Feb. 19, 1963 W. K. CROWNFIELD ETAL 3,078,021

APPARATUS FOR AUTOMATIC CENTERING OF STRIPS

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FIG. 1

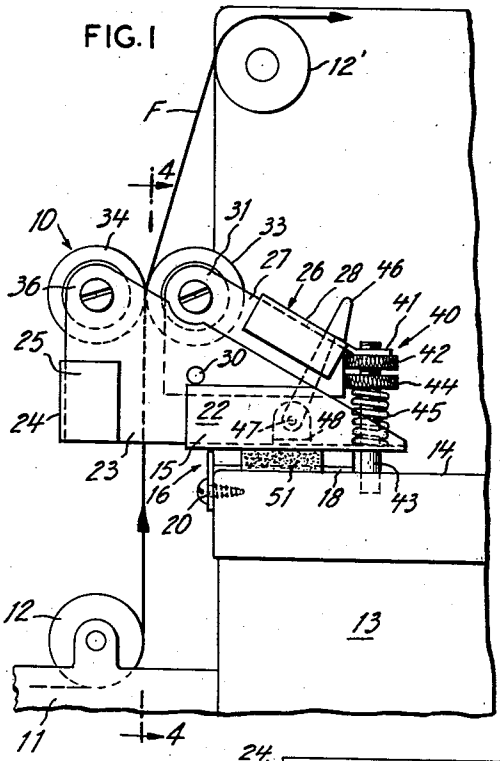


FIG. 3

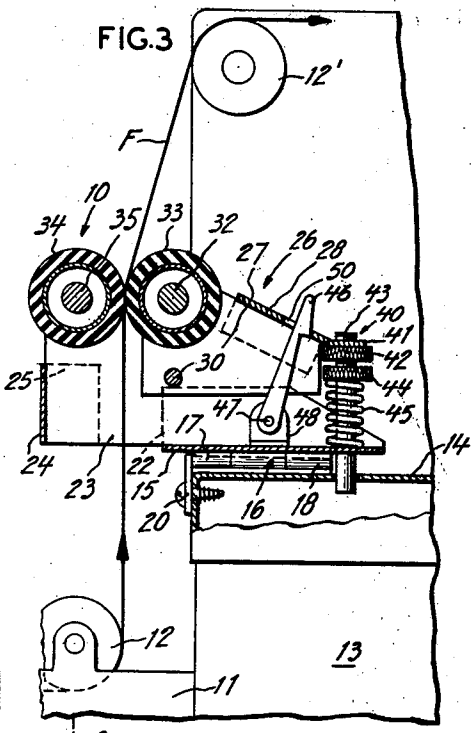


FIG. 2

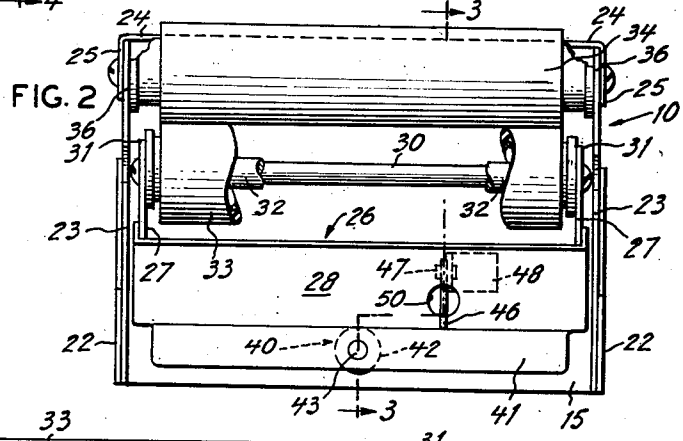
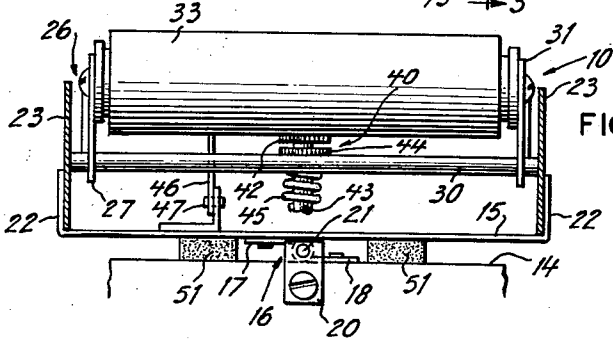


