

[54] WEB GUIDING APPARATUS

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[51] Int. Cl..... B65h 23/34

[58] **Field of Search**..... 226/189, 196, 197,
226/198, 199, 88; 242/76; 95/94 R

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Primary Examiner—Allen N. Knowles

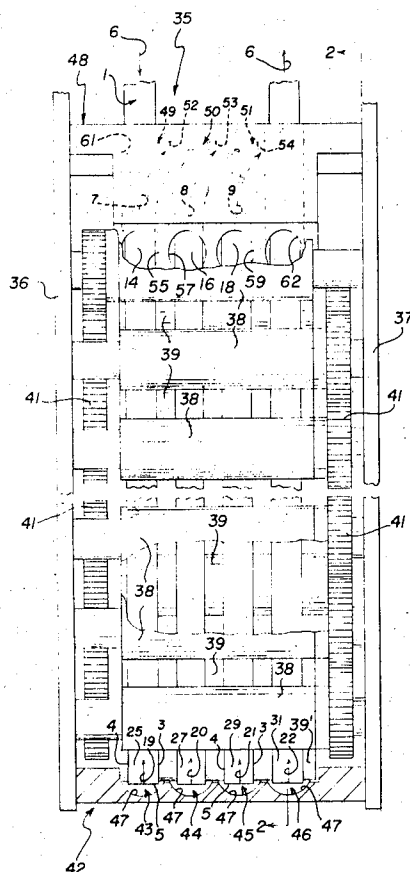
Attorney—W. H. J. Kline et al.

[57] ABSTRACT

A web guiding apparatus is adapted for use with flexible web material (a) which has a longitudinal axis, two

oppositely spaced longitudinal edges and a sensitive surface extending between the last-mentioned edges (b) and which when longitudinally bowed is generally resistive to transverse flexing. The apparatus guides such web material longitudinally along a multi-loop path having a series of parallel, path sections which are curved respectively about parallel, coplanar axes and individually have two spaced portions arranged in transversely offset relation. In the apparatus, a plurality of web guideways are provided for guiding such web material respectively along these path sections. Each of the web guideways has a web guiding surface which is contorted to longitudinally extend between the two, transversely offset portions of a respective one of the path sections. Also, since the web guiding surface is crosswise curved about the longitudinal axis of web material moving along the respective path section, and is longitudinally arched in substantially conformal relation with the curvature of the respective path section, the web guiding surface will abut only the two longitudinal edges of such a moving web so as to longitudinally bow the moving web without contacting the sensitive web surface and so as to support the same web for rotation about the longitudinal web axis.

