WEB GUIDING APPARATUS
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ABSTRACT OF THE DISCLOSURE

A tilt frame-type guiding apparatus to guide a traveling web without imposing unbalanced stresses on the web. The tilt frame is pivoted about an axis which is in the plane of and directionally aligned with the web leaving the guiding apparatus. An edge sensor is arranged to detect the edge of the web and to actuate a motor to pivot the tilt frame.

The present invention is directed to apparatus for guiding traveling webs of material and more particularly to a tilt frame-type guiding apparatus.

It is known in the handling of long webs of material such as film, paper or fabric, in which the web is drawn over rollers from one position to another, that there is a tendency for the web to be laterally displaced from the true or preselected path of the web. Thus, where some operation is to be performed on the traveling web, e.g., the application of a coating or the printing of a design, such operation may not be uniformly applied to the web. Furthermore, the winding of the web on a roll will not be uniform if the traveling web is permitted to become randomly displaced from the centerline of the machine.

Many methods of guiding traveling webs have been utilized employing tilting frames carrying one or more guide rollers over which the traveling web passes. The principle involved in all of these web guiding machines is that the traveling web will attempt to pass across a cylindrical roll, over which it is passing, at right angles to the axis of the roll. Some machines have been constructed wherein a tilting frame carrying at least one cylindrical roller is moved so as to direct the traveling web back to the true path of travel, i.e., to the center of the machine. The tilting frame has been driven by various electromechanical, pneumatic, hydraulic or similar drive systems. Likewise, many web guiding machines have been constructed which utilize the tension in the web itself to move the frame and thus are generally self-actuating. A common feature of most tilt frame web guiding machines of the prior art has been the location of the frame pivot axis near or upstream of the plane of the web entering the guide machine frame. All of these prior art web guiding machines have found suitable and satisfactory application in various situations. However, none of these web guiding machines have proved to be completely satisfactory when used for the transportation of webs which are extremely lightweight and which must be accurately delivered to a process station downstream from the web guiding machine. Particularly disadvantages of the web guiding apparatus of the prior art have been the unbalanced stresses resulting from a twist of the entering web about a pivot axis usually a substantial distance from where the web enters actually was, and the severe diagonal stresses generated in the leaving web as the guide swings to make the lateral correction. It has been found that such severe unbalanced web stresses can result in web wrinkling, stretching, tight and baggy edges, and tracking problems downstream from the web guiding apparatus.

In the present guide apparatus only slight diagonal stresses are generated in the entering web as the frame swings to meet it and the leaving web is stressed only by a slight symmetrical twist about the axis of the web.

Accordingly, the present invention is directed to a web guiding apparatus in which lateral deviation of the web from the true path of the web, e.g., along the centerline of the machine, is corrected without imposing unbalanced stresses in the web and without causing the foregoing problems downstream of the guide unit.

This is accomplished by the present invention by providing a web guiding apparatus in which the guide frame is pivoted about an axis which is in the plane of and directionally aligned with the web leaving the guiding apparatus. As a result, the guide frame is moved, by a suitable actuating mechanism, to meet the web as it enters the guide apparatus so that the traveling web moves onto the first guide roller attached to the guide frame with an edge of the web the same distance from a line which is perpendicular to the axial centerline of the first roller, and which line intersects the frame axis, as said axis is from the same edge of the web leaving the guiding apparatus regardless of the lateral displacement of the web from the true path at that point. As a result, the web guide apparatus of the present invention does not impose unbalanced or diagonal stresses upon the web as it leaves the guide apparatus and thus does not distort the web regardless of the lack of inherent strength of the web.

Accordingly, the present invention provides a web guiding apparatus for correcting the deviation of a moving web from the true path of the web. The guide includes a movable frame having at least one roller mounted thereon which is arranged for deflecting the web thereabout. The frame is arranged to be pivotally movable about an axis which is in the plane of and directionally aligned with the web leaving the guiding apparatus and is rotated by a suitable drive means. A web edge sensor is arranged to detect the edge of the web entering the guide and actuates the drive means to position the frame so that the line which is perpendicular to the axial centerline of said roller and which intersects the frame axis is the same distance from an edge of the web entering the guide apparatus as the frame axis is from the same edge of the web leaving the guiding apparatus.

Furthermore, the present invention provides a web guiding apparatus for correcting the deviation of the centerline of a moving web from the centerline of the true path thereof comprising a movable guide frame having at least a pair of cylindrical rollers disposed in parallel spaced relationship thereon. The rollers are arranged for deflecting the web thereabout. The frame on which the rollers are mounted is pivotally movable about an axis which is coincident with the centerline of the web leaving the guiding apparatus and in a plane containing the centerline of the true path of the web. The rollers are disposed in the frame so that a line perpendicular to the axial centerlines of the rollers and equidistant from the ends of both of the rollers intersects the pivotal axis of the frame. A drive means is arranged to rotate the frame about the axis. A sensing means is disposed on the frame for determining the position of the edge of the web entering the guide apparatus. And control means is arranged to actuate the drive means in response to the sensing means to dispose the frame so that a point equidistant from the ends of the first roller is aligned with the centerline of the web entering the guiding apparatus.