FIG. 4



INVENTORS
WILLIAM K. CROWNFIELD
HANS W. SACHS
CHARLES W. FROMM
BY Clyde A. Watson
ATTORNEY

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FIG. 5

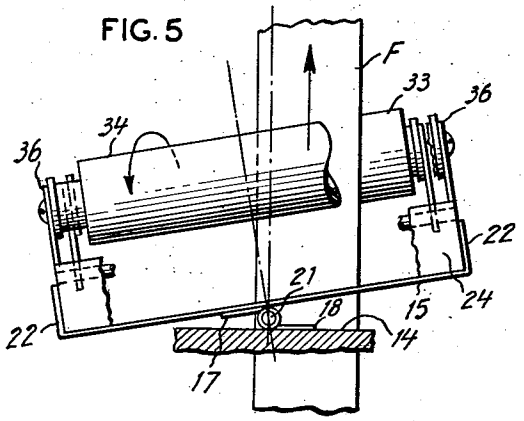


FIG. 6

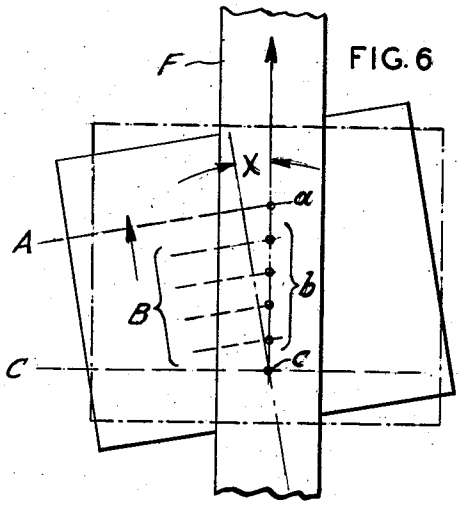
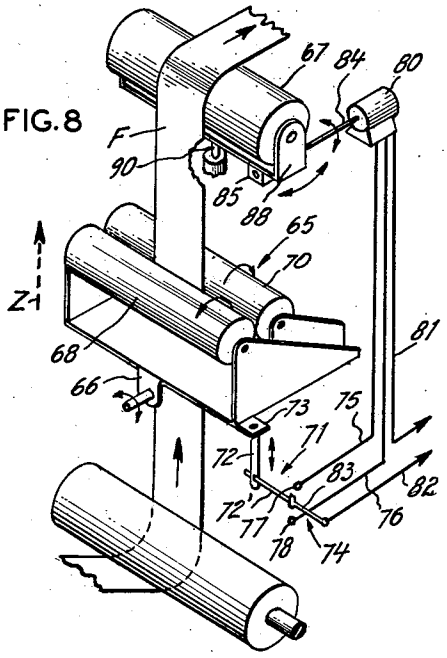


FIG. 8



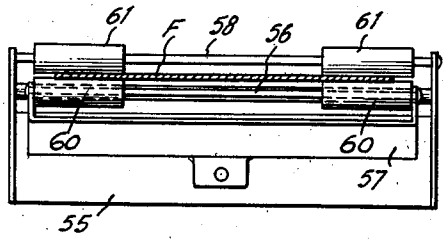


FIG. 7

FIG. 9

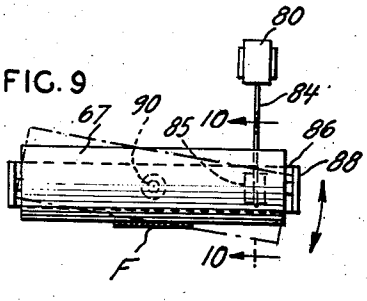
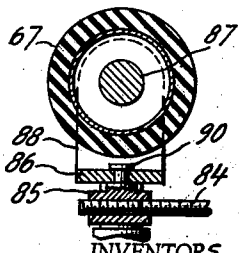


FIG. 10



INVENTORS.
WILLIAM K. CROWNFIELD
HANS W. SACHS
CHARLES W. FROMM
BY Clyde A. Tarbox
ATTORNEY

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APPARATUS FOR AUTOMATIC CENTERING OF STRIPS

William K. Crownfield, New Brunswick, N.J., Hans W. Sachs, Binghamton, N.Y., and Charles W. Fromm, Teaneck, N.J., assignors to Sperry Rand Corporation, New York, N.Y., a corporation of Delaware

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10 Claims. (Cl. 226—21)

This invention relates to an improvement in strip or web feeding apparatus and more particularly to the automatic centering and aligning of rapidly fed endless sheets of thin material such as paper, ribbon or strip sheet metal.

