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(54) **Sheet transport apparatus**

(57) Described herein is an apparatus for adjusting the nip normal force in a sheet transport. The transport has a drive roll (122) and an idler roll (124, 125) forming a nip therewith. One end (121) of the idler roll is fixed

and the other end (127) has an adjusting mechanism (130) to increase or decrease the normal force exerted in the nip to cause a sheet to skew as a result of the normal force.

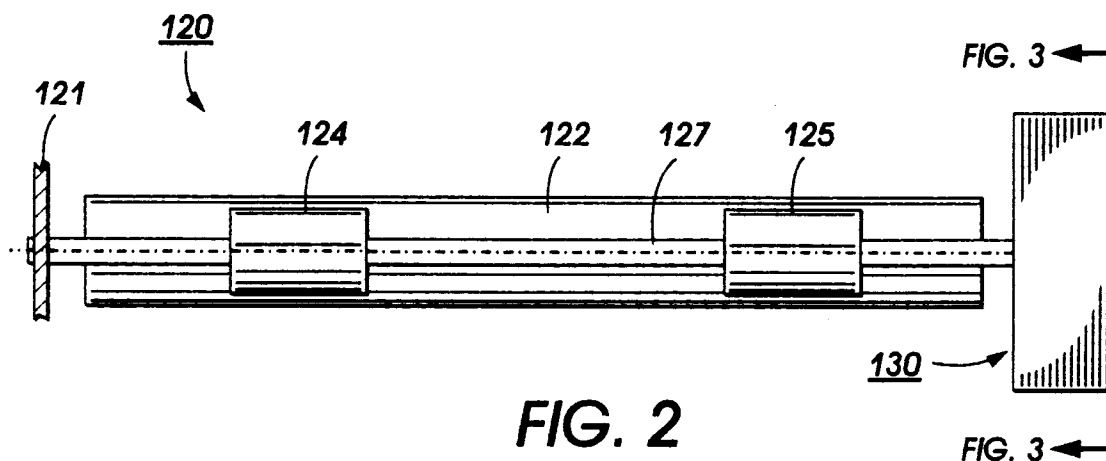


FIG. 2

FIG. 3

FIG. 3

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Description

This invention relates to improvements in or relating to a sheet transport, and is more particularly concerned with a device for adjusting the skew of a sheet being output from such a transport.

In a typical electrophotographic printing process, a photoconductive member is charged to a substantially uniform potential so as to sensitize the surface thereof. The charged portion of the photoconductive member is exposed to a light image of an original document being reproduced. Exposure of the charged photoconductive member selectively dissipates the charges thereon in the irradiated areas. This records an electrostatic latent image on the photoconductive member corresponding to the informational areas contained within the original document. After the electrostatic latent image is recorded on the photoconductive member, the latent image is developed by bringing a developer material into contact therewith. Generally, the developer material comprises toner particles adhering triboelectrically to carrier granules. The toner particles are attracted from the carrier granules to the latent image forming a toner powder image on the photoconductive member. The toner powder image is then transferred from the photoconductive member to a copy sheet. The toner particles are heated to permanently affix the powder image to the copy sheet. After each transfer process, the toner remaining on the photoconductor is cleaned by a cleaning device.

In printing machines such as those described above, a paper path using drive rolls and idler rolls directs the copy receiving substrates throughout the machine. Similar drive and idler rolls are used to handle original documents in automatic document handlers for imaging original documents. Two common configurations of idler roll assemblies are often used. The first has one, two or more idler rolls with internally mounted bearings rotating independently on a stationary shaft. The shaft can be either center or end loaded. In the second configuration the rolls are press fit or molded to a rotating shaft, the shaft is loaded at both ends requiring two bearing surfaces.

A fault of this configuration is that independent roll rotation allows the individual idler to follow the individual drive roll speeds, if the drive roll speeds are not exactly the same, due to slight differences in roll radii and/or uneven loading, a piece of paper driven at two different speeds will rotate, skewing the sheet as it travels through the nip. When rolls of these type are used in a sheet transport such as a registration transport there can be a skew induced on a sheet as it is fed. The solution for correcting this skew is currently to adjust the position of the entire transport assembly to bring the sheet within the required parameters. This is sometimes difficult to achieve due to space constraints and interference with other machine subsystems.

