

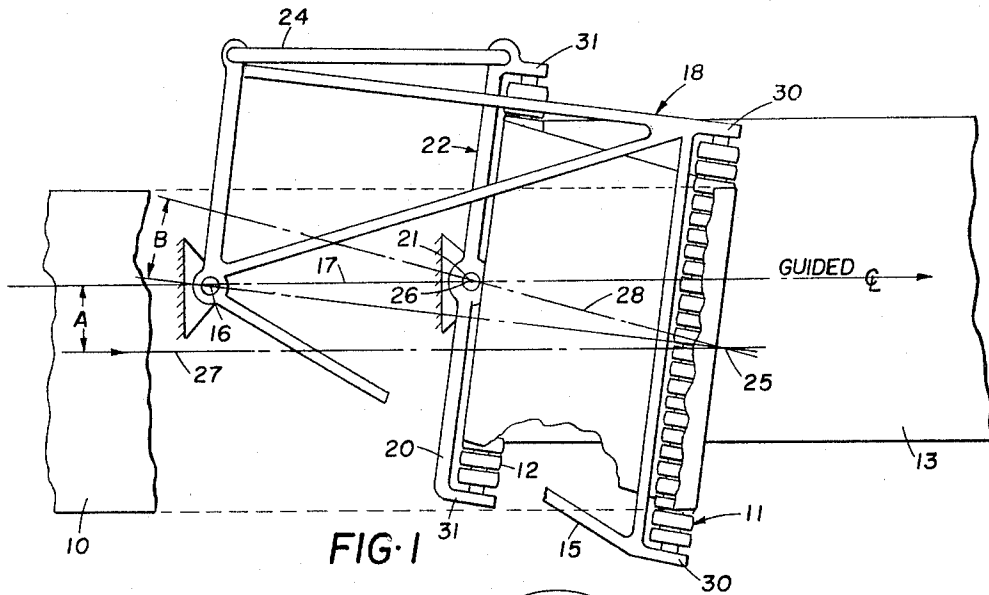
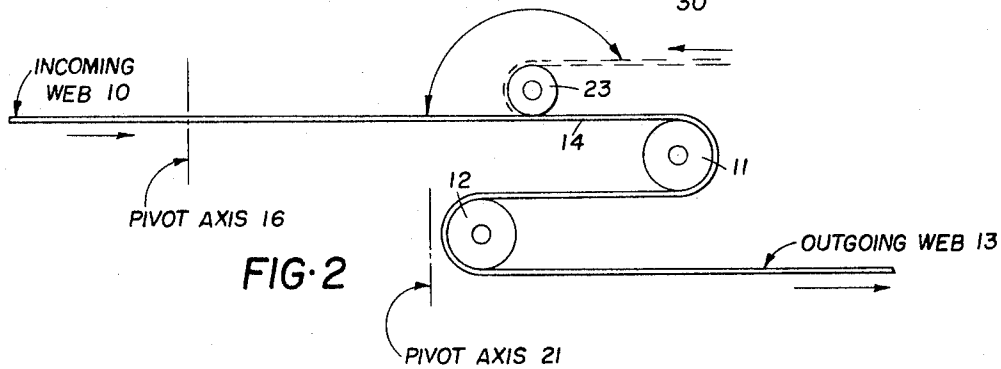
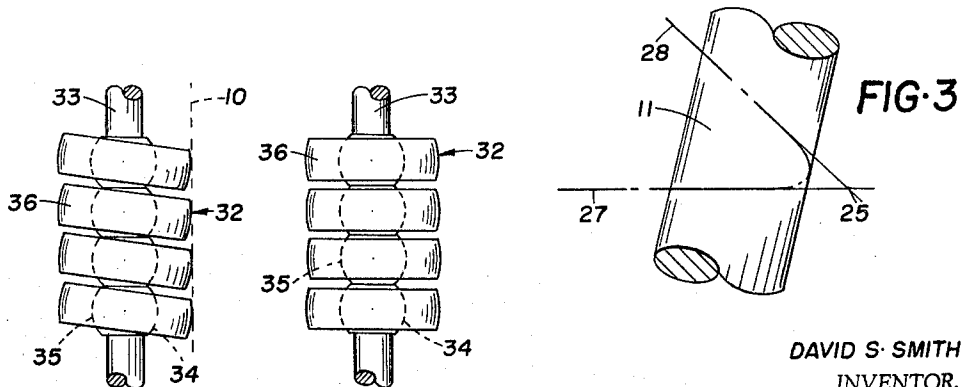
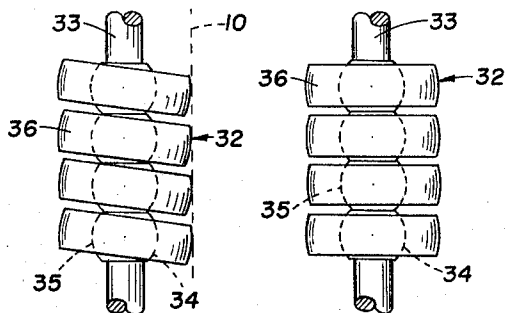
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WEB CENTERING DEVICE