While this device is developed for adaptation to strip feed mechanisms it can readily be applied to a motion picture or microfilm processing apparatus wherein successive stages of development and drying necessitate continuous rapid film travel over a number of rollers.

During the course of film strip processing it is necessary to feed the developed wet film into a drying chamber. However, prior to its entry into the dryer, it has been found advantageous to have the greater proportion of water shed from the film. This is presently being accomplished by the addition of rubber blades over which the film is forced, air blasts or jets against the moving strand, or sponges over which the strand is pulled. The most effective application is a pair of wringer rollers, preferably rubber surfaced, which, forced against one another diametrically squeeze all excess water from the strip as it passes therebetween. Although roller squeegees have proven very efficient there has been a major drawback in applying them to film strand drying. The full benefits of roller squeegee can only be obtained by applying pressure to the rollers as they are urged toward each other. Because of inconsistency inherent in feed and take up rollers and in stack dimensions it is almost impossible to prevent a strand from "walking" off roller centers. The reasons for "off tracking" are manifold and varied in that the rollers might be axially misaligned, the covering may vary in thickness or elasticity or may be inconsistent diametrically, the strand may be warped, longitudinally unequal in length, and the splices connecting the two ends of subsequent ribbons may be irregularly placed.

Corrective measures have been developed employing elaborate hydraulic, pneumatic or electric controls and power sources to shift the rollers for effecting a counter compensating or realigning and recentering action on the strand.

It is an object of the invention to provide a strip apparatus with a roller squeegee for removal of surface water from the strand or web.

It is another object of the invention to provide a strip apparatus with means for automatically realigning and recentering the strand which has "walked" off center.

It is a further object of the invention to provide a strip apparatus with a tiltable squeegee unit for simultaneously shedding excess water from and effecting a distinct counter action or center restoring force upon the "off tracking" strip.

These and other objects will be more apparent after reference is had to the following description and to the drawings, in the latter of which:

FIG. 1 is a view in side elevation of the squeegee device as applied to a film processor.

FIG. 2 is a top plan view of the squeegee device,

FIG. 3 is a longitudinal view in cross section taken on the line 3—3 of FIG. 2.

FIG. 4 is a transverse section taken on the line 4—4 of FIG. 1,

FIG. 5 is a view similar to FIG. 4 with certain parts in moved position,

FIG. 6 is a diagrammatic view illustrating the novel strand realigning feature,

FIG. 7 is an elevational view of a modified embodiment of this device,

FIG. 8 is an isometric view of a further modified embodiment using the apparatus as a sensing unit to convey tracking correction signals to rollers between which heavy, wide strip stock is fed,

FIG. 9 is a plan view showing the directions of movement of the correction roller, and

FIG. 10 is a cross section taken on line 10—10 of FIG. 9.

The wringer device, generally designated as 10, can be seen as operatively applied to a film processing apparatus, FIGS. 1 and 2, including a developing receptacle 11. A roller 12 feeds a film strand F from the receptacle vertically toward a second roller 12' on the drying area 13, a horizontal platform 14 of which, has said wringer 10 mounted thereon situating the device substantially intermediate the rollers 12 and 12'.

A base member 15 of the wringer device has mounted to its underside a pivoting means 16. For illustrative purposes the pivoting means is represented by a hinge comprising a wing 17 secured to the underside of the base member 15, and another wing 18 secured to the platform 14. A vertically depending tab 20, integral with the hinge stud or pin 21, is secured to an end wall of the dryer 13 at right angles to the platform. It is obvious that this construction permits the base member to tilt either to the left or right of the horizontal over the fixed center stud 21 of the hinge 16. Further, any well known tilting arrangement such as gimbals or a ball and socket combination may be applied to accomplish this action.