6 Claims, 11 Drawing Figures



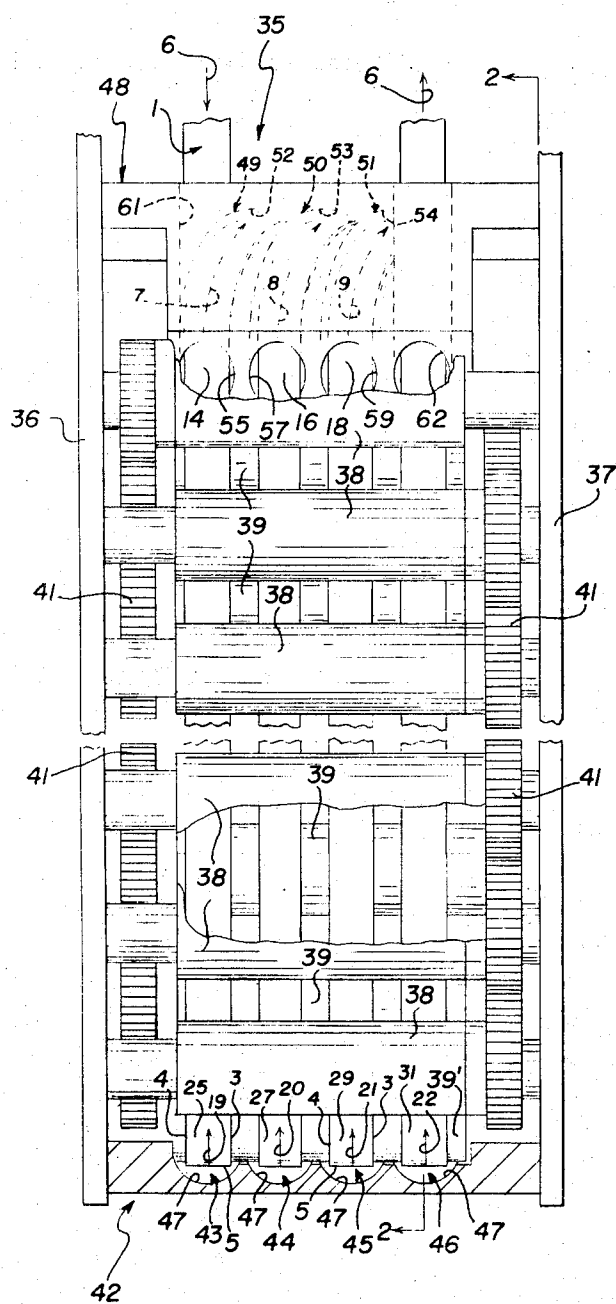


FIG. 1

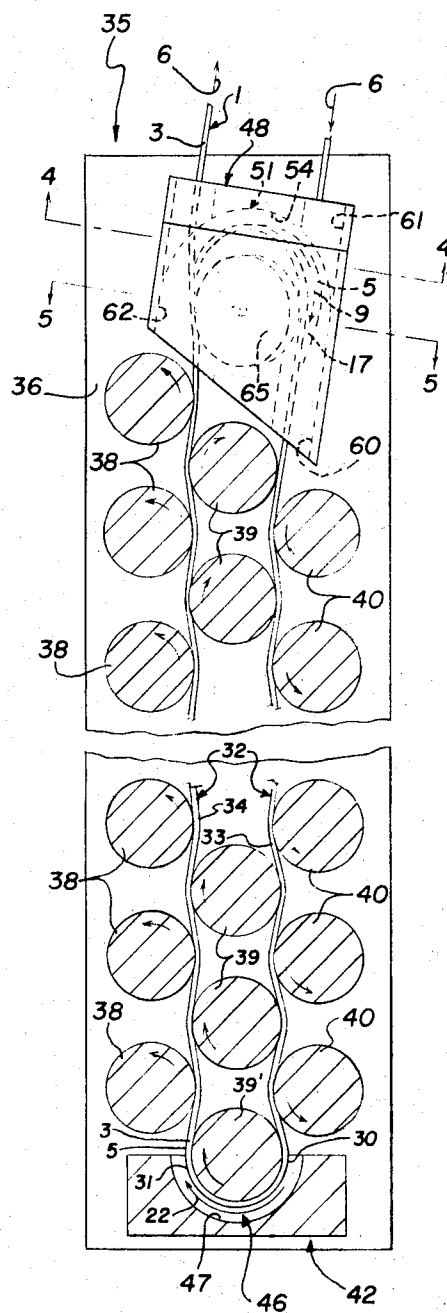


FIG. 2

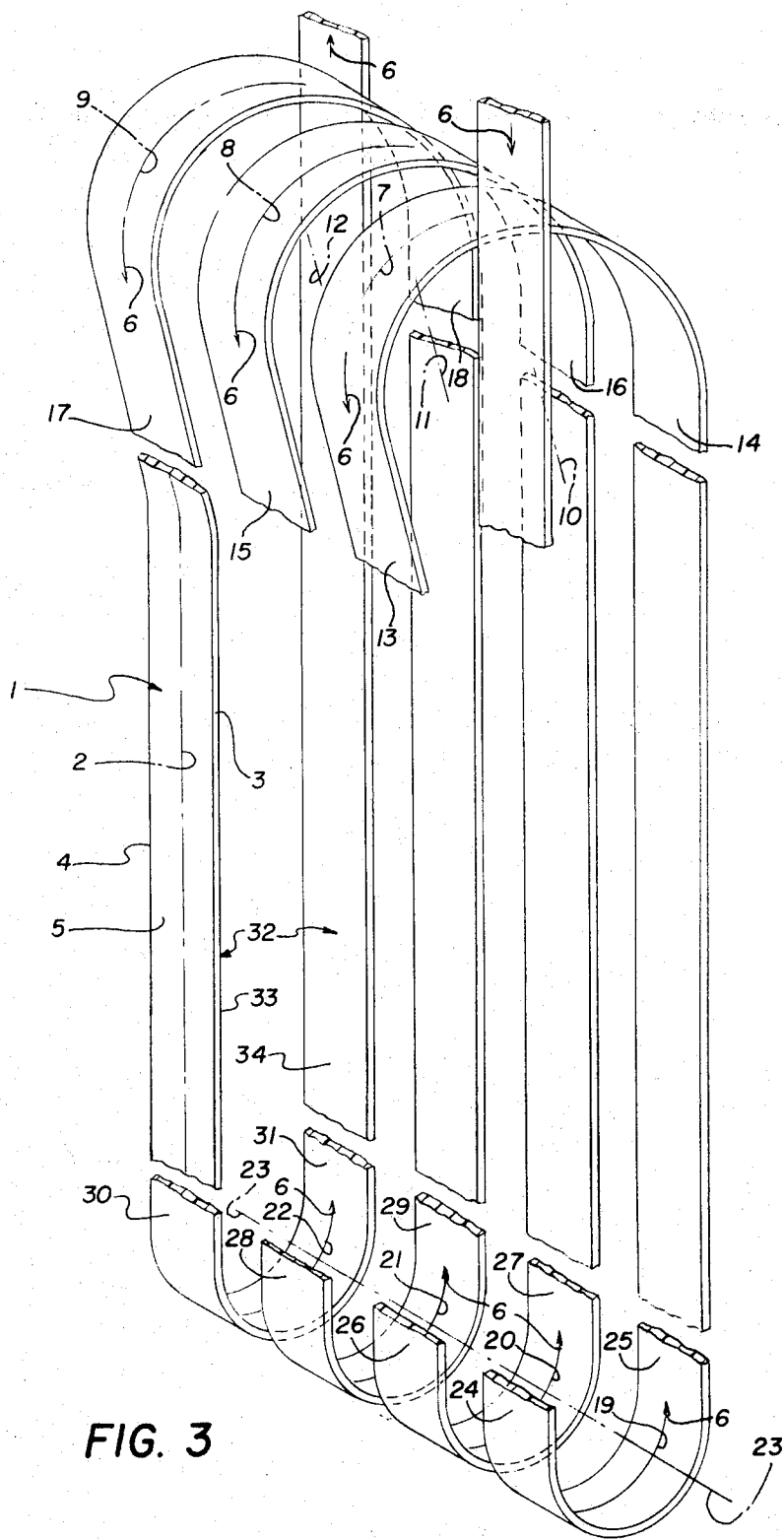


FIG. 3

FIG. 4

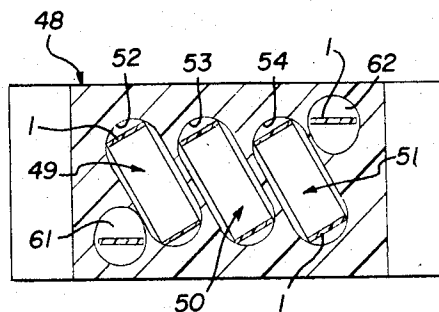


FIG. 5

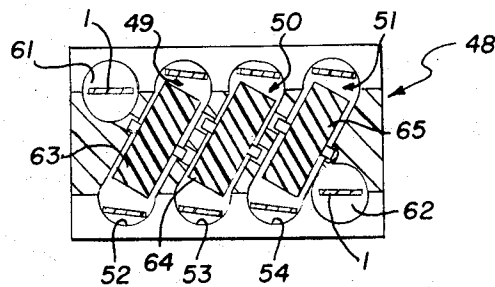


FIG. 6

