectively resist displacement of the shaft 166 downwardly and upwardly from the neutral position shown in FIGURE 12.

At the opposite end of the roll 160, there is provided a hanging link 172 which is suspended from another portion of the supporting member 163 and is connected to the journal means at the associated end of the roll 160. Again, it will be seen that the point at which the hanging link 172 is suspended from the supporting frame means is located upwardly and laterally inwardly of the point at which it is connected to the journal means comprised of the cartridge bearings 164 and the non-rotating shaft 166. At the end of the roll associated with the link 172 are provided second lost-motion connection means generally similar to the means described immediately previously and which provide a lost-motion connection between the link 172 and the journal means at the associated end of the roll. The elements of this lost-motion connection are generally similar to those previously described and are indicated with like reference numerals. The spring 176 at this end of the roll resists displacement of the shaft 166 in the downward direction and the spring 177 resists displacement thereof in the upward direction.

The end links or end link assemblies 162 and 172 are pivotally connected to the frame members about axes which are inclined to the horizontal, that is, are other than normal to the given direction from the central axis of the roll in which lies the center of the arc of contact between the web 165 and the roll. Thus, as shown in FIGURE 12, the link 162 pivots about an imaginary axis 196 and the link 172 pivots about another imaginary axis which lies directly behind the imaginary axis 196 as viewed in FIGURE 12. As an end of the roll 160 moves downwardly from the normal position shown in FIGURE 11, it moves in the approach direction of the web, and the opposite end of the roll which moves upwardly moves in the departure direction of the web.

There is provided a nip roll 186 which comprises a second parallel roll mounted coextensively with the roll 160 for movement bodily with the roll 160. There is provided nip-maintaining biasing means urging the rolls toward initial contact with each other along the center of the arc of contact between the web 165 and the roll 160.

The roll 186 is mounted on a non-rotating shaft 190 by means of cartridge bearings 191. The non-rotating shaft 166 rigidly supports end blocks 184 which rigidly support upstanding guide bars 185 on which a sliding block 187 is received. The sliding block 187 is downwardly biased by a spring 188 (FIGURES 12, 12*a*) the force of which may be adjusted by an adjustment bolt 189.

The guide roll apparatus of FIGURES 9 and 11 may be allowed to function as self-adjusting rolls without auxiliary position sensing and power linkage control means. However in many applications it may be desirable to provide such means particularly where there is no wrap of the web over the guide roll. Therefore there are illustrated in the drawings, hydraulic cylinders 150 and 180 respectively associated with the apparatus of FIGURES 9 and 11 and corresponding to the hydraulic cylinder 120 of the apparatus of FIGURE 7. It will be understood that the apparatus of FIGURES 1, 3, and 5 may be similarly provided with power linkage means and position sensing control means.

The web 165 may be wrapped on the roll 160 rather than having no wrap as illustrated.

When the guided web is fiber or plastic, it is usually preferred to employ a rubber-covered nip roll. Where the web is sheet steel, the nip roll is preferably a steel roll with a knurled or roughened finish which is hardened.

While the illustrated linkages and particularly the hanging link arrangements are presently preferred from the viewpoint of simplicity of the apparatus, it should be evident that in more general aspects of the invention other mechanical arrangements equivalent to the illustrated structures may be employed so long as the equivalent shifting movements of the rolls are accomplished. The following observations are pertinent to this point.

Shown in solid lines in FIGURES 1, 3, 7, 9, and 11 are the "normal" positions of the rolls 10, 30, 110, 130 and 160 which "normal" position obtains when the web is perfectly centered along the desired path of movement. Such "normal" positions of the rolls 60 and 80 of FIGURE 5 would be respectively slightly to the right and left of the solid line positions shown in FIGURE 5. For purposes of analyzing the desired motion of the end supports, there can be applied a rectilinear Cartesian coordinate system having as an origin the longitudinal centers of the rolls at the "normal" position of the rolls, and having as ordinates the distances in the direction from such origin toward the center of the arc of contact of the web with the roll, and having as abscissae the transverse distances (transverse with reference to the desired path of web movement) from the origin toward one certain end of the roll. The slope of the path of movement of the journaling means at this certain end of the roll will be positive according to such coordinate system and the slope of the path of the opposite journaling means at the opposite end of the roll will be negative. Furthermore, in the case of the apparatus of FIGURES 1, 3, 7, 9, and 11, the paths of movement of the journaling means at the opposite ends of the rolls will be symmetrical with respect to an imaginary plane which at the "normal" position of the roll is perpendicular to the axis of the roll and intersects the origin of the coordinate system.