Accordingly it is desirable to have a low cost method and device to adjust the sheet skew at assembly of a

machine without the need to move the entire transport assembly. It is also desirable to have any such adjuster be easy to use yet inexpensive so as to not induce additional complex mechanisms in a machine.

US-A-5 269 509 describes a cut sheet registration guide having at least two idler rolls biased into contact with a feed roll, the idler rolls being pivotally mounted on a bar which is itself pivotally mounted with respect to the axis of the feed roll.

US-A-4 997 179 discloses a sheet feeder having a drive roller in contact with an idler roll retained by a leaf spring to provide a normal force to a sheet.

US-A-4 452 524 describes a printing machine having a first frame portion having a fixed drive roll and a second frame portion having an idler roll position opposite the drive roll. The second frame is biased toward the first frame and the second frame is self-referenced against the first frame.

US-A-5 199 702 describes a transport apparatus having drive rolls and associated idler rolls to form a transport nip. The idler rolls being pivotally mounted in an assembly so as to self adjust to provide an equal nip force in the drive nip. The support housing is biased at one end.

In accordance with one aspect of the invention, there is provided apparatus for transporting a sheet having a skew adjustment, the apparatus comprising a drive nip being rotatably supported at a first end and at a second end and an adjuster device, located at the first end of said drive nip for applying a variable, adjustable force thereto to cause a sheet being driven thereby to be skewed accordingly.

In accordance with another aspect of the present invention, there is provided an electrophotographic printing machine having apparatus as described above.

For a better understanding of the present invention, reference will now be made, by way of example only, to the accompanying drawings in which:

Figure 1 is a schematic elevational view of a typical electrophotographic printing machine utilizing the sheet transport;

Figure 2 is a plan view of the transport drive roll assembly in accordance with the present invention;

Figure 3 is a first embodiment of the nip normal force adjusting mechanism;

Figure 4 is a second embodiment of the nip normal force adjusting mechanism;

Figure 5 is a third embodiment of the nip normal force adjusting mechanism;

Figure 6 is a fourth embodiment of the nip normal force adjusting mechanism; and

Figure 7 is a fifth embodiment of the nip normal force adjusting mechanism.

In the drawings, like reference numerals have been used throughout to identify identical elements. Figure 1 schematically depicts an electrophotographic printing

machine incorporating the features of the present invention therein. It will become evident from the following discussion that the development system of the present invention may be employed in a wide variety of devices and is not specifically limited in its application to the particular embodiment depicted herein.

Referring to Figure 1, an original document is positioned in a document handler 27 on a raster input scanner (RIS) indicated generally by reference numeral 28. The RIS contains document illumination lamps, optics, a mechanical scanning drive and a charge coupled device (CCD) array (not shown). The RIS captures the entire original document and converts it to a series of raster scan lines. This information is transmitted to an electronic subsystem (ESS) which controls a raster output scanner (ROS) described below.

Figure 1 schematically illustrates an electrophotographic printing machine which generally employs a photoconductive belt 10. Preferably, the photoconductive belt 10 comprises a photoconductive surface 12 made from a photoconductive material coated on a ground layer, which, in turn, is coated on an anti-curl backing layer. Belt 10 moves in the direction of arrow 13 to advance successive portions sequentially through the various processing stations disposed about the path of movement thereof. Belt 10 is entrained about stripping roller 14, tensioning roller 16 and drive roller 20. As roller 20 rotates, it advances belt 10 in the direction of arrow 13.

Initially, a portion of the photoconductive surface passes through charging station A. At charging station A, a corona generating device indicated generally by the reference numeral 22 charges the photoconductive belt 10 to a relatively high, substantially uniform potential.