Vertical walls 22 extend upward from each longitudinal extremity of the base 15 and carry rigidly secured thereto side walls 23, substantially of triangular shape, having the hypotenuse facing upward. The rear or right angle ends are bridged by a frame member 24, flaps 25, of which, are welded or otherwise secured to the walls 23.

A rocker 26 is composed of vertical plates or legs 27, each plate being positioned substantially adjacent and inside a side wall 23. A central cross web 28 is welded or otherwise secured by flanges to the legs 27, the upper edges of said legs being shaped to form inclines angularly similar to and extending upward and beyond the wall inclines. The rocker 26 carries, fixed in the right angle corners of plates 27, an axle 30, extending beyond both plates, and loosely journalled in the side walls 23. The upper apexes 31 of plates 27 have journalled therein the ends of the transverse shaft 32 of a rubber covered roller 33. Adjacent said roller 33 and substantially on the same diametral plane therewith is a second rubber covered roller 34 on a shaft 35, journalled in the apexes 36 of walls 23.

In order to assure constant pressured relationship between the peripheries of rollers 33 and 34 as well as having the degree of pressure subject to regulation, a spring urged contact regulator 40 is provided toward the end of base member 15 opposed to the roller end. The rocker bridge 28 extends rearwardly as a horizontal apron 41 to which is welded a lug 42 acting as additional bearing for a vertically depending screw threaded pin 43, peened or otherwise secured in the tapped hole in apron 41. A knurled nut 44 threaded on pin 43, bears against a compression spring 45 which is disposed about the pin 43 and rests on the base member 15, the pin in turn extending freely through a large hole in said base member. The spring 45 normally under compression will force the rocker roller 33, about pivot 30, to press against roller

34. It is obvious that as the thickness of material to be forced between the rollers increases or decreases, the roller pressure can be regulated by increasing or decreasing the operation length of the spring thereby relatively regulating the presure of the roller against the strip.

A lockout latch 46, pivotally secured as at 47 to a bracket 48, fast on base member 15, has a nose protruding through an opening 50 in the bridge 28. Bracket 48 is so placed, FIG. 1, with respect to the hole in the bridge that the latch normally stands at an angle. Obviously, if the rocker 28 is pushed down against the spring tension to free a strip from between the rollers the latch will fall by gravity causing the nose to engage the rim of the hole 50 thereby locking rocker roller 33 away from roller 34 until necessary manual adjustments to or replacements of a web or strip have been completed.

To prevent excessive tilting of the whole unit about the center pin 21 which can result from irregular feed speeds causing the strip to pull and jerk, resilient cushioning means such as sponge rubber blocks 51, FIG. 1 and 4, can be used. It is, however, essential that the cushioning or tilt retarding means is carefully proportioned to the application so that the counter action will not interfere with the interplay of forces upon which the device depends for proper function.

The ability and purpose of this device to recenter "off tracking" strip or web can best be understood if reference is made to FIGS. 5 and 6. In reality the tilting or teetering, though always existent, is virtually indiscernible to an observer since the tilt caused by strand displacement and the corrective tilt are almost simultaneous; the least misalignment of the strand is momentarily corrected. It must be noted, therefore, that for illustrative purposes only are the movements of the related members shown exaggerated.