The above description of the invention should make it apparent that many details of the apparatus embodying the invention may be varied without departing from the teaching of the invention. By way of further and more mundane examples of variations, the apparatus shown in FIGURE 3 or that shown in FIGURE 5 may be inverted and if desired be provided with centering means similar to the springs 18 shown in FIGURE 1. Dashpots may replace or supplement the springs 18 where conditions are encountered causing the roll to undesirably move rapidly back and forth through neutral position. A nip roll may be associated with the roll 110 of FIGURE 7 by foreshortening the roll to accommodate mounting of elements on the shaft 116 which would be substantially identical to the elements 184—191 of the apparatus of

FIGURE 11. Accordingly, the scope of the invention is not to be limited to precise details of the specifically described embodiments.

This application is in part a continuation of our application Serial No. 72,059, filed November 28, 1960.

What is claimed is:

1. In web-guiding apparatus, a roll, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being suspended from said supporting frame means and itself supporting said journaling means with the point at which said first link means is suspended from said supporting frame means being located upwardly and laterally inwardly of the point at which said first link means supports said journaling means, said second link means being suspended from said supporting frame means and being connected to said journaling means with the point at which said second link means is suspended from said supporting frame means being located upwardly and laterally inwardly of the point at which said second link means supports said journaling means, said apparatus being free of connection with any web-edge-sensing servomechanism means.

2. In web-guiding apparatus, a roll, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being suspended from said supporting frame means and itself supporting said journaling means with the point at which said first link means is suspended from said supporting frame means being located upwardly and laterally inwardly of the point at which said first link means supports said journaling means, said second link means being suspended from said supporting frame means and being connected to said journaling means with the point at which said second link means is suspended from said supporting frame means being located upwardly and laterally inwardly of the point at which said second link means supports said journaling means, a second parallel roll, means mounting said second parallel roll coextensively with said first-recited roll for movement bodily with said first-recited roll, and nip-maintaining biasing means urging said rolls toward each other.

3. In web-guiding apparatus, a roll for guiding a web which contacts a portion of the periphery of the roll along an arc of contact the center of which is in a given direction to one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being supported on said supporting frame means and itself supporting said journaling means with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, said second link means being supported on said supporting frame means and itself supporting said journaling means with the point at which said second link means is supported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, said apparatus being free of connection with any web-edge-sensing servomechanism means.

4. In web-guiding apparatus, a roll for guiding a web which contacts a portion of the periphery of the roll along an arc of contact the center of which is in a given direction to one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being supported on said supporting frame means and itself supporting said journaling means with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, first lost-motion connecting means between said first link means and said journaling means at the end of the roll associated with said first link means, the lost motion of said first lost-motion connecting means being back and forth through a first neutral point and back and forth along a direction having a vector extending in said given direction, first biasing means between said first link means and said journaling means for resisting displacement of said first lost-motion connecting means from said first neutral point, said second link means being supported on said supporting frame means and itself supporting said journaling means with the point at which said second link means is supported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, second lost-motion connecting means between said second link means and said journaling means at the end of the roll associated with said second link means, the lost motion of said second lost-motion connecting means being back and forth through a second neutral point and back and forth along a direction having a vector extending in said given direction, second biasing means between said second link means and said journaling means for resisting displacement of said second lost-motion connecting means from said second neutral point.

5. In web-guiding apparatus, a roll for guiding a web which contacts a portion of the periphery of the roll along an arc of contact the center of which is in a given direction to one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being supported on said supporting frame means and itself supporting said journaling means with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, said second link means being supported on said supporting frame means and itself supporting said journaling means with the point at which said second link means is supported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, a second parallel roll, means mounting said second parallel roll coextensively with said first-recited roll for movement bodily with said first-recited roll, and nip-maintaining biasing means urging said rolls toward initial contact with each other along said center of said arc of contact.

