

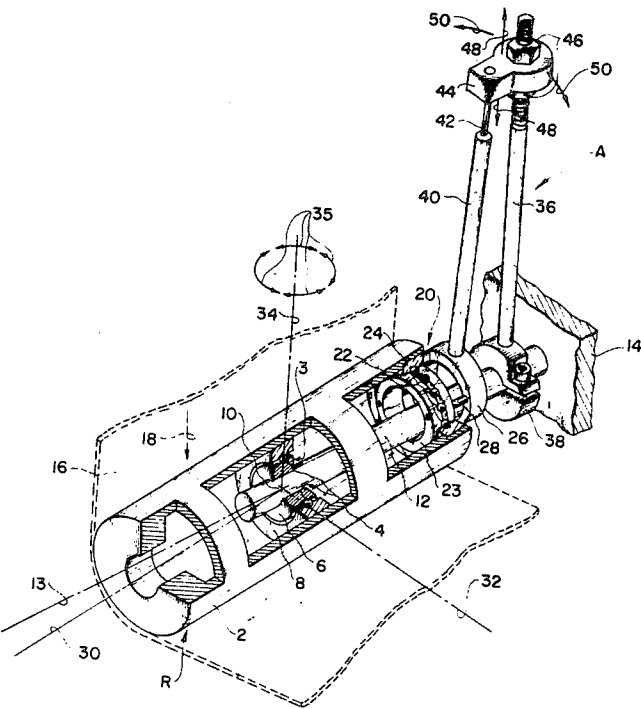
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[54] WEB-SUPPORTING DEVICE  
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226/194  
[51] Int. Cl. B65h 25/26  
[50] Field of Search 226/180,  
190, 194, 21, 23; 74/241; 198/202

[56] References Cited  
UNITED STATES PATENTS  
2,655,251 10/1953 Bankauf ..... 198/202  
3,149,497 9/1964 Haugen..... 74/241

**ABSTRACT:** A supporting roller across which a flexible web moves is rotatably mounted at its midpoint on a longitudinal shaft and is pivotally movable with respect to said shaft. Three orthogonal axes pass through the midpoint. The first axis is the longitudinal axis of the roller; the roller is adjustably positionable about the second axis; and the third axis is a gimbal axis about which the roller is free to rotate. In order to restrain the roller for these movements one end of the roller is provided with a roller bearing which is connected by flexures to an annulus extending around the shaft. In one embodiment the annulus is connected by a flexure arm to a lug which is longitudinally adjustable along a support post extending perpendicular from the shaft. Also, the post is adjustably positionable about the shaft so that the direction of the gimbal axis can be changed. In another embodiment a spring bracket biases the flexure member along its axis, the amount of the movement thereof being limited by a setscrew.