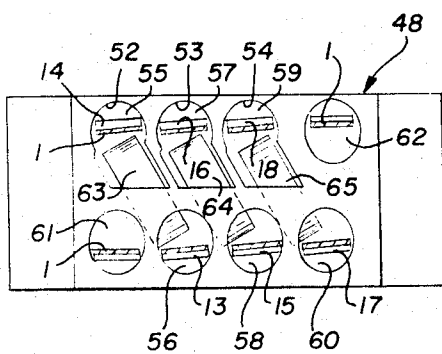


FIG. 7

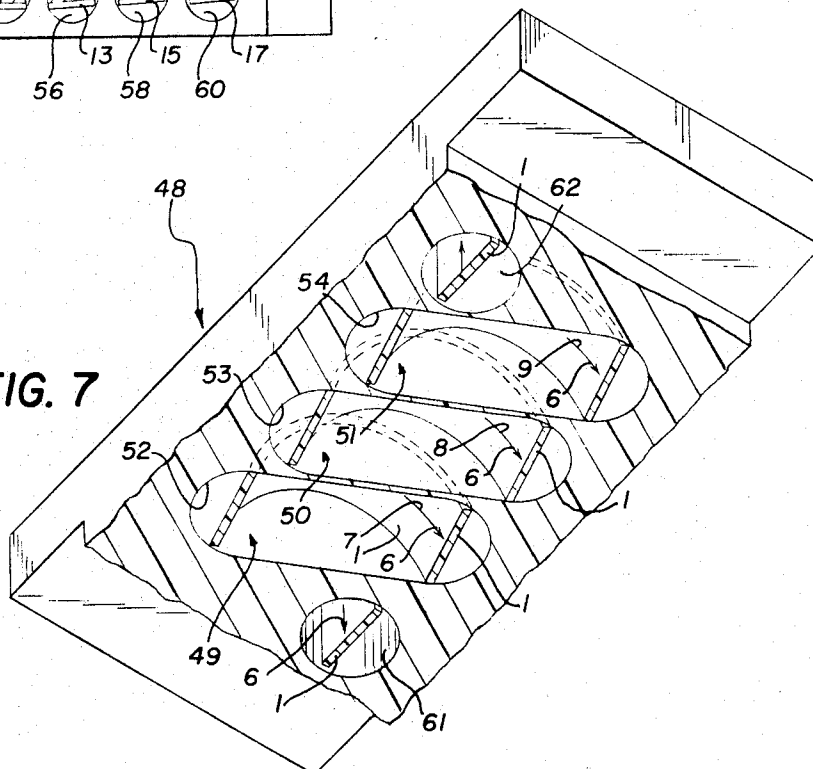


FIG. 8

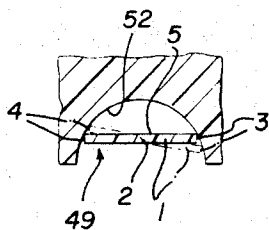


FIG. 10
(PRIOR ART)

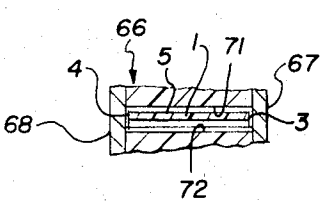


FIG. 9
(PRIOR ART)

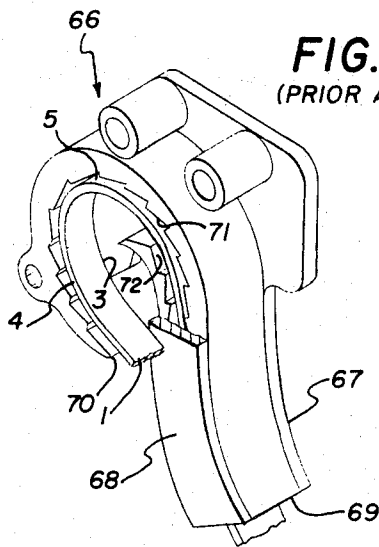
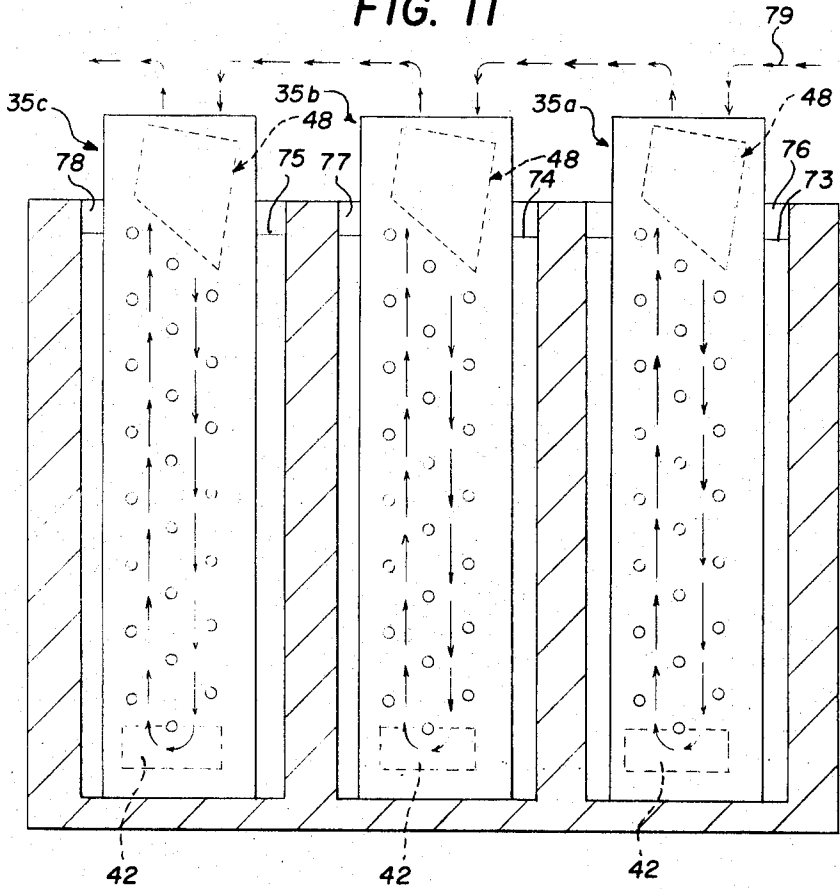