At an exposure station B, a controller or electronic subsystem (ESS), indicated generally by reference numeral 29, receives the image signals representing the desired output image and processes these signals to convert them to a continuous tone or greyscale rendition of the image which is transmitted to a modulated output generator, for example the raster output scanner (ROS), indicated generally by reference numeral 30. Preferably, ESS 29 is a self-contained, dedicated minicomputer. The image signals transmitted to ESS 29 may originate from a RIS as described above or from a computer, thereby enabling the electrophotographic printing machine to serve as a remotely located printer for one or more computers. Alternatively, the printer may serve as a dedicated printer for a high-speed computer. The signals from ESS 29, corresponding to the continuous tone image desired to be reproduced by the printing machine, are transmitted to ROS 30. ROS 30 includes a laser with rotating polygon mirror blocks. The ROS will expose the photoconductive belt to record an electrostatic latent image thereon corresponding to the continuous tone image received from ESS 29. As an alternative, ROS 30 may employ a linear array of light emitting diodes (LEDs) arranged to illuminate the charged portion of photocon-

ductive belt 10 on a raster-by-raster basis.

After the electrostatic latent image has been recorded on photoconductive surface 12, belt 10 advances the latent image to a development station C, where toner, in the form of liquid or dry particles, is electrostatically attracted to the latent image. The latent image attracts toner particles from the carrier granules forming a toner powder image thereon. As successive electrostatic latent images are developed, toner particles are depleted from the developer material. A toner particle dispenser, indicated generally by the reference numeral 44, on signal from controller 29, dispenses toner particles into developer housing 46 of developer unit 38 based on signals from a toner maintenance sensor (not shown).

After the electrostatic latent image is developed, the toner powder image present on belt 10 advances to transfer station D. A print sheet 48 is advanced to the transfer station D, by a sheet feeding apparatus. Preferably, the sheet feeding apparatus includes a nudger roll 51 which feeds the uppermost sheet of stack 54 to nip 55 formed by feed roll 52 and retard roll 53. Feed roll 52 rotates to advance the sheet from stack 54 into vertical transport 56. Vertical transport 56 directs the advancing sheet 48 of support material into the registration transport 120 in accordance with the present invention, described in detail below, past image transfer station D to receive an image from photoreceptor belt 10 in a timed sequence so that the toner powder image formed thereon contacts the advancing sheet 48 at transfer station D. Transfer station D includes a corona generating device 58 which sprays ions onto the back side of sheet 48. This attracts the toner powder image from photoconductive surface 12 to sheet 48. The sheet is then detached from the photoreceptor by corona generating device 59 which sprays oppositely charged ions onto the back side of sheet 48 to assist in removing the sheet from the photoconductive surface 12 of the photoreceptor belt 10. After transfer, sheet 48 continues to move in the direction of arrow 60 by way of belt transport 62 which advances sheet 48 to fusing station F.

Fusing station F includes a fuser assembly indicated generally by the reference numeral 70 which permanently affixes the transferred toner powder image to the copy sheet. Preferably, fuser assembly 70 includes a heated fuser roller 72 and a pressure roller 74 with the powder image on the copy sheet contacting fuser roller 72.

The sheet then passes through fuser 70 where the image is permanently fixed or fused to the sheet. After passing through fuser 70, a gate 80 either allows the sheet to move directly via output 84 to a finisher or stacker, or deflects the sheet into duplex path 100, specifically, first into single sheet inverter 82 here. That is, if the sheet is either a simplex sheet, or a completed duplex sheet having both side one and side two images formed thereon, the sheet will be conveyed via gate 80 directly to output 84. However, if the sheet is being duplexed and is then only printed with a side one image, the gate

80 will be positioned to deflect that sheet into the inverter 82 and into the duplex loop path 100, where that sheet will be inverted and then fed for recirculation back via belt 110 and roller pair 102 (controlled by controller 29) through transfer station D and fuser 70 for receiving and permanently fixing the side two image to the backside of that duplex sheet, before it exits via exit path 84.

After the print sheet is separated from photoconductive surface 12 of belt 10, the residual toner/developer and paper fiber particles adhering to photoconductive surface 12 are removed therefrom at cleaning station E. Cleaning station E includes a rotatably mounted fibrous brush in contact with photoconductive surface 12 to disturb and remove paper fibers and a cleaning blade to remove the nontransferred toner particles. The blade may be configured in either a wiper or doctor position depending on the application. Subsequent to cleaning, a discharge lamp (not shown) floods photoconductive surface 12 with light to dissipate any residual electrostatic charge remaining thereon prior to the charging thereof for the next successive imaging cycle.