6. In web-guiding apparatus, a roll for guiding a web which contacts a portion of the periphery of the roll along an arc of contact the center of which is in a given direction to one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being supported on said supporting frame means and itself supporting said journaling means with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, said second link means being supported on said supporting frame means and itself supporting said journaling means with the point at which said second link means is sup-

ported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, and biasing means yieldably urging said roll to a neutral central position, said apparatus being free of connection with any web-edge-sensing servomechanism means.

7. In web-guiding apparatus, a roll for guiding a web which contacts a portion of the periphery of the roll along an arc of contact the center of which is in a given direction to one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being supported on said supporting frame means and being pivoted thereto about an axis which is other than normal to said given direction, said first link means itself supporting said journaling means with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, said second link means being supported on said supporting frame means and being pivoted thereto about an axis which is other than normal to said given direction, said second link means itself supporting said journaling means with the point at which said second link means is supported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction.

8. In web-guiding apparatus, a roll for guiding a web which contacts a portion of the periphery of the roll along an arc of contact the center of which is in a given direction to one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being supported on said supporting frame means and being pivoted thereto about an axis which is other than normal to said given direction, said first link means itself supporting said journaling means with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, first lost-motion connecting means between said first link means and said journaling means at the end of the roll associated with said first link means, the lost motion of said first lost-motion connecting means being back and forth through a first neutral point and back and forth along a direction having a vector extending in said given direction, first biasing means between said first link means and said journaling means for resisting displacement of said first lost-motion connecting means from said first neutral point, said second link means being supported on said supporting frame means and being pivoted thereto about an axis which is other than normal to said given direction, said second link means itself supporting said journaling means with the point at which said second link means is supported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, second lost-motion connecting means between said second link means and said journaling means at the end of the roll associated with said second link means, the lost motion of said second lost-motion connecting means being back and forth through a second neutral point and back and forth along a direction having a vector extending in said given direction, second biasing means between said second link means and said journaling means for resisting displacement of said second lost-motion connecting means from said second neutral point.

9. In web-guiding apparatus, a roll for guiding a web which contacts a portion of the periphery of the roll along an arc of contact the center of which is in a given direction to one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being supported on said supporting frame means and being pivoted thereto about an axis which is other than normal to said given direction, said first link means itself supporting said journaling means with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, said second link means being supported on said supporting frame means and being pivoted thereto about an axis which is other than normal to said given direction, said second link means itself supporting said journaling means with the point at which said second link means is supported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, a second parallel roll, means mounting said second parallel roll coextensively with said first-recited roll for movement bodily with said first-recited roll, and nip-maintaining biasing means urging said rolls toward initial contact with each other along said center of said arc of contact.

10. In web-guiding apparatus, a roll for guiding a web which contacts a portion of the periphery of the roll along an arc of contact the center of which is in a given direction to one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, first and second link means each associated with its own end of said roll, supporting frame means, said first link means being supported on said supporting frame means and being pivoted thereto about an axis which is other than normal to said given direction, said first link means itself supporting said journaling means with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, first lost-motion connecting means between said first link means and said journaling means at the end of the roll associated with said first link means, the lost motion of said first lost-motion connecting means being back and forth through a first neutral point and back and forth along a direction having a vector extending in said given direction, first biasing means between said first link means and said journaling means for resisting displacement of said first lost-motion connecting means from said first neutral point, said second link means being supported on said supporting frame means and being pivoted thereto about an axis which is other than normal to said given direction, said second link means itself supporting said journaling means with the point at which said second link means is supported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means) laterally inwardly and along a direction having a vector which is in said given direction, second lost-motion connecting means between said second link means and said journaling means at the end of the roll associated with said second link means, the lost motion of said second lost-motion connecting means being back and forth through a second neutral point and back and forth along a direction having a vector extending in said given direc-

tion, second biasing means between said second link means and said journaling means for resisting displacement of said second lost-motion connecting means from said second neutral point, a second parallel roll, means mounting said second parallel roll coextensively with said first-recited roll for movement bodily with said first-recited roll, and nip-maintaining biasing means urging said rolls toward initial contact with each other along said center of said arc of contact.