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3,265,272

WEB CENTERING DEVICE

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The present invention relates to an improvement in web or strip feeding apparatus and more particularly to apparatus for automatically centering a moving web without causing damage to the web, the web being in the form of an endless sheet or strip, such as fabric, paper or other similar materials.

In the winding or reeling of a continuous web of material, it is of importance that the web be maintained in a predetermined path particularly that portion immediately ahead of a reel or core on which the web is being wound. Due to any one, or any combination of the following factors, such as misalignment of a group of rollers that form the web path, discrepancies in the web drive, differences in the web thickness, elasticity of the web and other factors, the tension in one side of the web can be increased to such an extent that the web tends to move toward the high tension side of the rollers so long as the tension exists, thereby moving the web out of its normally central path. As a result, the web approaches the reel or core at an offset that does not permit an even winding of the web on the reel or core. To correct this condition, complex electrical, hydraulic or pneumatic systems have been developed for controlling the angular relation of one or more rollers to the web path in response to a change in web tension or to web displacement to effect a compensating or aligning and centering action of the web.

In the present invention that is described hereinbelow, a pair of rollers, namely, a receiving roller and a delivering roller, form a substantially S-shaped path for the web, each roller being rotatably mounted in an individual frame. Each frame is pivotally mounted and the two frames are linked together so that they rotate through equal angles in response to any change in the web position. The pivotal axes of the frames are perpendicular to the extended outgoing center line of the web. The pivotal axis of the frame for the receiving roller is at a point whose distance from the effective point of the receiving roller is twice the distance between the effective points of the receiving and delivering rollers. The pivotal axis of the frame for the delivering roller is at a point coincident with the effective point of the delivering roller. The effective point of each roller is the point of intersection of the projected web center line entering and leaving the respective roller. Since the outgoing angle of the web is determined by the relationship of the frame axes and the effective points of the rollers, and since the incoming web center line is parallel to the line connecting the frame axes, the geometric relationship is such that the web runs to the delivering roller at an angle such that the center of tension passes through the axis of the frame for the delivering roller. With the effective point of the delivering roller coincident with the pivotal axis of its frame, the web is always delivered in a centered relation relative to the reel or core.

A primary object of the invention is to provide a centering device for a moving web that is automatically responsive to any change in web position and is self-actuating.

Another object of the invention is to provide a centering device for a moving web that is fully responsive to small changes in web position and has a very short response time.

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Still another object of the invention is to provide a centering device for a moving web in which the geometric relation of the pivotal axes of a pair of rollers is such that the center line of the outgoing web is maintained in a centered condition irrespective of any change in the tension of the web.

And yet another object of the invention is to provide a centering device for a moving web that is simple in construction and reliable in operation.

These and other objects and advantages of the invention will be apparent to those skilled in the art by a description of a preferred embodiment of the invention which follows.