The various machine functions are regulated by controller 29. The controller is preferably a programmable microprocessor which controls all of the machine functions hereinbefore described including toner dispensing. The controller provides a comparison count of the copy sheets, the number of documents being recirculated, the number of copy sheets selected by the operator, time delays, jam corrections, etc. The control of all of the exemplary systems heretofore described may be accomplished by conventional control switch inputs from the printing machine consoles selected by the operator. Conventional sheet path sensors or switches may be utilized to keep track of the position of the document and the copy sheets.

Turning now to Figure 2, there is illustrated a plan view of the registration transport nip assembly illustrating the drive roll 122, the idler rolls 124, 125 showing the fixed end 121 of the idler roll assembly and the adjustable end 127 of the idler roll assembly including the adjusting device 130. Depending on the skew of a sheet as it is fed through the drive nip, the outboard end of the idler can have a greater normal force applied to induce a skew in the sheet. A simple adjustment can be made until the sheet is fed from the transport in a condition which meets the operating parameters of the machine. Figures 3 to 7 illustrate various embodiments to adjust the normal force on the outboard end of the idler assembly.

Turning next to Figure 3, there is shown a first embodiment of the nip normal force adjusting mechanism. A spring 134 has a first end fixedly mounted at frame 131. The spring has a curvature and applies a force on bearing block 126 which increases the force applied by roll 125 against drive roll 122. The nonfixed end of spring 134 is held in place by a pin 133 which is inserted into one of a plurality of pin mounting holes 132. Depending on the placement of the pin mount, the curvature of

spring 134 is greater or lesser thereby applying more or less force on bearing block 126.

Figure 4 illustrates a second embodiment in which a spring 140 is again fixedly mounted at one end 141. The curvature of the spring again determines the amount of force exerted on bearing block 126. The non-fixed end of spring 140 is retained in race 144 which is attached to a threaded member 142. When the threaded member 142 is rotated in one direction the spring 140 is caused to bend and exert a greater force on block 126. When the direction of rotation is reversed, the spring straightens thereby exerting less force on block 126.

Figure 5 illustrates a third embodiment in which a spring 150 is again fixedly mounted at one end 151. The curvature of the spring again determines the amount of force exerted on bearing block 126. The nonfixed end of spring 150 is moved by a threaded member 152. When the threaded member 152 is rotated in one direction the spring 150 is forced against and exerts a greater force on block 126. When the direction of rotation is reversed, the spring straightens thereby exerting less force on block 126.

Figure 6 shows a compression spring 160 which is mounted between a frame and the bearing block 126. A threaded member 162 adjusts the distance that the spring 160 travels and accordingly adjusts the force exerted by it on block 126. Once again, rotation of the threaded member in one direction causes a greater force on the block 126 and opposite rotation lessens the force.

Figure 7 illustrates yet another embodiment to adjust the normal force exerted on the nip. A wedge type member 170 is located between a frame 172 and the bearing block 126. The further the wedge 170 is inserted, the greater the force that is exerted in the nip. The wedge 170 may be manually adjusted and have detents 173 as shown or it may be smooth and be adjusted by the use of a threaded member as illustrated earlier.

In recapitulation, there is provided an apparatus and method for adjusting the nip normal force in a sheet transport. The transport has a drive roll and an idler roll forming a nip therewith. One end of the idler roll is fixed and the other end has an adjusting mechanism to increase or decrease the force exerted in the nip to cause a sheet to skew as a result of the force. The adjusting mechanism may include a biased member to increase and decrease the nip normal force.

