APPARATUS FOR PROCESSING EXPOSED PHOTOGRAPHIC FILM OR THE LIKE

Inventors: Josef Busch, Eichendorffstr. 11, Bensberg; Herbert Bruck, Havelstr. 3, Leverkusen; Karl-Wilhelm Schranz, Bruchhauserstr. 16b, Opladen; Erwin Schön, Donhoffstr. 92, Leverkusen; Hans-Dieter Frick, Bozener Str. 7, Munich, all of Germany

Filed: June 11, 1971
Appl. No.: 152,269

ABSTRACT

A system of guide rollers for transporting exposed photographic film past one or more stations where the exposed surface of the film is coated with a viscous adhesive has a set of upper guide rollers and a set of lower guide rollers. The film is caused to travel along an elongated winding path which has vertical sections each extending between an upper guide roller and a lower guide roller, and at least one guide roller of each pair of successive guide rollers has a convex peripheral surface. The central line of each vertical section of the winding path coincides with tangents to the central portions of peripheral surfaces on the respective upper and lower guide rollers. The planes which are normal to the axes of pairs of successive guide rollers make an angle which exceeds zero degrees but is less than 91°.

18 Claims, 12 Drawing Figures
APPARATUS FOR PROCESSING EXPOSED PHOTOGRAPHIC FILM OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for manipulating band- or strip-shaped bodies, especially elongated photographic films or like photosensitive materials. More particularly, the invention relates to improvements in apparatus for processing exposed photosensitive materials in the form of webs, strips or the like. Still more particularly, the invention relates to improvements in apparatus which are especially suited for guiding and transporting web- or strip-shaped exposed photosensitive materials during contact with one or more developing, fixing, bleaching, washing and/or other agents.

It is already known to contact webs or strips of exposed photosensitive material with one or more developing or other treating agents which are applied to one surface of the material while the latter is held in motion and is trained over one or more rollers or analogous guide members. It is also known to employ viscous developing agents which are applied only once and which can be applied to webs or strips of exposed photosensitive material only if the latter is guided in such a way that one of its surfaces (namely, that surface which is to be contacted by a viscous developing agent) cannot be contacted by the surfaces of rollers or other mechanical guide elements. Any contact between the coated surface of photosensitive material and a roller or the like would be likely to destroy the film of adhesive developing agent and would adversely affect the quality of the latent image.

The problem of properly guiding strip-shaped photosensitive material in an apparatus of low capacity in such a way that one of its surfaces is held out of contact with mechanical guide elements can be readily solved if the path along which the photosensitive material must be guided is relatively short, namely, if the length of the interval during which the material is to dwell in the developing unit of the apparatus does not exceed the length of that interval which is required to advance the material along a path not longer than twice the distance between a pair of adjoining rollers or like guide members. However, if the path of such length is too short, for example, because the strip-shaped material must be transported lengthwise at a considerable speed, and if the height of the apparatus should remain within reasonable limits, the just described conventional apparatus are unsatisfactory for proper guidance of photosensitive material during contact with a viscous developing or other processing agent.

Certain other conventional processing apparatus employ sets of coaxial guide rollers which define for the strip-shaped photosensitive material a helical path. Such apparatus are satisfactory for guidance of relatively narrow strips but fail to satisfy if the photosensitive material is in the form of a relatively wide strip. Furthermore, the axes of coaxial guide rollers must be located at a considerable distance from each other so that such apparatus occupy substantial amounts of space. Therefore, apparatus which define a helical path have failed to gain widespread acceptance for the processing of wide strips of photographic copying paper which is used in modern high-speed copying or printing apparatus for exposed photographic roll film or the like.

SUMMARY OF THE INVENTION

An object of the invention is to provide novel and improved means for advancing, guiding and coating flexible band- or strip-shaped bodies, particularly lengths of photographic film or the like.

Another object of the invention is to provide novel and improved means for guiding coated band- or strip-like carriers in such a way that a substantial length of a carrier can be accommodated in a small area and that the coated surface of the carrier need not be contacted by any mechanical parts.

A further object of the invention is to provide guide means which can be installed in continuous developing apparatus for photographic film or the like.

An additional object of the invention is to provide novel and improved means for coating one surface of a travelling flexible band- or strip-shaped carrier with a viscous treating agent in such a way that the thickness of the applied treating agent can be regulated and maintained with a high degree of accuracy.

Still another object of the invention is to provide novel means for advancing band- or strip-shaped flexible carriers through the guide means of a continuous developing machine for photographic film or the like.