FIG. 11



WEB GUIDING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to apparatus for guiding web material along a predetermined path and, more particularly, to web guiding apparatus in which a web guideway serves to make edge-guiding contact with the web material.

As will be appreciated hereinafter, the present invention is particularly useful in devices for processing web material by fluid-treating such material and, more specifically, as means by which web material having a photographic surface is guided and supported during processing treatment by a fluid.

2. Description of the Prior Art

Numerous kinds of apparatus for fluid-treating photographic surfaces have heretofore been devised. Most often, such apparatus is intended to convert the latent image on an exposed photographic surface to a visible image. One well known version of this apparatus, which is adapted for use with film strip material, includes a plurality of tanks each of which contain a different film processing liquid such as a developing solution, a fixing solution and a washing solution. The tanks are arranged in fixed, aligned relation in order that an exposed film strip may be advanced from tank to tank and successively treated by the different processing liquids. To effect such film strip advance the film processing apparatus further includes several groupings of vertically disposed rollers which are respectively immersed in the different processing liquids, within the tanks, for moving the exposed film strip through such liquids. Other rollers are located between the tanks for moving the exposed film strip from tank to tank. Together, these rollers define a film strip advance path which interconnects the tanks. Upon rotationally driving all of the rollers at the same speed, the exposed film strip will be moved along the film strip advance path from tank to tank and will be successively immersed in the different processing liquids.

Typically, the vertically disposed roller grouping in a respective one of the processing tanks is arranged to move an exposed film strip within such tank along either a sinuous path, such as disclosed in U.S. Pat. No. 2,913,974 (patented on Nov. 24, 1959) or a quasi-helical path such as disclosed in U.S. Pat. No. 1,574,591 (patented on Feb. 23, 1926) and the O.G. defensive publication Peiffer and Reitter (Def. Pub. of Ser. No. 95,185 filed Dec. 4, 1970, published in 889 O.G. 5 on Aug. 31, 1971, Defensive Publication No. T889,028, U.S. Cl. 226-189). However, for the purpose of best understanding the present invention, the prior art description following immediately hereinafter is restricted to those roller groupings which are individually adapted to move the exposed film strip along a quasi-helical path. Such roller groupings, to be described, are proposed as a general representation of devices previously known.

The O.G. defensive publication Peiffer and Reitter discloses a vertically disposed roller grouping for moving a film strip longitudinally along a quasi-helical path which is defined by a plurality of interconnected nonoverlapping loops. The roller grouping is provided with a plurality of film strip turnaround passageways which are located, respectively, at head portions of the loops. The head portion of each loop is contorted, in a man-

ner so as to extend between two oppositely spaced legs of the loop which are arranged in transversely offset and parallel relation. Each of the passageways is longitudinally arched to substantially conform with the curvature of a respective one of the loop heads, and includes two oppositely facing sidewalls which are spaced apart to contact the two longitudinal edges of a film strip moving along the respective loop head. Entry and exit openings in each passageway are arranged in transversely offset relation so as to respectively align with the two spaced legs of a loop. Moreover, each passageway includes a floor surface and a ceiling surface which individually extend between the passageway sidewalls and are spaced apart to contact the base and emulsion-bearing faces of a film strip in the passageway. Accordingly, a film strip first moving into any one of the passageways will be laterally displaced by the passageway sidewalls and, in addition, will be bent into a curve by the passageway floor and ceiling surfaces. In this way, the passageways serve to thread a film strip initially over the head portions of the loops, for movement along the quasi-helical path.

Although the floor and ceiling surfaces of each film strip turnaround passageway are discontinuous, in order to reduce contact and friction respectively between these two surfaces and the base and emulsion-bearing faces of a film strip moving through the passageway, some contact and friction will never-the-less occur. Thus, the emulsion-bearing film face can possibly be scratched and marred. Moreover, because the two oppositely facing sidewalls in each passageway are spaced apart in parallel relation to contact the two longitudinal edges of a film strip moving through the passageway, such moving film strip is generally prevented from rotating about the longitudinal film strip axis. However, when the moving film strip is laterally displaced and bent into a curve, within the passageway, the moving film strip seeks to rotate about such axis and thus becomes strained and distorted so as to possibly separate at splices and joins therein.