Reference is now made to the accompanying drawings wherein like reference numerals and characters designate like parts and wherein:

FIG. 1 is a plan view of a preferred embodiment of the centering device in which a portion of the web has been omitted to more clearly show the operating elements;

FIG. 2 is a diagrammatic side view of the principal elements of FIG. 1 to more clearly show the relationship of the planes of the incoming and outgoing web;

FIG. 3 is a detailed view of a roller showing the effective point of an element of a web moved in a helical path around the roller; and

FIGS. 4 and 5 are detailed views of a form of roller assembly comprising a plurality of individual spherically mounted rollers.

With particular reference to FIGS. 1 and 2 the web 10 can be moved in any suitable manner and ahead of the reel or core (not shown) on which the web is wound, a pair of rollers 11 and 12 are arranged to provide a substantially S-shaped path for the web so that the outgoing web 13 is substantially parallel to that of the incoming web 14. As shown in FIG. 1, the outgoing web 13 can be displaced laterally from the incoming web 14 to provide a predetermined side-lay of the web, as designated by A in FIG. 1. Roller 11 is the receiving roller and is rotatably mounted in a frame 15 that is pivotally mounted at 16 for lateral displacement with any change in position of the incoming web 14. The pivotal axis 16 is arranged below the plane of the incoming web 14 and is perpendicular thereto and aligned with the extended center line 17 of the outgoing web 13. This first roller assembly, designated generally by the numeral 18, receives the incoming web and reverses its direction of movement into a plane that is substantially parallel to that of the incoming web, as shown in FIG. 2.

Roller 12 is rotatably mounted in a frame 20 that is pivotally mounted for movement about an axis 21. The axis 21 is perpendicular to the plane of the incoming web and aligned with the extended center line 17 of the outgoing web 13. This second roller assembly, designated by the numeral 22, receives the web from the first roller assembly 18 and delivers it in an outgoing direction that is in substantially the same direction as the incoming web and in a different plane. The relationship of the incoming and outgoing webs together with the S-shaped web path formed by the rollers 11 and 12 is shown to the best advantage in FIG. 2. In order to improve the stability of the system, especially where webs of low rate elasticity are to be handled, or where there is a large length to width ratio, a fixed roller 23 can be arranged as shown in FIG. 2. In this case, the incoming web 14 is then that part of the web arranged between roller 11 and the fixed roller 23.

The frames 15 and 20 are joined by a connecting link 24 so that any translational movement of roller 11 is imparted to the roller 12. As described hereinafter, the geometric relationship of the axes 16 and 21 is such that the rollers 11 and 12 are moved together through equal angles by any change in web position.

The pivotal axis 16 is arranged at a point whose distance from the effective point 25 of the roller 11 is twice the distance between the effective points 25 and 26 of rollers 11 and 12, respectively. The effective point 25 of roller 11 is the intersection of the center line 27 of the incoming web 14 and the projected web center line 28 leaving the same roller. In a like manner, the effective point 26 of roller 12 is the point of intersection of the projected web center line 28 entering the roller and the center line 17 of the outgoing web 13. The distance from the pivotal axis 16 to the effective point 25 is, therefore, twice that of the distance from effective point 25 to the effective point 26.

The tension of the incoming web 14 averages along a line that can be but is not necessarily coincident with its actual center line. If the average tension is offset from the pivotal axis 16 of the frame 15, the side forces cause the roller 11 and frame 15 to swing to one side or the other until the tension equalizes across the web. This condition occurs when the incoming and outgoing angles of the web are equal with respect to the axis of the roller 11. Since the outgoing angle is determined by the relationship of the axes 16 and 21 as well as the effective points 25 and 26, the geometric relationship is such that the web runs to roller 12 with the center of tension passing approximately through the pivotal axis 21. Since the effective point 26 is coincident with the pivotal axis 21, the outgoing web 13 is delivered from roller 12 in a centered position.

While the preferred embodiment of the invention shows the outgoing web 13 displaced in a lateral direction from that of the incoming web 14, the same arrangement of roller 11 and 12 can be utilized wherein there is no such displacement. In this case, the center lines 17 and 27 of the web are coextensive, as viewed in FIG. 1, and the axes 16 and 21 will be perpendicular to this common center line. The geometric relationship still exists so that any change in position of the incoming web causes the roller 11 to move about axis 16 and this motion is transmitted by the link 24 to frame 20 whereby the axes of rollers 11 and 12 are moved through the same equal angles.