FIG. 6 shows a linear development of a roller circumference marked off from 0° to 360°. Let it be assumed that a strand F, tracking off center, has "walked" to the right to an arbitrary point *a* on a contact line A of the roller periphery. The displacement of the strand from the center represents mechanically, the leverage by virtue of which the strand tension acts or pulls on the device to cause tilting. This displacement causes an unbalance of moments about pivot 21 since the strand has sufficiently overcome the inertia of the device and the friction of the pivot resulting in a counterclockwise movement of the rollers. It has been found that the side of the rollers to which the strand tends to "off track" always will follow the strand, said rollers rocking about the pivot. FIG. 6 illustrates, by angle X, the displacement of the strand relative to the rollers from which point the strand must be forced to return to the tracking center. It is well known that rollers of identical diameters exert peripheral pressure equally throughout the width of a strand passing therebetween. Since no contact slippage exists there is a constant tendency to retain or restore the strand center perpendicular to the roller axes. The rollers, presumably articulate by virtue of pivot 21, and tending to align the strand centrally and perpendicularly, exert more pressure on the left edge of the continuously moving strand. The strand will be forced to "walk" to the left resulting in the rollers immediately tilting in an opposed or clockwise direction. As the roller turns through successive small angles, points *b* on the center line of the strand intersect the lines of contact B on the roller periphery. Note that the strand points *b* are gradually approaching the roller tracking center as the angles of separation diminish. When the strand finally arrives at point *c*, the true tracking center, the pull is directly in line with pivot 21 resulting in horizontal stabilization of the rollers, as shown in phantom in FIG. 5, and perfect perpendicular alignment of strand with the rollers, horizontal contact line C.

In FIGS. 1–4, a squeegee wringer has been employed to illustrate the strand recentering principle of this invention. It is to be noted that an additional problem must be considered here in that effective squeegee pressure must be exerted on the wet film to squeeze off the surface water in addition to controlling the tension on the film to produce the desired interplay between strand and roller.

Other adaptations are possible in which dry strip materials such as ribbon, paper or magnetic tape, or strip metal can be fed between rollers wherein only the tension pressure of the strip need be considered.

For example, FIG. 7 illustrates the device adapted to be used with light weight wide strip such as manifolding ledger or newspaper stock. Frame 55 supports a horizontal shaft 58. A second frame 57, the end walls of which are situated inwardly of the frame 55 walls, carries shaft 56 parallel to shaft 58. Because of the extreme widths involved and since the device is designed essentially for dry stock feeding, rollers 60 and 61 on shafts 56 and 58, respectively, cover only the extreme ends of the shafts leaving the central portions free. Frame 57, similar to the heretofore described preferred form, is resiliently urged toward frame 55 to insure evenly distributed peripheral pressure of the engaging rollers on the strand F passing therebetween.

It has been found, in apparatus designed to feed heavy stock such as metal in strip or endless sheet form, that cumbersome rollers, necessary in conveying heavy strip of this type, cannot in themselves be utilized to successfully correct "off tracking." In FIGS. 8 and 9 a modified version of the device is employed as a sensing unit in such apparatus. A strip centering device 65 substantially as the preferred embodiment described is tiltably supported at 66 below a large roller 67 controlled for reciprocation over which a strand F is fed after having passed between a pair of sensing rollers 68 and 70, similar in construction and operation as rollers 33 and 34.

Various means can be employed to effect reciprocation of roller 67, for example, balance can be achieved by suitably situated pneumatic jacks and pumps or by leverage operated by cams or gearing. For illustration purposes this invention employs an electro-mechanical system 71 wherein a vertically depending rod 72, on horizontal plate 73, extending from one side of the frame of the sensing unit 65, carries a horizontal resilient member 72' which in turn is connected to the toggle arm of a three way switch 74. Leads 75 and 76 connect poles 77 and 78, respectively, of said switch to terminals on a reversing motor 80, mounted in close proximity to the roller 67. A third lead 81 connects the motor with the negative line of the power source and a positive source lead 82 is connected to the switch arm 83.

A long shaft 84 extends from the motor 80 having the opposite end screw threaded into a block 85 pivotally mounted to the under side of the yoke 86, the roller shaft 87 being journalled in the vertical arms 88. The yoke is pivoted for horizontal oscillation on a vertical pin 90 intermediate its arms 88. As the screw rotates by energizing motor 80, the block 85 and the integral yoke will swing slightly to the left or right around pivot pin 90.

In operation, for example if the tilt is to the left, that is to say the pivot 66 turns clockwise lifting the left end of the sensing unit, arrow Z, the rod at 72 will force the switch arm 83 to contact terminal 78 closing a circuit and driving the motor 80 in a "Forward" direction. The roller 67, turned to a position as shown in phantom in FIG. 9, will be drawn back to the center by virtue of the block 85 being pulled by the clockwise rotation of shaft 84. As soon as true center is attained the plate 67 will have been lifted to the horizontal and the switch arm will have broken contact with point 78 and be at Off position, thereby stopping the motor and subsequent tilting action of the roller. If the strip "off tracks" to the right the plate 73 on the unit will be lifted pulling the switch arm to engage contact 77, energizing the motor but in "Reverse" direction effecting a counter clockwise rota-

tion to roller 67 until the proper balance and strip realignment are again reestablished; for the switch will drop to Off position halting the motor's energization.