Another object of the invention is to provide a novel system of guide rollers for band- or strip-shaped carriers one side of which should not be contacted by mechanical parts and which must be guided along an elongated path the overall length of which considerably exceeds twice the distance between a pair of neighboring guide rollers.

A further object of the invention is to provide a system of guide rollers which can be placed close to each other without permitting any contact between one side of the band-like material and the mechanical parts of the apparatus wherein the rollers are put to use in connection with the transport, guidance, coating, washing, drying and/or other treatment of photographic films or the like.

The invention is embodied in an apparatus for treating travelling flexible band- or strip-shaped bodies with flowable agents, particularly for applying viscous agents to coated sides of carriers which are provided with coats of photosensitive material. The apparatus comprises at least two sets of guide rollers having axes located in at least two different planes (preferably in two substantially horizontal planes which are located at different levels) and peripheral surfaces defining an elongated meandering or winding path for a travelling flexible body. The path has elongated sections each extending between a given guide roller of a first set and a given guide roller of a second set, and the axes of such given guide rollers are inclined with reference to each other. At least one of each pair of given guide rollers (i.e., of two successive guide rollers one of which forms part of the first set and the other of which forms part of the second set) has a convex peripheral surface. The central line of each of the aforementioned elongated sections of the meandering path for the flexible body coincides with tangents to the central portions of peripheral surfaces of the respective given guide rollers.

The planes which are normal to the axes of pairs of successive (given) guide rollers make with each other an angle which exceeds zero degrees but is less than 91°. This causes a twisting of those stretches of a flexi-
The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

**BRIEF DESCRIPTION OF THE DRAWING**

FIG. 1 is a diagrammatic side elevational view of a developing apparatus having sets of guide rollers which are mounted in accordance with a first embodiment of the invention;

FIG. 2 is a perspective view of certain guide rollers shown in FIG. 1, further showing the advancing means for the flexible body which is treated while travelling about the guide rollers;

FIG. 3a is an enlarged plan view of a detail in FIG. 2, substantially as seen in the direction of arrow III shown in FIG. 2;

FIG. 3b is an elevational view of the structure shown in FIG. 3a;

FIG. 4a is a plan view of a second system of guide rollers;

FIG. 4b is an elevational view of the structure shown in FIG. 4a;

FIG. 5a is a plan view of a third system of guide rollers;

FIG. 5b is an elevational view of the structure shown in FIG. 5a;

FIG. 6a is a plan view of a fourth system of guide rollers;

FIG. 6b is an elevational view of the structure shown in FIG. 6a;

FIG. 7 is a perspective view of a device which can be used in the apparatus of FIG. 2 to apply to the travelling flexible body a layer of viscous material; and FIG. 8 is a partly sectional different perspective view of the device shown in FIG. 7.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

FIG. 1 illustrates schematically a continuous developing apparatus for photographic film. The apparatus comprises two magazines or sources 1, 2 of convoluted exposed film which can be conveyed through the apparatus simultaneously or one after the other. The film which is convoluted in the magazine 1 is indicated at 1a and the other film is indicated at 2a. The magazines 1, 2 are mounted on or adjacent to one side wall of the housing 3 of the apparatus. The reference character 4 denotes a film storing unit which can store a certain length of film 1a and/or 2a so as to insure that the trailing end of an expiring film can be spliced or otherwise connected to the leading end of a fresh film before the trailing end of the expiring film enters the first treating unit 5. The unit 5 is provided with means for contacting the film 1a or 2a with one or more wet or moist agents. Such contacting means includes nozzles which discharge the agents in such a way that they contact one side or surface of the moving film. At least some of the agents are assumed to be viscous pastes which are employed for developing and fixing of the photosensitive material on the film. The first treating unit 5 is followed by a washing unit 6 and thereupon by a drying unit 8. The dried film is collected by a takeup reel or spool 7 which is adjacent to another side wall of the housing 3.