U.S. Pat. No. 1,574,591 discloses an arrangement of pulleys for moving a film strip longitudinally along a quasi-helical path which is defined by a plurality of interconnected nonoverlapping loops. Several of the pulleys have individual axes of rotation which are inclined at an angle with respect to a shaft rotatably supporting these pulleys. Each of the several pulleys includes a hub member and two parallel facing flange members, which serve to guide the film strip for movement along a respective one of the loop heads. Specifically, the two flange members serve to laterally displace the film strip in much the same way as the two sidewalls of the film strip turnaround passageway. Thus here again, as in the previous example, a film strip moving along a respective loop head will be generally prevented from rotating about the longitudinal film strip axis by two parallel facing guide surfaces in contact with the two longitudinal film strip edges. Accordingly, such moving film strip will be strained and distorted so as to possibly separate at splices or joins therein. Moreover, since the several pulleys are not adapted to affirmatively bend the moving film strip in a curve (as does the film strip turnaround passageway), the several pulleys do not serve to thread the moving film strip over the respective loop heads.

It will therefore be appreciated, in view of the prior art description just presented, that a web guiding sur-

face which is adapted (1) to laterally urge a film strip for movement along a respective one of the loop heads, while supporting such a moving film strip for rotation about the longitudinal film strip axis, (2) and to longitudinally bow the moving film strip without contacting the emulsion-bearing film face, has obvious advantages.

SUMMARY OF THE INVENTION

Accordingly, a primary object of the present invention is to provide web guiding apparatus which is improved so as to avoid the foregoing difficulties existing with respect to those devices heretofore known.

Another object of the present invention is to provide web guiding apparatus which is adapted to urge web material in a direction transverse to the longitudinal web axis while supporting such an urged web for rotation about the same axis.

A further object of the present invention is to provide web guiding apparatus which is adapted to longitudinally bow such an urged web without contacting a particular surface thereof.

Yet a further object of the present invention is to provide web guiding apparatus which is adapted to substantially minimize the strain or mechanical load placed on material guided thereby.

In accordance with a preferred embodiment of the present invention there is disclosed, in detail hereinafter, web guiding apparatus adapted for use with flexible web material (a) which has a longitudinal axis, two oppositely spaced longitudinal edges and a sensitive surface extending between the last-mentioned edges (b) and which when longitudinally bowed is generally resistive to transverse flexing. The apparatus guides such web material longitudinally along a multi-loop path having a series of parallel, path sections which are curved respectively about parallel, coplanar axes and individually have two spaced portions arranged in transversely offset relation. In the apparatus, a plurality of web guideways are provided for guiding such web material respectively along these path sections. Each of the web guideways has a web guiding surface which is contorted to longitudinally extend between the two, transversely offset, portions of a respective one of the path sections. Also, since the web guiding surface is crosswise curved about the longitudinal axis of web material moving along the respective path section, and is longitudinally arched in substantially conformal relation with the curvature of the respective path section, the web guiding surface will abut only the two longitudinal edges of such a moving web so as to longitudinally bow the moving web without contacting the sensitive web surface and so as to support the same web for rotation about the longitudinal web axis. Thus, web material first entering into any one of the web guideways will be laterally urged by the web guiding surface thereof, for movement between the two transversely offset portions of a respective path section, and will not be strained or distorted during such movement as in the foregoing examples of previously known devices.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and objects of the present invention and the manner of obtaining them will become more apparent by reference to the following detailed description of a preferred embodi-

ment of such invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a front elevation view, partially in section, of web guiding apparatus in accordance with a preferred embodiment of the present invention and showing the manner in which web material is moved by such apparatus longitudinally along a multi-loop path;

FIG. 2 is a section view of the web guiding apparatus and the web material moved thereby, as viewed along the line 2—2 in FIG. 1;

FIG. 3 is a schematic perspective view which illustrates movement of the web material longitudinally along the multi-loop path;

FIG. 4 is a section view of several web guideways in the web guiding apparatus, as viewed along the line 4—4 in FIG. 2, and showing the manner of supporting the web material in such guideways;

FIG. 5 is a section view of the several web guideways and the web material supported thereby, as viewed along the line 5—5 in FIG. 2;

FIG. 6 is an underside view of the several web guideways and the web material supported thereby;

FIG. 7 is a perspective view of the several web guideways and the web material supported thereby, as depicted in FIG. 4;

FIG. 8 is a section view of one of the web guideways and the web material supported thereby, precisely illustrating the manner in which the one guideway supports the web material;

FIG. 9 is a perspective view of the web turnaround passageway and web material supported thereby, which is disclosed in the O.G. defensive publication Peiffer and Reitter;

FIG. 10 is a section view of the passageway and the web material supported thereby, which is first illustrated in FIG. 9; and