In a position of equilibrium, the axes of rollers 11 and 12 are parallel and the moment arms, as represented by A which is the perpendicular distance between pivotal axis 16 and the average tension line of the incoming web 14 and by B which is the perpendicular distance between pivotal axis 16 and the extended web center line 28 between rollers 11 and 12, are equal. Any change in the lateral position of the incoming web 14 changes the arm A and causes the axis of roller 11 to move about the pivotal axis 16, the turning moment being the product of the moment arm A and the average web tension. This turning moment is transmitted to roller 12 by arm 24 so that arm B becomes equal to arm A. When the arms A and B are made equal to zero, there is no predetermined lateral displacement of the outgoing web 13 relative to the incoming web 14. However, as described above, the geometry of the system still exists and any change in the lateral position of the incoming web is corrected by movement of rollers 11 and 12 so that the outgoing web 13 is automatically corrected and hence, maintained in a centered position.

The rollers 11 and 12 can be solid rollers that are mounted in bearings carried by the extensions 30 and 31 of the frames 15 and 20, respectively, or as shown in FIGS. 4 and 5, can comprise a plurality of individual rollers 32. In the embodiment shown in FIGS. 4 and 5, a shaft 33 can be rotatably mounted in the extensions 30, for example, and is provided with a plurality of central spherical zones 34 that are equally spaced along the shaft 33. Each of the rollers 32 is provided with an inner spherical bearing surface 35 which engages a respective zone 34 and with a spherical peripheral surface 36. Each spherical roller 32 can rotate in any di-

rection so that its plane of rotation approximates the helical path of a longitudinal elemental portion of the web which contacts the sphere. The rollers 32 are shown in such a position in FIG. 5. Such an arrangement of rollers accommodates the angular relationship of the rollers to any lateral displacement of the web and such displacement with respect to the roller is minimized by this structure.

The preferred embodiment of the invention as shown in FIG. 1 can be utilized for either an in-line or displaced arrangements of the incoming and outgoing web. When the outgoing web is displaced laterally with respect to the incoming web, the rollers 11 and 12 then assume an angular relationship relative to the webs. Further, the arrangement of the rollers 11 and 12 can be caused to undercorrect or overcorrect in accordance with the location of the effective point of the delivery roller 12 in relation to the pivotal axis of its respective frame. Undercorrection can be caused by web curvature which can, in turn, be caused by shrinkage or stretching of one edge of the web.

While the invention has been described with respect to a preferred embodiment thereof, it should be apparent to those skilled in the art that various modifications therein can be made without departing from the spirit of the invention. The invention is not to be limited to the embodiment disclosed but is of a scope as defined by the appended claims.

I claim:

1. Apparatus for centering a moving web, comprising in combination:

a first roller assembly for receiving said web and reversing its direction of movement, said assembly being pivotally mounted for movement about an axis substantially perpendicular to the center line of said incoming web;

a second roller assembly for receiving said web from said first roller assembly and delivering it in an outgoing direction that is in substantially the same direction as said incoming web and in a different plane, said second assembly being pivotally mounted for movement about an axis substantially parallel to that of said first roller assembly; and

means interconnecting said first and second roller assemblies for pivoting said second roller assembly in response to pivotal movement of said first roller assembly to maintain the center line of said outgoing web in a predetermined relation to the axis of said second roller assembly.

2. Apparatus in accordance with claim 1 wherein the axis of said first roller assembly is substantially perpendicular to the extended center line of said outgoing web and beyond the axis of said second roller assembly in the direction of said incoming web.

3. Apparatus in accordance with claim 1 wherein the center line of said incoming web is substantially parallel to the line connecting the pivotal axes of said first and second assemblies.