While the principles of this invention have been described in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as limitations to the scope of the invention as set forth in the accompanying claims.

What is claimed as novel is:

1. Apparatus for guiding a web fed along a given path and in a given plane, comprising

(*a*) first roller means mounted for rotation about a first axis of rotation parallel to and to one side of said given plane,

(*b*) second roller means mounted for rotation about a second axis of rotation parallel to and on the other side of said given plane,

(*c*) said first and second axes of rotation being coplanar and lying in a second plane perpendicular to said given plane,

(*d*) pivot means mounting said first and said second roller means for pivotal movement,

(*e*) rocker means mounting said second roller means for movement toward and away from said first roller means, and

(*f*) biasing means urging said second roller means into engagement with said first roller means, said biasing means being located between and equidistant from the ends of said first and said second roller means,

(*g*) said first and said second roller means gripping the web along a reference line as the web passes therebetween,

(*h*) whereby walking of the web from the given path pivots the pivot means and therewith the first and second roller means to a position where the first and second roller means grip the web along a line at an angle to the reference line, said first and second roller means and the web producing coaction forces to automatically effect the return of the web to the given path.

2. The apparatus of claim 1 wherein said biasing means is adjustable.

3. The apparatus of claim 1, wherein said pivot means includes resilient means for damping any oscillations of said pivot means which may occur during pivotal movement thereof.

4. The apparatus of claim 1, wherein

(*a*) said first roller means comprises first and second spaced rollers,

(*b*) said second roller means comprises third and fourth spaced rollers,

(*c*) said first and said third rollers being positioned on opposite sides of and in contact with one edge of the web,

(*d*) said second and said fourth rollers, being positioned on opposite sides and in contact with the other edge of the web.

5. Apparatus for guiding a web fed along a given path and in a given plane, comprising

(*a*) first roller means mounted for rotation about a first axis of rotation parallel to and on one side of said given plane,

(*b*) second roller means mounted for rotation about a second axis of rotation parallel to and on the other side of said given plane,

(*c*) said first and second axes of rotation being coplanar and lying in a second plane perpendicular to said given plane,

(*d*) pivot means mounting said first and second roller means for pivotal movement,

(*e*) rocker means mounting said second roller means for movement toward and away from said first roller means, and

(*f*) biasing means urging said second roller means into engagement with said first roller means, said biasing means being located between and equidistant from the ends of said first and said second roller means,

(*g*) said first and second roller means gripping the web along a reference line as the web passes therebetween,

(*h*) centering roller means mounted for rotation about a third axis of rotation parallel to the given plane, said centering roller means having a surface in contact with the web surface, said contacting surfaces having a normal contact relationship,

(*i*) pivoting means interconnected to said centering roller means for pivoting the centering roller means to a position wherein the centering roller means surface is still in contact with the web but having a contact relationship differing from the normal contact relationship,

(*j*) force transmitting means interconnecting said pivoting means to the pivot means mounting said first and said second roller means to transmit any motion of said pivot means to the pivoting means and thereby to the centering roller means,

(*k*) said centering roller means when moved by said pivoting means coacting with the web producing centering forces to return the web to the given path.

6. Apparatus for guiding a moving strip,

(*a*) a first roller,

(*b*) a pair of spaced support members rotatively carrying said first roller, said first roller being positioned in the space between the pair of spaced support members, to one side of the strip, and in contact with the surface of the strip along a reference line,

(*c*) a second roller,

(*d*) a pair of spaced rocker means, rockably mounted on said pair of spaced support members, rotatively carrying said second roller and rockably mounting said second roller for movement towards and away from said first roller, said second roller being positioned in the space between the second pair of spaced rocker members, to the other side of the strip, and in contact with the surface of the strip along the said reference line,