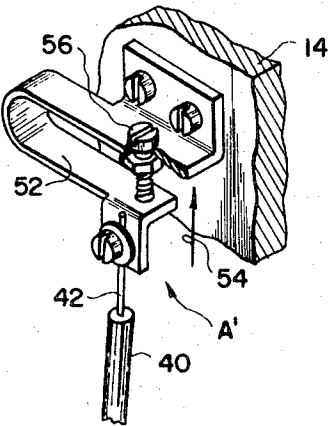


FIG. 2

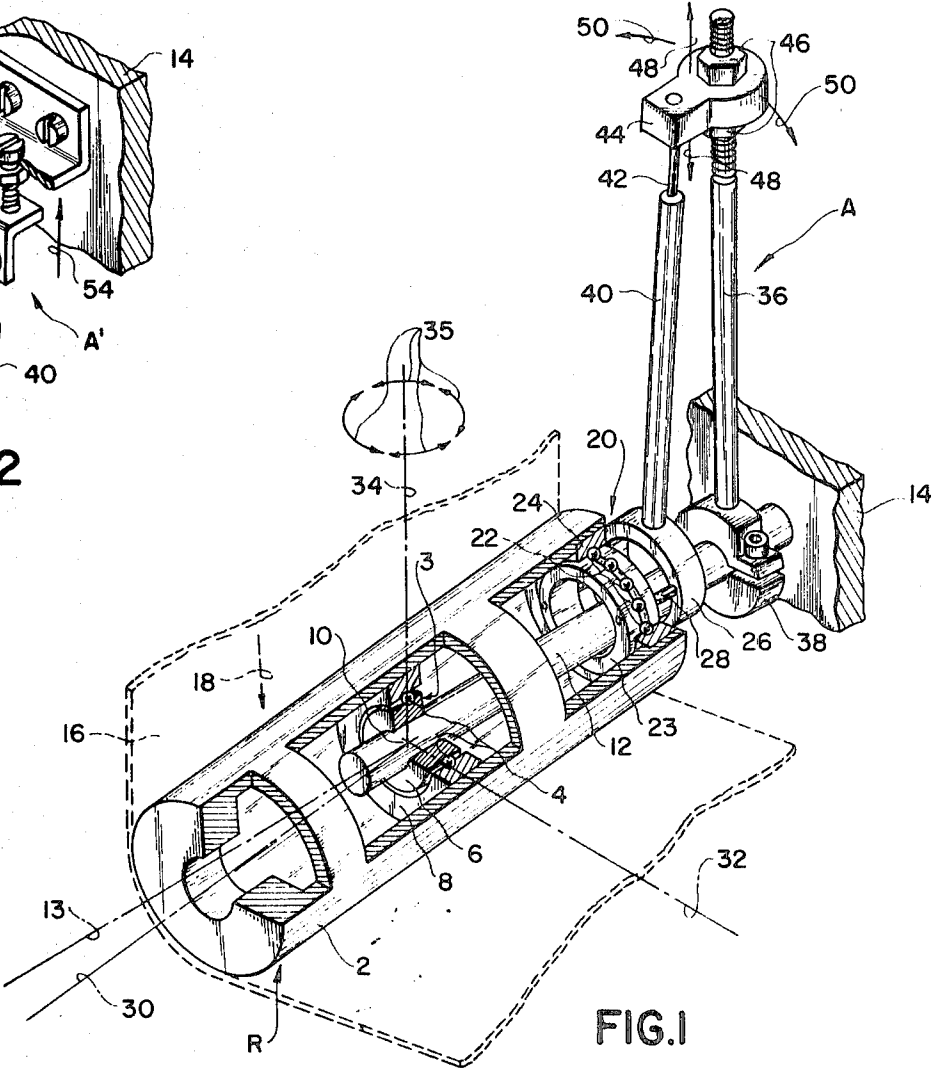


FIG. 1

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## WEB-SUPPORTING DEVICE

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

This invention relates to a web-supporting device and more particularly to an adjustably positioned roller which is pivotal about a gimbal axis passing through the midpoint of the roller.

## 2. Description of the Prior Art

Various attempts have been made in the prior art to provide guides and suitable constraints for flexible belts or webs which are fed from a supply roll to a takeup roll. Also, similar devices have been provided for endless belts. Idler rollers have been provided which are self-aligned by a belt or web which tends to run off one side of the roller. To provide even tension across the belt, rollers have been mounted for pivotal movement about a center point, as disclosed in commonly assigned U.S. Pat. No. 3,161,283 to Knab et al. which issued Dec. 15, 1964; U.S. Pat. No. 3,315,859 to Owen et al. which issued Apr. 25, 1967; and U.S. Pat. No. 3,342,389 which issued to Drexler on Sept. 19, 1967. In each of these devices means are provided at the edge of the roller for sensing misalignment of the belt causing the roller to pivot in such a way as to correct this misalignment. Such arrangement can result in damage to the edge of the web and in an unstable system whereby the web is continually wandering back and forth across the roller. In a web path, where a web is subject to both upstream and downstream constraints, it is desired that the roller provide a stable adjustable lateral position of the web without imposing nonuniform stresses on the web.

## SUMMARY OF THE INVENTION

In the present invention a flangeless support roller for a web is mounted for rotational and pivotal movement about a midpoint, but the roller is further restrained for movement about only one of three orthogonal axes passing through the roller. One of these axes is the longitudinal axis of the roller. The second orthogonal axis is the axis about which the roller is to be adjusted, and the third orthogonal axis is the axis about which the roller is free to rotate. This latter axis will be referred to as the gimbal axis. Thus, by providing means for adjusting the direction of the longitudinal roller axis with respect to the web about the second axis and for allowing the longitudinal roller axis to be free about the third or gimbal axis, a tracking roller is provided which allows adjustment of the lateral web position at the roller and imposes the proper restraints on the web without imposing additional unwanted restraints.