11. In web-guiding apparatus, first and second rolls for guiding a web which contacts a portion of the periphery of each roll along an arc of contact the center of which is as to each roll in a given direction to one side of the axis of the particular roll, journaling means associated with said first roll in journaling relationship therewith, supporting frame means, first and second link means each associated with its own end of said first roll, said first link means being supported on said supporting frame means and itself supporting said journaling means of said first roll with the point at which said first link means is supported on said supporting frame means being located (with respect to the point at which said first link means itself supports said journaling means of said first roll) laterally inwardly and along a direction having a vector which is in the said given direction associated with said first roll, said second link means being supported on said supporting frame means and itself supporting said journaling means of said first roll with the point at which said second link means is supported on said supporting frame means being located (with respect to the point at which said second link means itself supports said journaling means of said first roll) laterally inwardly and along a direction having a vector which is in the said given direction associated with said first roll, journaling means associated with said second roll in journaling relationship therewith, third and fourth link means each associated with its own end of said second roll, said third link means being supported on said supporting frame means and itself supporting said journaling means of said second roll with the point at which said third link means is supported on said supporting frame means being located (with respect to the point at which said third link means itself supports said journaling means of said second roll) laterally inwardly and along a direction having a vector which is in the same given direction associated with said second roll, said fourth link means being supported on said supporting frame means and itself supporting said journaling means of said second roll with the point at which said fourth link means is supported on said supporting frame means being located (with respect to the point at which said fourth link means itself supports said journaling means of said second roll) laterally inwardly and along a direction having a vector which is in the same given direction associated with said second roll, said first and third link means supporting ends of said first and second rolls which are at the same side of said web and said second and fourth link means correspondingly supporting other ends of said first and second rolls which are at the other side of said web, the points at which said first and second link means support said journaling means of said first roll being normally displaced from each other with respect to said given directions associated with both said first and second rolls in the same sense as respectively the points at which said fourth and third link means support said journaling means of said second roll are displaced from each other with respect to said given directions.

12. In web-guiding apparatus at least one shifting roll for guiding a web along a given path, said web contacting a portion of the periphery of the said at least one roll along an arc of contact the center of which is in a given direction to one side of the axis of said at least one roll, journaling means associated with said at least one roll in journaling relationship therewith, supporting linkage means for mounting said roll and journaling means for shifting movement back and forth through a "normal" position which obtains when said web is perfectly centered on said given path, said supporting linkage means including first mounting means at a first end of said at least one roll for supporting said journaling means at said first roll end for transverse shifting movement along a first given path and back and forth through a first central position corresponding to the said "normal" position of said at least one roll, the slope of said first path at said first central position being positive according to a rectilinear Cartesian coordinate system having as an origin the longitudinal center of said at least one roll at the said "normal" position of the roll and in which coordinate system the ordinates represent distances in said given direction and the abscissae represent distances transverse to said given path with locations toward said first roll end corresponding to abscissae of positive sign, said supporting linkage means also including second mounting means at the second end of said at least one roll for supporting said journaling means at said second roll end for transverse shifting movement along a second given path and back and forth through a second central position corresponding to the "normal" position of the said at least one roll, the slope of said second path at said second central position being negative according to said rectilinear Cartesian coordinate system, said apparatus being free of connection with any web-edge-sensing servomechanism means.