The various features of novelty which characterize the present invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention together with its drawbacks and the specific objects obtained by its use, reference should be had to the accompanying drawings and descriptive matter in which the preferred embodi-
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ments of the present invention are illustrated and described.

Of the drawings:
FIG. 1 is a schematic illustration of the present invention;
FIG. 2 is a side elevation of a first embodiment of the present invention;
FIG. 3 is a side elevation showing an alternate embodiment of the present embodiment of the present invention; and
FIGS. 4, 5, and 6 are schematic illustrations of further alternate embodiments of the present invention.

Referring to the schematic illustration of the present invention in FIG. 1, a web 10 is shown entering the guide apparatus, generally indicated at 12, in the direction indicated by the arrows. The web 10, which may be paper, film, cloth or any other long strip of flexible material, may be displaced from the centerline 14 of the machine, which is indicated as the true path of the web, as it approaches the guide apparatus 12. The web may be directed into the guide apparatus by being deflected over a roller 16. The web guide apparatus comprises a generally rectangular frame 18 on which is mounted a pair of guide rollers 20 and 22. These rollers are disposed in parallel spaced relationship, generally transversely of the web 10 and are suitably mounted on the frame 18, in a manner well known in the art. The traveling web 10 is passed around the first guide roller 20 and then the second roller 22 leaves the guide apparatus in a substantially parallel to the plane in which it entered the guide apparatus. The web may then be passed around a final roller 26 and onto a following portion of the apparatus where a further operation or processing treatment may be performed. It will be noted that in traversing the guide apparatus, the web, which was initially displaced by an amount "A" from the centerline 14 of the machine, has been returned to it. The frame 18 of the guide apparatus is arranged to be pivotally movable about an axis 28 which is in the plane of and directionally aligned with the web leaving the guide apparatus. The rollers, 20 and 22, are generally arranged on the frame so that a line 23 perpendicular to each roller axis and equidistant from the ends thereof intersects axis 28 of the guide frame 18. The frame may be supported in various ways which will be apparent to those skilled in the art. Two specific examples are illustrated in FIGS. 2 and 3 and will be further described hereinafter.

A web edge sensing or detecting device 30, many of which are known in the art, may be attached to and move with the guide frame 18. It is arranged to sense the location of at least one edge of the web 10 approaching the first guide roller 20 and is connected through a controller 32 which is arranged to actuate a drive mechanism 34 connected to the guide frame 18. The drive mechanism 34 may be electromechanical, pneumatic, hydraulic, or any other type which is well known in the art, and operates to move the guide frame 18 about its axis 28.

In operation, as the web 10 approaches the guide apparatus 12, offset from the true path of the web, e.g. the centerline 14 of the machine, the edge detector 30 senses the amount of offset and produces a signal proportional thereto which is transmitted to the controller 32 which in turn actuates the drive mechanism 34 which pivots the guide frame 18 about axis 28 so that the line which is perpendicular to the axial centerline of the first roller 20 and which intersects the frame axis is the same distance from the edge of the web approaching the guide apparatus as the frame axis is from the same edge of the web leaving the guide apparatus. Inasmuch as the first roller and the second roller on the guide frame are disposed parallel to each other, and since the web tends to pass over both rollers at right angles to their axis of rotation, the web will be centered on the second roller 22 which, as noted above, has been rotated by the frame 18 about an axis 28 which is disposed in the plane of and directionally aligned with the web leaving the guide apparatus.

While the diagonal stresses in the web leaving the guide apparatus disclosed above are substantially eliminated, the stresses from twisting are also minimized when the frame axis 28 is disposed coincident with the centerline of the web leaving the guide apparatus and in a plane coincident with the centerline of the machine downstream of the guide assembly. Thus, the web 10 leaving the second roller 22 may be aligned with the centerline 14 of the machine and has a slight twist about its axis which may be subsequently removed by passing over roller 26. As the deviation of the centerline of the web 10 from the centerline 14 of the machine varies, the variation is sensed by detector 30 which will operate through the controller 32 to move the guide frame 18 so that the centerline of the web continues to be met by the center of the first roll 20 of the guide assembly.

With the apparatus of the present invention, the guide roller is moved to meet the web rather than the guide assembly attempting to move the web from its displaced position back to the centerline of the machine as do web guiding machines of the prior art. As a result, the present automatic web guide apparatus is self-adjusting upon the web, particularly the leaving web, which stresses have been found to cause the above noted problems, so that low-strength webs can be accurately aligned for subsequent processing downstream of the guide apparatus.