FIG. 11 is a side elevation view, partially in section, showing a number of web guiding apparatus disposed in several tanks for moving web material successively through different processing solutions in such tanks.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and in particular to FIG. 3, there is shown a flexible web material 1 of the kind (a) which has a longitudinal axis 2, two oppositely spaced longitudinal edges 3 and 4 and a sensitive or particular surface 5 extending between the last-mentioned edges (b) and which when longitudinally bowed, i.e., bent into a curve, is generally resistive to transverse flexing (as is the situation with most kinds of photographic film strip material). As schematically illustrated in FIG. 3, the web material 1 is moving longitudinally along a multi-loop or quasi-helical path, coextensive with the illustrated segment of web material, and generally indicated by a number of arrows 6. The path 6 has an upper or first series of parallel, path sections 7, 8 and 9 which are curved respectively about parallel, coplanar axes 10, 11 and 12. In turn, these upper path sections 7, 8 and 9 individually have two spaced portions 13 and 14, 15 and 16, and 17 and 18 which are arranged in transversely offset relation. The path 6 also has a lower or second series of parallel, path sections 19, 20, 21 and 22 which are curved about a common axis 23. The lower path sections 19, 20, 21 and 22 individually have two spaced portions 24 and 25, 26 and 27, 28 and 29, and 30 and 31 which are ar-

ranged in parallel facing relation. Accordingly, the web material 1 moving along the path 6 forms three nonoverlapping loops. However, for the purpose of clarity of illustration, FIG. 3 shows only a single full loop 32; whereas, the remaining two loops are partially shown. As shown, the loop 32 includes two parallel facing leg sections 33 and 34 which are interconnected at the lower path section 22. Moreover, the loop 32 is connected with the next preceding loop by the upper path section 9.

In FIGS. 1 and 2, there is shown a web transport rack 35 which, as will become apparent hereinafter, serves to move the flexible web material 1 longitudinally along the quasi-helical path 6. The rack 35 has two spaced sidewalls 36 and 37 between which a plurality of rollers and gears, to be described, are rotatably supported. As viewed in FIGS. 1 and 2, a first group of rollers 38 is arranged between the sidewalls 36 and 37 so that the respective roller axes of rotation extend horizontally, one under the other, and lie in a single vertical plane to form a first vertically aligned array of parallel spaced rollers. In a similar manner, second and third groups of rollers 39 and 40 are individually arranged to form second and third vertically aligned arrays of parallel spaced rollers (see FIG. 2). Each of the rollers in the first, second and third roller groups 38-40 are interconnected by a number of gear wheels 41. These gear wheels 41 are rotated at the same speed by an appropriate drive source (not shown) to similarly rotate the first, second and third groups of rollers 38-40. The arrangement between the gear wheels 41 and the first, second and third groups of rollers 38-40 is such that the first and third groups of rollers 38 and 40 are rotated in the same direction and the second group of rollers 39 are rotated in an opposite direction, as schematically illustrated in FIG. 2. Thus, in such illustrated arrangement, the second and third groups of rollers 39 and 40 cooperate to move the web material 1, therebetween, in a downward direction generally within a vertical plane. Likewise, the first and second groups of rollers 38 and 39 cooperate to move the web material 1, therebetween, in an upward direction generally within a vertical plane which is, of course, spaced from and parallel to the first-mentioned vertical plane.

Now, assuming for the moment that the flexible web material 1 is wound in the quasi-helical path 6, in the manner shown by FIGS. 1-3, then the second and third groups of rollers 39 and 40 will cooperate to move the web material vertically downward along one side of the path and the first and second groups of rollers 38 and 39 will cooperate to move the web material vertically upward along another opposite side of such path. Moreover, since a lower-most roller 39' in the second roller group is rotating in a clockwise direction, as viewed in FIG. 2, such roller will serve to move the web material 1 from a lower-most location between the second and third roller groups 39 and 40 to a lower-most location between the first and second roller groups 38 and 39. It will therefore be appreciated that the first, second and third groups of rollers 38-40 serve to move the web material 1 along the opposite leg sections of the different loops in the path 6, and the lower-most roller 39' of the second roller group serves to move the web material along the lower path sections 19-22. This last-mentioned feature is most clearly illustrated in FIG. 2, which shows the second and third roller groups 39 and 40 moving the web material 1 vertically down-

ward along the leg section 33 of the loop 32, the lower-most roller 39' moving the web material clockwise along the loop lower section 22, and the first and second roller groups 38 and 39 moving the web material vertically upward along the other leg section 34 of such loop.

Further considering FIGS. 1 and 2, there is shown a lower web guide block 42 which interconnects the rack sidewalls 36 and 37 and is located slightly below the lower-most roller 39' in the second roller group. This block 42 has four web guideways 43, 44, 45 and 46 which are arranged in parallel spaced relation and individually extend half-way about the periphery of the lower-most roller 39'. Moreover, as shown in FIG. 1, these web guideways 43-46 are respectively located opposite the lower path sections 19-22. Each of the web guideways 43-46 is provided with a web guiding surface 47 which, as suggested by FIG. 2, is longitudinally arched to substantially conform with the curvature of the lower path sections 19-22 and which, as shown in FIG. 1, is crosswise curved. Thus, as can be realized from FIG. 1, if the flexible web material 1 moving about the lower-most roller 39' and along any of the lower path sections 19-22 should fall slightly away from such roller, so as to be moved within a respective one of the web guideways 43-46, the web guiding surface 47 of the respective web guideway will only contact the two longitudinal web edges 3 and 4 while avoiding contact with the sensitive web surface 5. This is so, because as previously stated, the web material 1 is of the kind which when longitudinally bent into a curve is generally resistive to transverse flexing.

Again considering FIGS. 1 and 2, there is shown an upper web guide block 48 which interconnects the rack sidewalls 36 and 37 and includes three parallel spaced, web guideways 49, 50 and 51. As will be appreciated hereinafter, these web guideways 49, 50 and 51 are provided for guiding the flexible web material 1 from an upper-most location between the first and second roller groups 38 and 39, respectively along the upper path sections 7, 8 and 9, to an upper-most location between the second and third roller groups 39 and 40. In other words, the web guideway 49 is provided for guiding the web material 1 along the upper path section 7 from the section portion 14 to the section portion 13, the web guideway 50 is provided for guiding the web material along the upper path section 8 from the section portion 16 to the section portion 15, and the web guideway 51 is provided for guiding the web material along the upper path section 9 from the section portion 18 to the section portion 17 (see FIGS. 1, 2, 6 and 7).