Certain novel parts of the just described apparatus are illustrated in greater detail in FIG. 2 of the drawing. The apparatus is directly coupled with a high-speed photographic copying machine 39 which exposes successive portions of a band- or strip-shaped carrier 40 for photosensitive material. The carrier 40 may consist of felted paper which is coated with a suitable emulsion. The freshly exposed portions of the carrier 40 advance through a storing unit 4 which corresponds to the storing unit 4 of FIG. 1 and enter the first treating unit 9 by way of an inlet opening 9a provided in the housing 9b of the unit 9. This unit accommodates a horizontal combined guide and drive roller 11 which is adjacent to a nozzle 12 having one or more slit-shaped orifices (see the orifice 36b in FIG. 8) for a viscous flowable developing agent which is applied to the adjacent exposed surface of the carrier 10, namely, to that surface which faces away from the axis of the drive roller 11. As shown, the nozzle 12 is installed at a level below the axis of the drive roller 11 in such position that it applies a viscous developing agent in the region where the carrier 10 is being deflected through substantially 90° by the peripheral surface of the roller 11. The carrier 10 is thereupon twisted through substantially 45° during travel along that elongated section of the meandering path for the carrier which extends toward the peripheral surface of a guide roller 25 mounted in the housing 9b at a level above the drive roller 11. A further twisting of the carrier 10 through 45° takes place during travel along that elongated section of the meandering path which extends from the guide roller 25 toward a second lower guide roller 13 located at a level slightly below the level of the drive roller 11. The axis of the guide roller 13 is parallel to the axis of the the drive roller 11 and to the axis of a further lower guide roller 14 located at the level of the guide roller 13 and serving to deflect the carrier 10 through 90° so that the carrier advances upwardly and is twisted through 45° during travel along a further elongated section of the meandering path toward the periphery of a second upper guide roller 15 having a horizontal axis making with the axis of the guide roller 25 an angle of about 90°. The lower guide roller 13 is axially offset with reference to the drive roller 11 by a distance equaling or approximating the width of the carrier 10. The axes of the upper guide rollers 15, 25 are preferably located in a common horizontal plane.

The positions of the rollers 11, 13, 14, 15, 25 with reference to each other are selected in such a way that the central line of each vertical section of the meandering path (i.e., the central line of each twisted stretch of the carrier 10 which extends between the rollers 11 and 25 or 25 and 13 or 14 and 15) coincides with a line which is tangential to the central portions of peripheral surfaces of the rollers 11-25, 25-13 or 14-15. Furthermore, the diameters of the upper guide rollers 25, 15 are preferably selected in such a way that the aforementioned tangents between the rollers 25-13 and 15-14 are at least substantially vertical and parallel to...
each other. As shown in FIG. 3a, the maximum diameter D25 of the roller 25 is the diagonal of a rectangle one side of which equals the maximum diameter D13 of the lower guide roller 13. The same holds true for the maximum diameters D15 and D14 of the guide rollers 15 and 14. The other side of the rectangle having the diagonal D25 equals the distance DD between the centers (maximum diameters D11, D13) of the rollers 11, 13. This distance also equals the length of the longer side of the rectangle having shorter sides D14, D16 and a diagonal D15.

At least the rollers 13, 14, 15, 25 are barrel-shaped (see FIGS. 3a and 3b), i.e., they have convex peripheral surfaces. FIGS. 3a and 3b further show that the drive roller 11, too, may be of barrel shape but it is equally within the purview of the invention (and considered preferable at this time) to employ a cylindrical drive roller. The convexity of the peripheral surfaces of rollers 13, 14, 15, 25 depends on the distance between the two sets of upper and lower guide rollers, on the desired extent of twisting of the vertically extending stretches of the carrier 10, and on the width of the carrier. The shorter the distance between the upper and lower guide rollers and the greater the desired extent of twisting of the carrier 10, the more pronounced is the convexity of peripheral surfaces of the rollers 13, 14, 15 and 25, i.e., the greater is the difference between the maximum diameters D13, D14, D15, D25 and the diameters at both axial ends of the respective guide rollers. This prevents changes in the length of the marginal portions of the carrier 10 during transport through the housing 9b. In the absence of careful consideration of the just enumerated factors, the central portions of the carrier 10 would be transported without excessive stretching but the marginal portions of the carrier could be subjected to highly undesirable tensioning stresses which could cause tearing, especially if the carrier is relatively wide and consists of felted material having a relatively low resistance to tearing.

As mentioned above, the drive roller 11 is preferably a circular cylindrical body having a peripheral surface of constant diameter. This is desirable in order to insure uniform application of viscous developing agent which issues from the slit-shaped orifice or orifices of the nozzle 12, i.e., the nozzle 12 can apply to the adjacent exposed surface of the carrier a film or layer of constant thickness if the diameter of the drive roller 11 is constant from end to end. If the drive roller 11 is a circular cylinder, the convexity of the peripheral surface of the next-following guide roller (25 in FIG. 2) is increased accordingly.