This is accomplished in the present invention by providing means at one end of the roller for adjustably positioning a longitudinal axis of the roller about the second orthogonal axis and for positioning the direction of the second and third orthogonal axes with respect to the web. In one embodiment this adjustment means includes an annulus surrounding a longitudinal shaft which is nominally parallel to an approach and an exit plane of the web and is connected to a roller bearing at one end of the roller for adjustably positioning the roller. The annulus in turn is connected to a flexure arm extending substantially perpendicularly from the longitudinal axis. A support post extends perpendicularly from the longitudinal shaft and is provided with means connected to the flexure arm for adjustably positioning the latter with respect to the longitudinal shaft. In addition, the post is adjustably mounted for pivotal adjustment about the longitudinal shaft to adjustably position the direction in which the second and third orthogonal axes lie with respect to the web. Conveniently, a counter balance is provided at the opposite end of the roller to counter balance the weight of the bearing, annulus and flexure arm at the opposite end.

In an alternative embodiment, the flexure arm is connected to a biasing bracket which exerts a longitudinal force on the flexure member and has a setscrew which limits the amount of movement that can be imposed upon the flexure member and hence on the end of the roller.

There are at least two uses for rollers constructed in accordance with this invention: If the gimbal axis is substantially parallel to the direction of the web approach plane, the roller can be used with a web which is laterally constrained upstream and angularly constrained downstream or it can be used with a web which is laterally constrained upstream and laterally constrained downstream. When so used, the roller maintains a stable adjustable lateral position for the web at the roller location and does not cause uneven tension distribution in the entering or leaving web sections.

Additional advantages of this invention will become apparent from the description which follows, taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of one form of the present invention, with parts broken away for clarity of illustration; and FIG. 2 is a fragmentary perspective view of an alternative gimbal axis adjustment.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

In accordance with this invention, a roller assembly R includes a roller 2, as shown is mounted for rotation and pivotal movement in a bearing member 3 having ball bearings 4 mounted between an inner race 6 and slightly loose outer race 8 at the midpoint 10 of the roller. Inner race 6 is fixedly connected to a shaft 12, having an axis 13 and extending from a frame or base 14 of the apparatus in which the tracking roller is used.

Roller 2 is adapted to support a web 16, which may move in the direction of arrow 18 and engages roller 2 along an approach plane and departs therefrom along an exit plane as shown. Roller support shaft 12 is nominally mounted so as to be generally parallel with both the approach and exit plane of web 16. However, in actual practice it is virtually impossible to provide such a precise alignment of shaft 12. Therefore, to compensate for any misalignment, means must be provided for adjusting the position of roller 2 with respect to shaft 12 so that it causes the web to seek the desired lateral position without imposing any unwanted constraints on web 16 as it passes thereacross.

To accomplish this, bearing assembly 20 is provided which includes ball bearings 22 between an inner race 23 and an outer race 24; fixedly connected to the roller. Conveniently, outer race 24 is fixedly mounted in the end of the roller and the inner race 23 is free to rotate therein. A roller adjustment assembly A is provided which in this embodiment includes an annulus 26 extending around shaft 12 adjacent bearing assembly 20 and is connected to inner race 23, as by a pair of flexure members at opposite sides thereof, such as flexure member 28.

Three orthogonal axes pass through midpoint 10 about which movement or position of roller 2 is important. These axes are roller axis 30, adjustment axis 32, and gimbal axis 34. Through roller adjustment assembly A, the roller is constrained so that it is free to rotate about gimbal axis 34, as illustrated by arrows 35, but is adjustably positionable with respect to adjustment axis 32. To provide this adjustment, an adjustment post 36 extends perpendicularly from shaft 12 and is attached thereto by a clamp 38. A flexure arm 40 extends from annulus 26 and has a reduced portion 42 which serves as a pivot by which flexure arm 40 is attached to a lug 44. Lug 44 is adjustable along post 36 by means of spaced adjustment nuts 46. By this means the end of roller 2 is moved in the direction of arrows 48 to adjustably position the roller about axis 32. The direction of gimbal axis 34 can be adjusted with respect to the approach and exit planes of the web by means of clamp 38 which may be loosened to rotate post 36 about shaft 12 in the direction of arrows 50. The weight of bearing assembly 20, annulus 26 and flexure arm 40 is counterbalanced conveniently by thickened portion 51 at the opposite end of roller 2.