A specific embodiment of a web guiding apparatus incorporating the present invention is illustrated in FIG. 2. The generally rectangular guide frame 118 is supported from a structural member 119 by means of an A-frame bracket 121 which is pivotally supported around a vertical axis 126 in the plane of and directionally aligned with the web leaving the guide apparatus, e.g. coincident with the centerline of the web 110 leaving the guide assembly. Specifically, vertically aligned bearing members 123 are attached to a structural member 119 and a bearing member 131 connects the A-frame thereto. The guide frame has bearings 133 dependent from the lower portion thereof, in which are mounted the guide rollers 120 and 122. The web sensing device 130 is connected to the frame 118 subjacent the first guide roller 120 and is arranged to sense the location of the web 110 approaching the guide frame from roller 116. The signal generated by the web edge detector 130 is transferred through a controller (not shown) to a guide actuator 134, which in this case is a hydraulic piston assembly. This arrangement may be used where support of the guide assembly is easily accomplished from overhead structural members.

In locations where such an arrangement would not be feasible, an arrangement such as that illustrated in FIG. 3 may be used wherein the guide apparatus is supported from the bottom. In this arrangement, the guide frame 218 is supported by rollers 227 mounted on a base and arranged to permit pivotal movement of the guide frame about an axis 228, e.g. one which is disposed coincident with the center line of the web 210 leaving the guide frame. This axis is provided with a bearing member 231 which extends upwardly from the base on which rollers 227 are mounted. Guide rollers 220 and 222 are mounted on the upper end of the guide frame 218 and operate in the same manner as the guide rollers of the previously discussed arrangements. A web edge detecting device 230 is mounted on the guide frame 218 at a location to sense the position of the web edge entering the guide apparatus. In this arrangement, the web is directed onto the guide apparatus by roller 216. The web is then aligned in the manner previously discussed and leaves the guide apparatus via rolls 226 and 237 to a winding spool 239. 30.

While each of the arrangements illustrated in FIGS. 1 to 3 have been directed to a guide apparatus wherein the web is displaced upwardly thereafter, it will be appreciated that this is not necessary to the operation of the present invention and that any other orientation of the
guide assembly could be utilized so long as it is arranged so that the guide frame may be rotated about an axis which is in the plane of and directionally aligned with the web leaving the guide assembly. More specifically, this axis may also be in a plane containing the centerline of the true path of the web. For example, should the arrangement of the machine with which the guide assembly of the present invention is associated make it desirable, the guide rollers could be disposed vertically and the guide frame be pivotally movable about a horizontal axis. Likewise, an orientation somewhere between horizontal and vertical could be used.

While the guide apparatus so far illustrated has employed two guide rollers mounted on the guide frame, it will be appreciated that additional rollers can likewise be mounted on the guide frame in parallel relationship with the other rollers.

Furthermore, a guide arrangement incorporating the present invention can be constructed wherein the web forms less or more than 90° contact with the guide rollers. For example, a schematic illustration of a further alternate embodiment of the present invention is shown in FIG. 4, wherein the moving web passes over rollers connected to a guide frame with an angle of contact less than 90°. However, supporting the guide rollers is pivoted about an axis 428 which is in the plane of and directionally aligned with the web 410 leaving roller 420, and since the plane of the web 410 entering the guide apparatus is parallel to the plane of the web leaving the guide apparatus, the concept of the present invention is incorporated.

Similarly, FIG. 5 is a schematic illustration of an embodiment in which the web 510 contacts the guide rollers with an angle of contact more than 90°. In this arrangement, the guide frame 518 is pivoted about an axis 528 which is in the plane of and directionally aligned with the web 510 leaving the guide apparatus.

A further example is illustrated in FIG. 6, wherein only one guide roller 622 is utilized which is connected to a guide frame 618 pivoted about an axis 628 in the plane of and directionally aligned with the web 610 leaving the guide apparatus. The particular arrangement, however, is limited in the amount of web displacement it can correct so that it will be used where only minor corrections are necessary.

Thus, it will be seen that while only two guide rollers have been illustrated in the preferred guide assembly illustrated, any number of guide rollers may be utilized, depending upon the particular arrangement of the web transport machine with which it is employed.

Accordingly, it will be seen that the present invention provides a web guide apparatus which controls the lateral position of a moving web without generating unbalanced web stresses which result in such problems as wrinkling, stretching, tight and baggy edges, and tracking errors. As a consequence, extremely sensitive or lightweight materials may be accurately and safely guided with the apparatus of the present invention.

Furthermore, since the web may be always centered on the guide rollers, they need only be as long as the web is wide, resulting in space and weight savings, which may be realized therein.

The invention has been described in detail with particular reference to the preferred embodiments thereof, but it will be understood that variations and modifications can be effectuated within the spirit and scope of the invention as described hereinabove and as defined in the appended claims.