The carrier 10 which advances beyond the guide roller 15 of the upper set of guide rollers is thereupon caused to move downwardly and is trained around the convex peripheral surface of a further guide roller 16 of the lower set which is adjacent to a dispensing nozzle 12a serving to discharge water or another washing agent which removes the viscous agent. The number of deflections of the carrier 10 between the inlet opening 9a and the nozzle 12a depends on the desired length of the interval during which the viscous developing agent is to remain in contact with one surface of the carrier. Thus, the nozzle 12a can be placed adjacent to another guide roller in the housing 9b if the length of the just mentioned interval is to be increased or reduced, depending on the nature of emulsion on the carrier 10, on the speed of transport of the carrier through the housing 9b, on the distance between the upper and lower guide rollers and/or on the nature of the viscous developing agent. The thus washed increments of the carrier 10 are thereupon caused to move about the preferably convex peripheral surface of a lower guide roller 16a in a second treating unit 19 and the exposed surface of the carrier is coated with a further agent which is discharged through one or more slit-shaped orifices of a nozzle 17 similar to or identical with the nozzle 12. The agent which is discharged by the orifice or orifices of the nozzle 17 can be a stop-fixing bath. The relative positions of remaining guide rollers shown in FIG. 2 within the confines of the composite housing including the housing 9b are preferably identical with the positions of the aforementioned rollers. For example, the rollers numbered 13', 14', 15', 25' respectively correspond to the aforementioned rollers 13, 14, 15 and 25. One or more of the unnumbered guide rollers in the housing 9b can be mounted adjacent to one or more additional nozzles for discharge of a bleeding fixing agent (unit 18) which can remain in contact with the carrier 10 for a relatively long interval of time, for example, while the carrier 10 advances along six, eight, 10 or 12 successive guide rollers. A further nozzle (not specifically shown) can discharge water or another washing agent (unit 20) which washes the carrier and the latter is thereupon dried in a unit 21 while travelling along rollers similar to those numbered 13, 14, 15 and 25. Such rollers insure gentle treatment of emulsion on the exposed side of the carrier 10. The dried portions of the carrier thereupon advance through the nip of two advancing rolls 22, 23 and the carrier is finally convoluted on the core of a takeup reel 24. The advancing roll 23 is driven in a manner not shown in the drawing (for example, by an electric motor which also drives the roller 11) and has a roughened friction-generating peripheral surface which engages the adjacent surfaces of successive increments of the carrier 10. The other advancing roll 22 is biased against the other surface of the carrier 10 in the nip between the rolls 22, 23 by one or more springs 22a or the like. The roll 22 has a certain freedom of movement with reference to the roll 23 and is preferably provided with a smooth peripheral surface.

FIGS. 3a and 3b show that the maximum diameters of the guide rollers of the upper set (such as the guide rollers 25, 15) considerably exceed the maximum diameters of the guide rollers of the lower set (such as the rollers 13, 14, 16). The maximum diameters of the upper guide rollers are selected in such a way that the two vertical tangents to the central portions of the peripheral surface on an upper guide roller coincide with vertical tangents to the central portions of peripheral surfaces on the associated lower guide rollers (see the tangents T25 and T25a or the tangents T15 and T15a in FIG. 3a). It is again pointed out that the drive roller 11 is preferably a circular cylinder having a constant diameter from end to end in order to insure uniform application of viscous developing agent to that portion of the carrier 10 which is trained over the cylindrical peripheral surface of the drive roller. The drive roller and the guide rollers are preferably
mounted for rotation with minimal friction by resorting to corrosionsistant antifriction bearings which can resist the corrosive action of burning or other agents and employ balls or rolls consisting of synthetic plastic material, glass or a combination of such materials (for example polypropylene/polyamide-glass balls). The bearing for the guide roller 25 of FIG. 3b is shown schematically at 125.

As shown in FIG. 3a, the vertical plane which includes the axis of the guide roller 25 makes an angle of 45 degrees with the vertical planes including the common axis of the rollers 11 and 13. The same holds true for the planes including the axes of the guide rollers 14, 15 and 16.