It will be noted that reduced section 42 of flexure 40 serves as a pivot point to permit rotation of roller 2 about gimbal axis 34 without interference from the roller adjustment assembly A. Also, flexures 28 permit pivotal movement of roller 2 about adjustable axis 32 as adjustment lug 44 is moved through its adjustment range. However, after adjustment, the position of roller 2 about axis 32 is fixed.

An alternative adjustment assembly A is shown in FIG. 2 wherein the reduced end 42 of flexure 40 is attached to a U-shaped spring bracket 52 which in turn is attached to frame or housing 14 as shown. Spring bracket 52 exerts a force on flexure 40 in the direction of arrow 54. The extent of movement of flexure 40 is limited by an adjustable setscrew 56.

From the foregoing, the advantages of this invention are readily apparent. A web-handling device is provided which facilitates free movement of the roller about a gimbal axis extending through the midpoint of the roller, but the roller is adjustably fixed about an adjustment axis which is perpendicular to the gimbal axis and to the longitudinal axis of the roller. Thus, the longitudinal axis of the roller can be positioned so as to be exactly perpendicular to the desired web approach direction and the direction of the gimbal axis may be adjusted to be substantially parallel with the web approach plane as desired for the particular use for which the roller is to be put depending on the upstream and downstream constraints already exerted on the web.

The invention has been described in considerable detail with reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

We claim:

1. A web-tracking device for transporting a web between upstream and downstream constraints and having first, second and third orthogonal axes, said web being adapted to come into engagement with said tracking device along an upstream approach direction, said device comprising:

means defining a fixed longitudinal axis;

a roller for supporting a web, said roller having two ends and a midpoint and being rotatably supported solely at said midpoint for rotation about said fixed axis said orthogonal axes extending through said midpoint, wherein said first orthogonal axis is said roller axis and is normally coincident with said fixed axis; and

means for constraining said roller for free pivotal movement about said third orthogonal axis as a gimbal axis and for adjustment of said roller axis about said second orthogonal axis so that said roller axis is substantially perpendicular to said approach direction.

2. A web-tracking device as claimed in claim 1 wherein said constraining means includes:

means connected to one end of said roller adjustably movable in a direction perpendicular to said fixed axis to adjustably position said roller about said second orthogonal axis.

3. A web-tracking device for transporting a web between upstream and downstream constraints and having first, second and third orthogonal axes, said web being adapted to come into engagement with said handling device along an upstream approach direction, said device comprising:

a fixed shaft having a longitudinal axis;

a roller for supporting a web, said roller having first and second ends and a midpoint through which said orthogonal axes extend, said first orthogonal axis being said roller axis;

mounting means concentrically arranged with respect to said midpoint as the sole means for rotatably mounting said roller on said shaft so that said roller axis is free to pivot in all directions about said midpoint, being unsupported at said first and second ends;

first adjustable positioning means for adjustably fixing the position of said roller axis about said second orthogonal axis so that said roller axis is substantially perpendicular to said upstream approach direction without restraining movement of said roller about said third orthogonal axis.

4. A web-tracking device as claimed in claim 3, further including:

second adjustable positioning means for adjustably positioning said orthogonal axes about said longitudinal axis.

5. A web-tracking device as claimed in claim 3, wherein said first adjustable positioning means includes:

a bearing rotatably attached to said first end of said roller; means connected to said bearing for adjustably locating said one end of said roller transversely with respect to said shaft.

6. A web-tracking device as claimed in claim 5, further including:

counterbalance means on said second end of said roller to counterbalance said bearing.

7. A web-tracking device as claimed in claim 5, wherein said adjustable locating means includes:

an annulus extending around said shaft and connected to said bearing; an arm, having a longitudinal axis, extending from said annulus;

means biasing said arm along said longitudinal axis thereof; and means limiting the movement of said arm in response to said biasing means.

8. A web-tracking device as claimed in claim 5, wherein said locating means includes:

an annulus extending around said shaft and connected to said bearing;

a support post spaced from said annulus and extending perpendicularly from said shaft;

an arm extending from said annulus;

adjustment means on said post connected to said arm for positioning said one end of said roller with respect to said shaft.

9. A web-tracking device as claimed in claim 8, further including:

adjustable clamp means for adjustably connecting said post about said shaft.

10. A web-tracking device as claimed in claim 8, further including:

first means pivotally connecting said annulus to said bearing; and

second means pivotally connecting said arm to said adjustment means.

11. A web-tracking device as claimed in claim 10 wherein said first and second means are flexure members.