The claims:

1. A web guiding apparatus for correcting the deviation of a moving web from the true path of said web comprising at least one roller arranged for deflecting the web thereof, said roller being pivotally movable about an axis which is in the plane of and directionally aligned with the web leaving the guidance apparatus, means including a drive means arranged to rotate said roller about said axis, and means for sensing the edge of said web arranged to actuate said drive means to rotate said roller so that the line which is perpendicular to the axial centerline of said roller and which intersects said axis is the same distance from an edge of said web entering said guiding apparatus as said axis is from the same edge of the web leaving the guiding apparatus.

2. A web guiding apparatus for correcting the deviation of a moving web from the true path of said web comprising a movable guide frame, at least one roller mounted on said movable frame, said roller being arranged for deflecting the web thereof, said frame being pivotally movable about an axis which is in the plane of and directionally aligned with the web leaving the guiding apparatus, means including a drive means arranged to rotate said frame about said axis, and means for sensing the edge of said web arranged to actuate said drive means to position said frame so that the line which is perpendicular to the axial centerline of said roller and which intersects said axis is the same distance from an edge of said web entering the guiding apparatus as said axis is from the same edge of the web leaving the guiding apparatus.

3. A web guiding apparatus according to claim 2 characterized by the fact that the axis about which the frame is rotated is coincident with the centerline of the web leaving the guiding apparatus.

4. A web guiding apparatus according to claim 2 characterized by the fact that the plane of the web leaving the guiding apparatus is substantially parallel to the plane of the web entering the guiding apparatus.

5. A web guiding apparatus for correcting the deviation of the centerline of a moving web from the centerline of the true path of said web comprising a movable guide frame, at least a first and a second cylindrical roller disposed in parallel spaced relationship on said movable frame, said rollers being arranged for deflecting the web thereof, said frame being pivotally movable about an axis which is in the plane of and directionally aligned with the web leaving the guiding apparatus, said rollers being disposed in said frame so that a line perpendicular to the axial centerlines thereof intersects said axis, drive means arranged to rotate said frame about said axis and means for sensing the edge of said web entering said guiding apparatus disposed on said frame, and control means arranged to actuate said drive means in response to said sensing means to dispose said frame so that said perpendicular line of said first roller is the same distance from an edge of said web entering the guiding apparatus as said axis is from the same edge of the web leaving the guiding apparatus.

6. A web guiding apparatus for correcting the deviation of the centerline of a moving web from the centerline of the true path of said web comprising a movable guide frame, at least a first and a second cylindrical roller disposed in parallel spaced relationship on said movable frame, said rollers being arranged for deflecting the web thereof, said frame being pivotally movable about an axis which is in the plane of and directionally aligned with the web leaving the guiding apparatus, said rollers being disposed in said frame so that a line perpendicular to the axial centerlines thereof intersects said axis, drive means arranged to rotate said frame about said axis, and means for sensing the edge of said web leaving said guide, and control means arranged to actuate said drive means in response to said sensing means to dispose said frame so that said perpendicular line of said first roller is the same distance from an edge of the web entering the guiding apparatus as said axis is from the same edge of the web leaving the guiding apparatus, said guiding apparatus being arranged to discharge said web in a plane
substantially parallel to the plane of the web entering said guiding apparatus.

7. A web guiding apparatus according to claim 6 characterized by the fact that said web edge sensing means is mounted on and moves with said frame.

8. A web guiding apparatus for correcting the deviation of a moving web from the true path of said web comprising at least one roller arranged for deflecting the web thereabout, said roller being pivotally movable about an axis which is coincident with the centerline of the web leaving the guide apparatus, means including a drive means arranged to rotate said roller about said axis, and means for sensing the edge of said web arranged to actuate said drive means to position said roller so that a point equidistant from the ends of the roller is constantly aligned with the centerline of the web entering the guide apparatus.

9. A web guiding apparatus for correcting the deviation of the centerline of a moving web from the centerline of the true path of said web comprising a movable guide frame, at least a first and a second cylindrical roller disposed in parallel spaced relationship on said movable frame, said rollers being arranged for deflecting the web thereabout, said frame being pivotally movable about an axis which is coincident with the centerline of the web leaving the guiding apparatus and in a plane containing the centerline of the true path of said web, said rollers being disposed in said frame so that a line perpendicular to the axial centerlines of and equidistant from the ends of said first and second rollers intersects said axis, drive means arranged to rotate said frame about said axis, means for sensing the edge of said web entering said guide, and control means arranged to actuate said drive means in response to said sensing means to dispose said frame so that a point equidistant from the ends of said first roller is constantly aligned with the centerline of the web entering the guiding apparatus, said guiding apparatus being arranged to discharge said web in a plane substantially parallel to the plane of the web entering said guiding apparatus.

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