13. In web-guiding apparatus at least one shifting roll for guiding a web along a given path, said web contacting a portion of the periphery of the said at least one roll along an arc of contact the center of which is in a given direction to one side of the axis of said at least one roll, journaling means associated with said at least one roll in journaling relationship therewith, supporting linkage means for mounting said roll and journaling means for shifting movement back and forth through a "normal" position which obtains when said web is perfectly centered on said given path, said supporting linkage means including first mounting means at a first end of said at least one roll for supporting said journaling means at said first roll end for transverse shifting movement along a first given path and back and forth through a first central position corresponding to the said "normal" position of said at least one roll, the slope of said first path at said first central position being positive according to a rectilinear Cartesian coordinate system having as an origin the longitudinal center of said at least one roll at the said "normal" position of the roll and in which coordinate system the ordinates represent distances in said given direction and the abscissae represent distances transverse to said given path with locations toward said first roll end corresponding to abscissae of positive sign, first lost-motion connecting means between said first mounting means and said journaling means at said first roll end, the lost motion of said first lost-motion connecting means being back and forth through a first neutral point and back and forth along a direction having a vector extending in said given direction, first biasing means between said first mounting means and said journaling means for resisting displacement of said first lost-motion connecting means from said first neutral point, said supporting linkage means also including second mounting means at the second end of said at least one roll for supporting said journaling means at said second roll end for transverse shifting movement along a second given path and back and forth through a second central position corresponding to the "normal" position of the said at least one roll, the slope of said second path at said second central position being negative according to said rectilinear Cartesian coordinate system, second lost-motion connecting means between said second mounting means and said journaling means at said second roll end, the lost motion of said second lost-motion connecting means being back and forth through a second neutral point and

back and forth along a direction having a vector extending in said given direction, second biasing means between said second mounting means and said journaling means for resisting displacement of said second lost-motion connecting means from said second neutral point.

14. In web-guiding apparatus, a shifting roll for guiding a web along a given path, said web contacting a portion of the periphery of the roll along an arc of contact the center of which is in a given direction at one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, supporting linkage means for mounting said roll and journaling means for shifting movement back and forth through a "normal" position which obtains when said web is perfectly centered on said given path, said supporting linkage means including first mounting means at a first end of said roll for supporting said journaling means at said first roll end for transverse shifting movement along a first given path and back and forth through a central position corresponding to the said "normal" position of the roll, the slope of said first path at said first central position being positive according to a rectilinear Cartesian coordinate system having as an origin the longitudinal center of said roll at the said "normal" position of the roll and in which coordinate system the ordinates represent distances in said given direction and the abscissae represent distances transverse to said given path with locations toward said first roll end corresponding to the abscissae of positive sign, said supporting linkage means also including second mounting means at a second end of said roll for supporting said journaling means at said second roll end for transverse shifting movement along a second given path, said second given path being symmetrical to said first given path with respect to an imaginary plane which at the "normal" position of the roll is perpendicular to the axis of said roll and which intersects said origin, said apparatus being free of connection with any web-edge-sensing servomechanism means.

15. In web-guiding apparatus, a shifting roll for guiding a web along a given path, said web contacting a portion of the periphery of the roll along an arc of contact the center of which is in a given direction at one side of the roll axis, journaling means associated with said roll in journaling relationship therewith, supporting linkage means for mounting said roll and journaling means for shifting movement back and forth through a "normal" position which obtains when said web is perfectly centered on said given path, said supporting linkage means including first mounting means at a first end of said roll for supporting said journaling means at said first roll end for transverse shifting movement along a first given path and back and forth through a central position corresponding to the said "normal" position of the roll, the slope of said first path at said first central position being positive according to a rectilinear Cartesian coordinate system having as an origin the longitudinal center of said roll at the said "normal" position of the roll and in which coordinate system the ordinates represent distances in said given direction and the abscissae represent distances transverse to said given path with locations toward said first roll end corresponding to abscissae of positive sign, first lost-motion connecting means between said first mounting means and said journaling means at said first roll end, the lost motion of said first lost-motion connecting means being back and forth through a first neutral point and back and forth along a direction having a vector extending in said given direction, first biasing means between said first mounting means and said journaling means for resisting displacement of said first lost-motion connecting means from said first neutral point, said supporting linkage means also including second mounting means at a second end of said roll for supporting said journaling means at said second roll end for transverse shifting movement along a second given path, said second given path being symmetrical to said first given path with respect to an imaginary plane which at the "normal" position of the roll is perpendicular to the axis of said roll and which intersects said origin, second lost-motion connecting means between said second mounting means and said journaling means at said second roll end, the lost motion of said second lost-motion connecting means being back and forth through a second neutral point and back and forth along a direction having a vector extending in said given direction, second biasing means between said second mounting means and said journaling means for resisting displacement of said second lost-motion connecting means from said second neutral point.

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