(*e*) a base member interconnecting the pair of spaced support members,

(*f*) a cross member interconnecting the pair of spaced rocker members,

(*g*) a lip on said cross member thereon spaced from and parallel to said base member,

(*h*) biasing means positioned midway between the ends of said first and said second rollers in the space between and engaging said cross member and said base member, said biasing means coacting with said cross member and said base member to rock said pair of spaced rocker members and thereby bias said second roller towards said first roller whereupon said first and second rollers apply pressure to said strip as it passes between said rollers,

(*i*) a platform, and

(*j*) pivot means interconnecting said base member and said platform and balancing said base member in a balanced position,

(*k*) whereby walking of the strip, from a position centered with respect to the ends of the rollers, pivots the base member out of its balanced position and therewith the first and second rollers to a position where the surfaces of the rollers contact the strip along a line at an angle to the reference line, said first and second rollers and the strip in the pivoted position coacting to produce restoring forces to return the strip to its centered position and the base member to its balanced position.

7. The apparatus of claim 6 wherein the pivot means includes resilient members coacting with said base member and platform to dampen any oscillation of said base member during pivotal movement thereof, said resilient

members being ineffective to disturb the unbalancing or rebalancing of the base member.

8. The apparatus of claim 6, wherein said adjustable biasing means includes,

(*a*) an externally threaded member,

(*b*) an internally threaded member threaded onto said externally threaded member, and

(*c*) a spring positioned around said externally threaded member between said base member and said internally threaded member,

(*d*) said spring being compressed or allowed to expand by rotating said internally threaded member and changing the position thereof with respect to the externally threaded member to vary the spring pressure against said lip and said base member and thereby vary the pressure between said rollers.

9. The apparatus of claim 6, including

(*a*) an aperture formed in the cross member,

(*b*) a latch member pivotally mounted on the platform and extending through said aperture in said cross member,

(*c*) a catch formed on said latch, said catch engaging an edge of said cross member adjacent said aperture when said rockable member and cross member are rocked in a direction which carries said second roller away from said first roller to thereby maintain said rollers spaced one from the other.

10. Apparatus for guiding a moving strip,

(*a*) a first roller,

(*b*) a pair of spaced support members rotatively carrying said first roller, said first roller being positioned in the space between the pair of spaced support members, to one side of the strip, and in contact with the surface of the strip along a reference line,

(*c*) a second roller,

(*d*) a pair of spaced rocker means, rockably mounted on said pair of spaced support members, rotatively carrying said second roller and rockably mounting said second roller for movement towards and away from said first roller, said second roller being positioned in the space between the second pair of spaced rocker members, to the other side of the strip, and in contact with the surface of the strip along the said reference line,

(*e*) a base member interconnecting the pair of spaced support members,

(*f*) a cross member interconnecting the pair of spaced rocker members,

(*g*) a lip on said cross member thereon spaced from and parallel to said base member,

(*h*) biasing means positioned midway between the ends of said first and said second rollers in the space between said cross member and said base member, said biasing means engaging said cross member and said base member and coacting therewith to rock said pair of spaced rocker members and thereby bias said second roller towards said first roller whereupon said first and second rollers apply pressure to said strip as it passes between said rollers,

(*i*) a platform,

(*j*) pivot means interconnecting said base member and said platform and balancing said base member in a balanced position,

(*k*) a third roller,

(*l*) a pair of spaced mounting members rotatively carrying said third roller, said third roller being positioned in the space between the pair of spaced mounting members and normally in contact with the surface of the strip along a predetermined portion of the strip,

(*m*) an interconnecting piece inetrconnecting the pair of spaced mounting members,

(*n*) a pivot pin mounting said interconnecting piece,

(*o*) an internally threaded block pivoted to said interconnecting piece,

(*p*) a bi-directional motor having a shaft, said shaft including an externally threaded portion mated with said internally threaded block,

(*q*) multi-position switch means for controlling the operation of and direction of said motor, and

(*r*) lever means interconnecting said multi-position switch means to the base member and responsive to the pivotal movement of the base member to operate the motor and through said motor shaft to pivot the third roller to a position wherein it contacts the strip along a portion at an angle to the predetermined portion of the strip,

(*s*) said strip coacting with said third roller to produce forces which return the strip to the given path.

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