The web guideways 49, 50 and 51 respectively have web guiding surfaces 52, 53 and 54 which, in turn, respectively extend between the two spaced portions 13 and 14, 15 and 16, and 17 and 18 of the upper path sections 7, 8 and 9 (see FIGS. 1, 2 and 6). As shown in FIGS. 4-8, the web guiding surfaces 52, 53 and 54 are crosswise curved (in a semi-circular manner) about the longitudinal axis 2 of the flexible web material 1 which is moving respectively through the web guideways 49, 50 and 51 (and, of course, along the upper path sections 7, 8 and 9). Thus, the web guiding surfaces 52-54 individually abut the two longitudinal edges 3 and 4 of such moving web 1, to support the moving web for rotation about the longitudinal web axis 2 and, in addition, define a space adjacent the sensitive web surface 5, as most clearly illustrated in FIG. 8. Moreover, the

web guiding surfaces 52, 53 and 54 are longitudinally curved to extend in substantially conformal relation with the curvature respectively of the upper path sections 7, 8 and 9 (see FIGS. 1, 2 and 7). Thus, the web guiding surfaces 52-54 upon individually abutting the two longitudinal edges 3 and 4 of the moving web 1 will thereby longitudinally bow the same web without contacting the sensitive web surface 5 (see FIGS. 1, 2 and 7). This is so, because as previously stated, the web material 1 is of the kind which when longitudinally bowed is generally resistive to transverse flexing.

As shown in FIGS. 1, 2 and 6, the web guideways 49, 50 and 51 respectively have web entrance and exit openings 55 and 56, 57 and 58, and 59 and 60. The entrance and exit openings 55 and 56 are arranged in transversely offset, spaced relation so as to respectively align with the two transversely offset portions 14 and 13 of the upper path section 7. Similarly, the entrance and exit openings 57 and 58 are arranged in transversely offset, spaced relation so as to respectively align with the two transversely offset portions 16 and 15 of the upper path section 8. And, the entrance and exit openings 59 and 60 are arranged in transversely offset, spaced relation so as to respectively align with the two transversely offset portions 18 and 17 of the upper path section 9. Thus, the flexible web material 1 which is moving through the web guideways 49-51 will be urged laterally, i.e. in a direction transverse to the longitudinal web axis 2, respectively by the web guiding surfaces 52-54, in order to guide such moving web between the portions 13 and 14, 15 and 16, and 17 and 18 of the upper path sections 7-9.

According to a typical sequence of operation, the flexible web material 1 is fed into the web transport rack 35, by passing through a web ingress guideway 61 in the upper web guide block 48, and thence is advanced vertically downward (as viewed in FIGS. 1 and 2) by the second and third groups of rollers 39 and 40. Upon being expelled from between the second and third roller groups 39 and 40, the web material 1 is advanced by the lower-most roller 39' in a clockwise direction, as viewed in FIG. 2. The web material 1 is then advanced vertically upward by the first and second groups of rollers 38 and 39, and thence is introduced into the entrance opening 55 of the web guideway 49 (see FIG. 1). Thus, the advancing web 1 will have completed a first loop of the quasi-helical path 6. The web guideway 49 then laterally urges the advancing web 1 to the next succeeding loop of the path 6. After leaving the web guideway 49, by means of the exit opening 56, the web material 1 is again advanced vertically downward by the second and third groups of rollers 39 and 40 (though, in this instance, at a different location between these rollers). It will be appreciated that the web material 1 continues to be similarly advanced, as shown in FIGS. 1 and 2, until the web material is fed out of the rack 35, by passing through a web egress guideway 62 in the upper web guide block 48.

As shown in FIGS. 2, 5 and 6 the upper web guide block 48 rotatably supports three parallel, spaced rollers 63, 64 and 65 respectively within the web guideways 49, 50 and 51. If the flexible web material 1 moving through any one of the web guideways 49-51 should fall slightly away from the web guiding surface 52, 53 and 54 of such guideway, then the moving web will come to rest on a respective one of the rollers 63-65. In this way, continued movement of the web

material 1 along the web guideways 49-51 is insured.

Considering now an example of the prior art, there is shown in FIGS. 9 and 10, a web turnaround passageway 66 which is disclosed in the O.G. defensive publication Peiffer and Reitter and has been described in detail hereinbefore. Briefly stated, this passageway 66 is longitudinally arched and includes two parallel facing sidewalls 67 and 68 which are spaced apart to respectively abut the two longitudinal edges 3 and 4 of the flexible web material 1 moving through such passageway. Web entry and exit ends 69 and 70 of the passageway 66 are arranged in transversely offset, spaced relation. Moreover, the passageway 66 includes multi-stepped surfaces 71 and 72 which individually extend between the passageway sidewalls 67 and 68 and are spaced apart to contact opposite surfaces (including the sensitive surface 5) of the web material 1 moving through such passageway. Accordingly, as can be realized from FIGS. 9 and 10, the web material 1 upon advancing into the passageway 66 will be laterally displaced by the passageway sidewalls 67 and 68 (in contact with the longitudinal web edges 3 and 4) and, in addition, will be longitudinally bent into a curve by the passageway surfaces 71 and 72 (the first of which is shown in contact with the sensitive web surface 5). Thus, the sensitive web surface 5 may be scratched or marred by the passageway surface 71. Moreover, because the web material 1 moving through the passageway 66 is so displaced and bent into a curve, within the passageway, the moving web will seek to rotate about the longitudinal web axis 2. However, since the moving web 1 is prevented from such rotation, by longitudinal edge-contact with the passageway sidewalls 67 and 68, the moving web thus becomes strained and distorted.