Claims

1. Apparatus for transporting a sheet having a skew adjustment, the apparatus comprising:

a drive nip (120, 122, 125) being rotatably supported at a first end (127) and at a second end (121); and

an adjuster device (126, 130, 131, 132, 133, 134; 140, 141, 142, 144; 150, 151, 152; 160, 162; 170, 172, 173), located at the first end (127) of said drive nip (120, 122, 125) for applying a variable, adjustable force thereto to cause a sheet being driven thereby to be skewed accordingly. 5

2. Apparatus according to claim 1, wherein said drive nip (120, 122, 125) comprises: 10

a drive member (122) rotatably supported at both ends thereof; and
an idler member (126), in contact with said drive member (122) to form the nip therewith and rotatably supported at both ends thereof. 15

3. Apparatus according to claim 2, wherein said adjuster device (126, 130, 131, 132, 133, 134; 140, 141, 142, 144; 150, 151, 152; 160, 162; 170, 172, 173) comprises: 20

a bearing block (126) supporting said first end of said idler member (126);
a biasing member (134; 140; 150; 160; 170) contacting said bearing block (126) and applying a force thereto; and 25
a cooperating member (133; 142; 152; 162; 172), cooperating with said biasing member (134; 140; 150; 160; 170) to vary the amount of force applied to said bearing block (126). 30