A modified system consisting of two sets of guide rollers for a relatively wide strip- or band-shaped carrier for a photographic emulsion is illustrated in FIGS. 4a and 4b. The carrier 10a is trained over the guide rollers in such a way that one of its surfaces (namely, that surface which is coated with emulsion) remains out of contact with the preferably convex peripheral surfaces of (barrel-shaped) guide rollers. The guide rollers 26 of the upper set are rotatable about a common horizontal axis defined by a single shaft 27 or by a series of discrete coaxial shafts. The guide rollers 28 and 28a of the lower set form two rows and are rotatable about horizontal axes which are parallel to each other and normal to the axis of the shaft 27. The rollers 28 of one row of the lower guide rollers are laterally offset or staggered with reference to the rollers 28a of the other row. The system of FIGS. 4a and 4b renders it possible to employ a set of upper guide rollers 26 whose dimensions are identical with those of the set of lower guide rollers 28 and 28a. However, it is possible to modify the system of FIGS. 4a and 4b by moving the lower guide rollers of each row closer to each other and by replacing the upper guide rollers 26 with guide rollers of smaller dimensions. The carrier 10a is twisted through 90° during travel along each such elongated section of the winding path which extends between the convex peripheral surface of an upper guide roller 26 and the convex peripheral surface of a lower guide roller 28 or 28a. The guide rollers 28 and 28a are preferably equidistant from each other.

An advantage of the just described system is that the axes of the guide rollers 26, 28, 28a are disposed in a rectangular coordinate system and that the upper guide rollers 26 can be mounted on a common shaft because they have a common axis of rotation. This reduces the manufacturing and assembly cost of the system.

In FIGS. 4a and 4b, the vertical plane including the common axis of the guide rollers 26 makes an angle of 90° with the vertical planes including the axes of the lower guide rollers 28 and 28a. The distance between the neighboring guide rollers 28 or 28a preferably equals or approximates the diameter of a guide roller 26.

FIGS. 5a and 5b illustrate a system consisting of two sets of guide rollers which occupies even less room than the systems of FIGS. 3a–3b and 4a–4b. The guide rollers 29 of the lower set are rotatable about a common horizontal axis and the guide rollers 30 of the upper set are rotatable about parallel horizontal axes each of which makes an angle of 45° with the common axis of the guide rollers 29. The maximum diameter D30 of each guide roller 30 is the diagonal of a rectangle having a first side whose length equals the maximum diameter D29 of a guide roller 29 and a second side having a length corresponding to the distance DC between the centers (maximum diameters D29) of two neighboring guide rollers 29. The system of FIGS. 5a and 5b requires a higher initial outlay for the bearings for the guide rollers 30 each of which is rotatable about a separate axis; however, such outlay is justified if a large number of elongated stretches of the flexible strip- or band-shaped carrier 10b is to be accommodated in a small area.

The diameters D30 of the guide rollers 30 of the upper set of guide rollers are parallel to each other. FIGS. 6a and 6b show a system which embodies certain features of the systems illustrated in FIGS. 3a–3b and 5a–5b.

The guide rollers 31 of the lower set are arranged in groups of several (three) rollers, each group having a common horizontal axis of rotation. The common axes of guide rollers 31 in the illustrated groups are parallel to each other and are located in a common horizontal plane. One of the shafts for a group of three coaxial guide rollers 31 is shown at 32.

The guide rollers 33 of the upper set are disposed in groups of two guide rollers each. The guide rollers 33 of each such group have parallel horizontal axes which make an angle of 45° with the axes of the corresponding groups of lower guide rollers 31. The axes of guide rollers 33 in neighboring groups make an angle of 90°. The vertically extending stretches of the carrier 10c are twisted through 45°.

The system of FIGS. 6a and 6b occupies little room and can properly guide a substantially long length of flexible band-or strip-shaped carrier. Each group of guide rollers 31 in the lower set can consist of more than three guide rollers, and the number of guide rollers 33 in the upper set is then increased accordingly. The maximum diameter D33 of each guide roller 33 is the diagonal of a rectangle with sides D31 and DE wherein D31 is the maximum diameter of a guide roller 31 and DE is the distance between the centers (maximum diameters D31) of two neighboring guide rollers 31 in a group. The guide rollers 31 and 33 are barrel-shaped, i.e., they have convex peripheral surfaces.

FIGS. 7 and 8 illustrate the details of a nozzle (e.g., the nozzle 12 of FIG. 2) for discharging a viscous treating agent. The nozzle comprises a support or base plate 34 which is secured to or provided on the housing of the respective unit and supports a block 36 adjustably secured thereto by screws 35, bolts or analogous fasteners. The block 36 is formed with a chamber 36a and with a slit-shaped orifice 36b. The chamber 36a is connected with a metering pump 38 by means of a conduit 37. The latter can contain a tempering device such as a schematically indicated plate heat exchanger 39. The pump 38 draws a viscous treating agent from a tank 40.