It will therefore be appreciated, in view of the description hereinbefore, that the web guideways 49-51 represent a significant improvement over the web turnaround passageway 66. This is so, because the web guideways 49-51 (1) serve to laterally displace the flexible web material 1 moving therethrough, while also supporting such moving web for rotation about the longitudinal web axis 2, (2) and further serve to longitudinally bow the moving web without contacting the sensitive web surface 5.

In FIG. 11, there is illustrated one application of the web transport rack 35 just described. According to this application, three web transport racks 35A, 35B and 35C are respectively immersed in a developing solution 73, a fixing solution 74 and a washing solution 75 which, in turn, are respectively contained in three open tanks 76, 77 and 78. Thus, if an exposed film strip material (not shown) is advanced along a path, generally indicated by the reference number 79 in FIG. 11, each of the racks 35A, 35B and 35C will guide the exposed film strip material along a quasi-helical path (not shown) within a respective one of the tanks 76-78 so as to successively immerse the exposed film strip material, for processing treatment, in the developing, fixing and washing solutions 73-75.

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

I claim:

1. An improved web guiding apparatus of the kind adapted for use with flexible web material (a) which

has a longitudinal axis, two oppositely spaced longitudinal edges and a particular surface extending between the last-mentioned edges (b) and which when longitudinally bowed is generally resistive to transverse flexing, wherein a web guideway is provided for guiding such web material longitudinally along a curvilinear path from first to second, spaced, path portions which are arranged in transversely offset relation, and wherein the improvement comprises:

said web guideway including means, disposed for abutment with the two longitudinal edges of web material moving along said curvilinear path, for longitudinally bowing the moving web without contacting the particular web surface and for supporting the moving web for rotation about the longitudinal web axis.

2. An improved web guiding apparatus as recited in claim 1, wherein said web urging, bowing and supporting means includes:

oppositely facing guide surface areas of said web guideway which longitudinally extend between said first and second path portions in substantially conformal relation with the curvature of said path, and are crosswise curved about the longitudinal axis of web material moving along said path.

3. An improved web guiding apparatus as recited in claim 1, wherein said web supporting means includes:

oppositely facing guide surface areas of said web guideway which longitudinally extend between said first and second path portions in substantially conformal relation with the curvature of said path, and are crosswise curved about the longitudinal axis of web material moving along said path.

4. An improved web guiding apparatus of the kind adapted for use with flexible web material (a) which has a longitudinal axis, two oppositely spaced longitudinal edges and a particular surface extending between the lastmentioned edges (b) and which when longitudinally bowed is generally resistive to transverse flexing, wherein such web material is guided longitudinally along a multi-loop path having a series of parallel, path sections which are curved respectively about parallel, coplanar axes and individually have two spaced portions arranged in transversely offset relation, wherein a plurality of web guideways are provided for guiding such web material respectively along said path sections, and wherein the improvement comprises:

each of said web guideways including means, disposed for abutment only with the two longitudinal edges of web material moving along a respective one of said path sections, for urging the moving web in a direction transverse to the longitudinal web axis, for longitudinally bowing the moving web without contacting the particular web surface, and for supporting the moving web for rotation about the longitudinal web axis.

5. An improved web guiding apparatus of the kind adapted for use with flexible web material (a) which has a longitudinal axis, two oppositely spaced longitudinal edges and a particular surface extending between the last-mentioned edges (b) and which when longitudinally bowed is generally resistive to transverse flexing, wherein such web material is guided longitudinally along a multi-loop path having a series of parallel, path sections which are curved respectively about parallel, coplanar axes and individually have two spaced portions arranged in transversely offset relation, wherein a plurality of web guideways are provided for guiding such web material respectively along said path sections, and wherein the improvement comprises:

each of said upper web guideways including a web guiding surface which longitudinally extends between said two transversely offset portions of a respective one of said upper path sections and is crosswise curved about the longitudinal axis of web material moving along said one upper path section for abutment with the two longitudinal web edges, to support the moving web for rotation about the longitudinal web axis and urge the moving web in a direction transverse to the longitudinal web axis, and which further is longitudinally arched in substantially conformal relation with the curvature of said one upper path section, to longitudinally bow the moving web without contacting the particular web surface; and

each of said lower web guideways including a web guiding surface which longitudinally extends between said two spaced portions of a respective one of said lower path sections, is crosswise curved about the longitudinal axis of web material moving along said one lower path section for abutment with the two longitudinal web edges, and is longitudinally arched in substantially conformal relation with the curvature of the said one lower path section, to longitudinally bow the moving web without contacting the particular web surface.

6. An improved web guiding apparatus of the kind adapted for use with flexible web material which has a longitudinal axis and two longitudinal edges, wherein a web guideway is provided for guiding such web material longitudinally along a curvilinear path from first to second, spaced, path portions which are arranged in transversely offset relation, and wherein the improvement comprises:

said web guideway including means, disposed for abutment with the two longitudinal edges of web material moving along said curvilinear path, for supporting the moving web for rotation about the longitudinal web axis.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,779,439 Dated December 18, 1973

Inventor(s) Thomas C. Jessop

It is certified that error appears in the above-identified patent
and that said Letters Patent are hereby corrected as shown below:

Page 1, lines 2 and 4, change inventors last name
"Fessop" to --Jessop--.

Column 5, line 14, change "quasihelical" to --quasi-helical--.

Signed and sealed this 23rd day of April 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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