4. Apparatus in accordance with claim 1 wherein the axis of said first roller assembly is substantially perpendicular to the extended center line of said outgoing web at a first point that is spaced from a second point, as determined by the intersection of the extended assembly, by a distance substantially twice that between said second point and a third point, as determined by the intersection of the extended web center line entering and leaving said second roller.

5. Apparatus in accordance with claim 4 wherein the axis of said second roller assembly is substantially perpendicular to the extended center line of said outgoing web at said third point.

6. Apparatus in accordance with claim 1 wherein said outgoing web is delivered by said second roller assembly in a plane that is substantially parallel to that of said incoming web and displaced laterally therefrom.

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7. Apparatus for centering a moving web comprising in combination:

- a first roller for receiving the incoming web and substantially reversing its direction of movement;
- a second roller displaced in a direction toward said incoming web from said first roller for receiving said web from the latter and delivering it in an outgoing direction that is in substantially the same direction as said incoming web and in a different plane;
- first pivotal support means for said first roller having an axis substantially perpendicular to the extended center line of said outgoing web;
- second pivotal support means for said second roller having an axis substantially perpendicular to the extended center line of said outgoing web and intermediate said second roller and the axis of said first pivotal support means; and
- means interconnecting said first and second pivotal support means for transmitting any angular movement of said first pivotal support means to said second pivotal support means as a function of the change in position of said incoming web to maintain the center line of said outgoing web in a predetermined relation to the axis of said second pivotal support means.

8. Apparatus in accordance with claim 7 wherein said first and second rollers are rotatably mounted in their respective pivotal support means.

9. Apparatus in accordance with claim 7 wherein the axis of said first pivotal support means is substantially perpendicular to the extended center line of said outgoing web at a first point that is spaced from a second point, as determined by the intersection of the extended web center lines entering and leaving said first roller, by a distance substantially twice that between said second point and a third point, as determined by the intersection of the extended web center lines entering and leaving said second roller.

10. Apparatus in accordance with claim 9 wherein the axis of said second pivotal support means is substantially perpendicular to the extended center line of said outgoing web at said third point.

11. Apparatus in accordance with claim 7 wherein each of said first and second rollers comprises a shaft having a plurality of spherical zones arranged longitudinally thereof and a roller having a spherical surface mounted on each of said zones for rotation in any direction, the plane of rotation of each of said rollers corresponding substantially to the plane of the helical path of the longitudinal elemental line of the web that is contacted by each respective roller.

12. Apparatus for centering a moving web, comprising in combination:

- a first roller angularly disposed in relation to the incoming web for changing its direction of movement;

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- a second roller displaced from said first roller in a direction toward said incoming web and arranged substantially parallel thereto for receiving said web from said first roller and guiding it in an outgoing direction that is substantially the same as that of said incoming web and in a different plane, the center line of said web in said outgoing direction being substantially parallel to that of said incoming web;
- first pivotal support means for said first roller having an axis substantially perpendicular to the extended center line of the outgoing web at a first point that is spaced from a second point, as determined by the intersection of the extended web center line entering and leaving said first roller, by a distance substantially twice that between said second point and a third point, as determined by the intersection of the extended web center line entering and leaving said second roller;
- second pivotal support means for said second roller having an axis substantially perpendicular to the extended center line of said outgoing web at said third point; and
- means interconnecting said first and second pivotal support means for transmitting any translational movement of said first roller to said second roller as a function of any change in position of said incoming web to maintain the center line of said outgoing web in a predetermined relation to the axis of said second pivotal support means.

13. Apparatus in accordance with claim 12 wherein said first and second rollers are rotatably mounted in their respective pivotal support means.

14. Apparatus in accordance with claim 12 wherein said outgoing web is delivered by said second roller assembly in a plane that is substantially parallel to that of said incoming web and displaced laterally therefrom.

15. Apparatus in accordance with claim 12 wherein each of said first and second rollers comprises a shaft having a plurality of central spherical zones arranged longitudinally thereof and a roller having a spherical peripheral surface mounted on each of said zones for rotation in any direction, the plane of rotation of each of said rollers corresponding substantially to the plane of the helical path of the longitudinal elemental line of the web that is contacted by each respective roller.

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