The width of the orifice 36b exceeds the desired thickness of the layer or film of viscous material which is to be applied to one side of a band- or strip-shaped carrier (not shown). The thickness of such layer or film is determined by the distance between the exposed surface 36c at the outer end of the orifice 36b and the exposed surface of the carrier. Such distance can be
3,724,355

3. A combination as defined in claim 2, wherein said planes make an angle which at least approximates 90° and the guide rollers of one of said sets have a common axis of rotation.

4. A combination as defined in claim 3, wherein the guide rollers of the other set form two rows of coaxial rollers and the guide rollers of one of said rows are staggered sideways with reference to the guide rollers of the other row.

5. A combination as defined in claim 4, wherein the guide rollers of each of said rows are separated from each other by distances approximating the diameter of a roller in said one set.

6. A combination as defined in claim 2, wherein the guide rollers of one of said sets form pairs of coaxial rollers and the neighboring guide rollers of the other set have mutually inclined axes.

7. A combination as defined in claim 6, wherein the axes of guide rollers in at least one of said sets are located in a common plane.

8. A combination as defined in claim 2, wherein the convexity of said convex peripheral surfaces is also a function of the magnitude of said angle.

9. A combination as defined in claim 1, wherein at least one guide roller in one of said sets has a circular cylindrical peripheral surface of constant diameter.

10. A combination as defined in claim 9, wherein said one set of guide rollers is located at a level below the other set.

11. A combination as defined in claim 9, further comprising an adjustably mounted nozzle having an elongated orifice adjacent to the peripheral surface of said one guide roller and means for supplying to said nozzle a viscous material for the application of such material to the adjacent surfaces of successive increments of a flexible body which is trained over said one guide roller, the width of said orifice exceeding the desired thickness of viscous material on the surface of the flexible body.

12. A combination as defined in claim 11, wherein said orifice is located at a level below the axis of said one guide roller.

13. A combination as defined in claim 1, further comprising a pair of advancing rolls located past said guide rollers as considered in the direction of lengthwise travel of the flexible body and arranged to pull the body along said path.

14. A combination as defined in claim 13, wherein the body is trained over one of said advancing rolls and said one advancing roll has a friction generating peripheral surface, and further comprising means for biasing the other advancing roll against those increments of the flexible body which contact the peripheral surface of said one advancing roll.

15. A combination as defined in claim 1, further comprising corrosion-resistant antifriction bearing means for at least some of said guide rollers.

16. A combination as defined in claim 15, wherein said antifriction bearing means comprises rolling elements of a material selected from the group consisting of vitreous and synthetic plastic substances.

17. In an apparatus for treating travelling flexible band- or strip-shaped bodies with flowable agents, particularly for applying viscous agents to coated sides of carriers provided with coats of photosensitive material, a combination comprising at least two sets of guide rollers, each set having a flexible body for treatment located between the carriers and having a uniform width relative to the central portion of said flexible body, at least one of said sets of guide rollers having a convex peripheral surface configured to counteract said tendency of said marginal portions to increase their length relative to said central portion so that the tensional stressing of said flexible body in the path sections between said pairs of guide rollers is at least substantially uniform across the entire cross section of said flexible body, the degree of convexity of said convex peripheral surface being a function of the width of said flexible body and of the distance between the rollers of said pairs of guide rollers the central line of each of said sections of said path coinciding at least substantially with the tangents to the central portions of peripheral surfaces of the respective given guide rollers.

2. A combination as defined in claim 1, wherein the planes which are normal to the axes of said pairs of given guide rollers make an angle of less than 91°.
rollers having axes located in at least two different planes and peripheral surfaces defining an elongated meandering path for a travelling flexible body, said path having elongated sections each extending between a given guide roller of a first set and a given guide roller of a second set, the axes of said given guide rollers being inclined with reference to each other and the planes which are normal to the axes of said pairs of given guide rollers making an angle of less than 91°, the guide rollers of one of said sets having a common axis of rotation and being equidistant from each other and the diameter of each guide roller of the other set constituting the diagonal of a rectangle one side of which equals the diameter of a guide roller of said one set and the other side of which equals the distance between the centers of two neighboring rollers of said one set, at least one of each pair of given guide rollers having a convex peripheral surface and the central line of each of said sections of said path coinciding at least substantially with the tangents to the central portions of peripheral surfaces of the respective given guide rollers.

18. A combination as defined in claim 17, wherein the diameters of guide rollers of said other set are parallel to each other.

* * * * *