4. Apparatus according to claim 3, wherein said biasing member (134; 140; 150) comprises a leaf spring. 35

5. Apparatus according to claim 3, wherein said biasing member (160) comprises a coil spring.

6. Apparatus according to claim 4 or 5, wherein said cooperating member (142; 152; 162) comprises a threaded member. 40

7. Apparatus according to claim 3, wherein said biasing member (170) comprises a wedge member (170). 45

8. Apparatus according to claim 7, wherein said cooperating member (172) comprises a frame. 50

9. An electrophotographic printing machine having apparatus according to an one of the preceding claims. 55

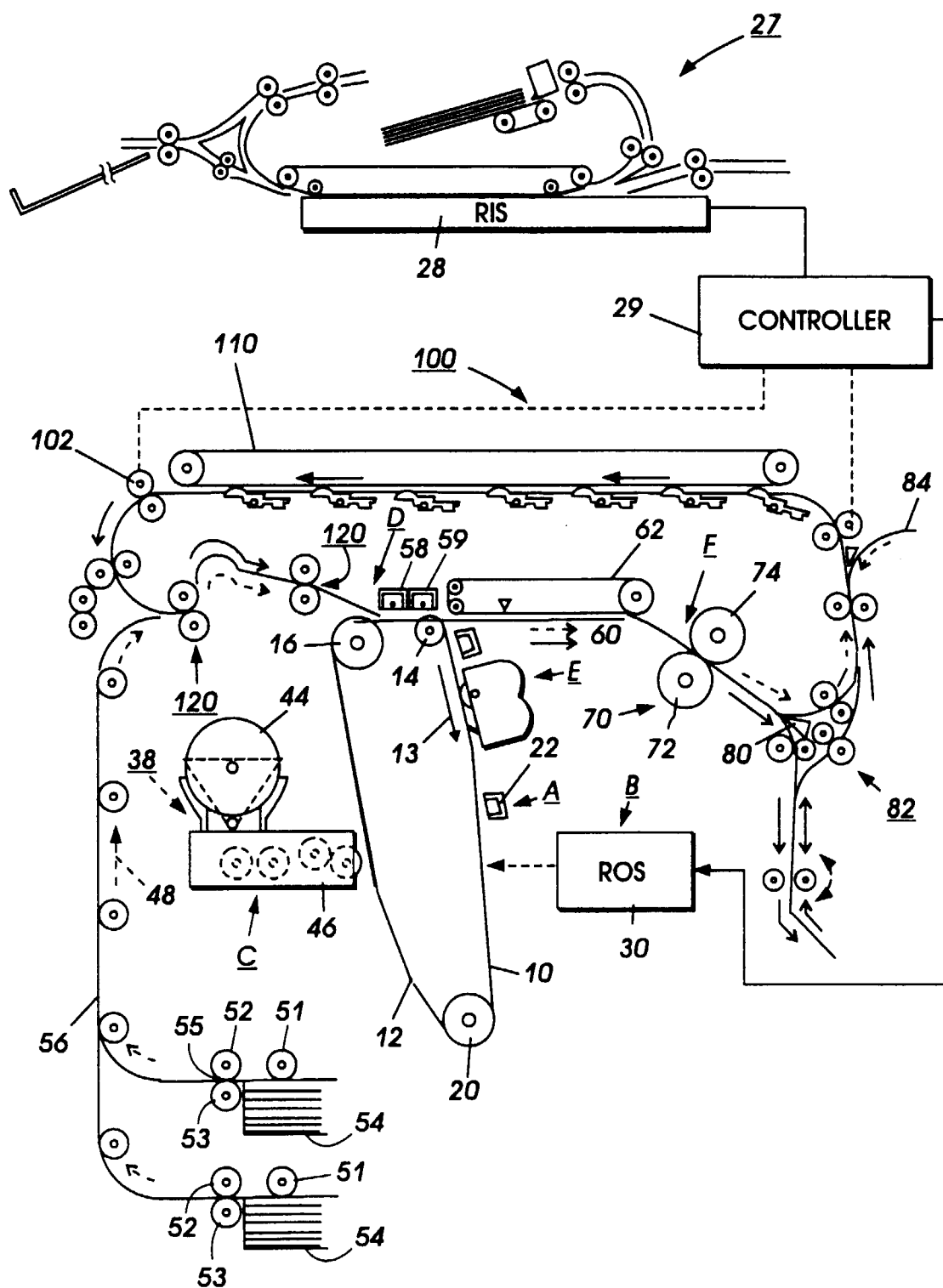
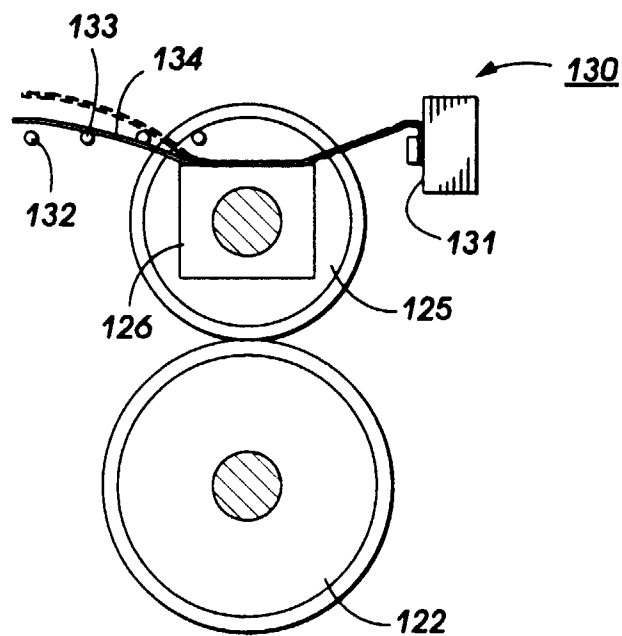
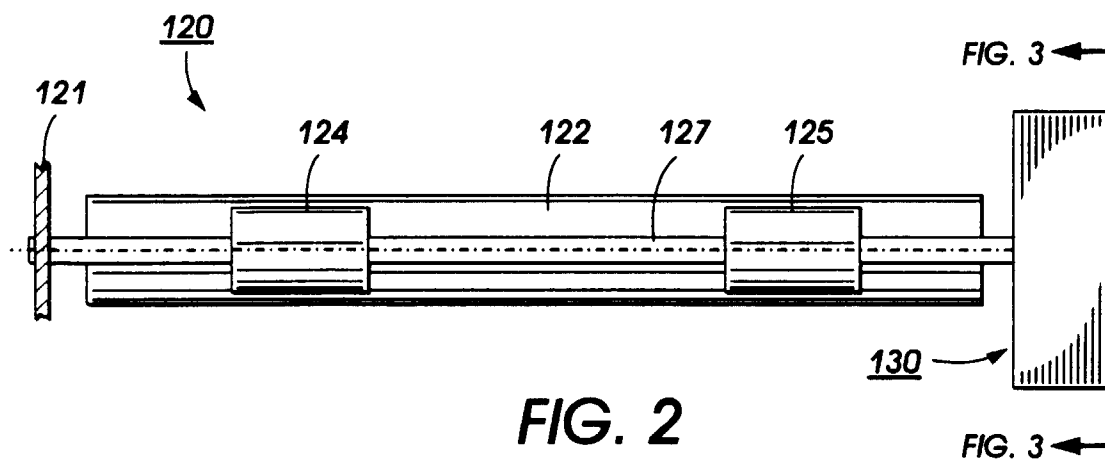


FIG. 1



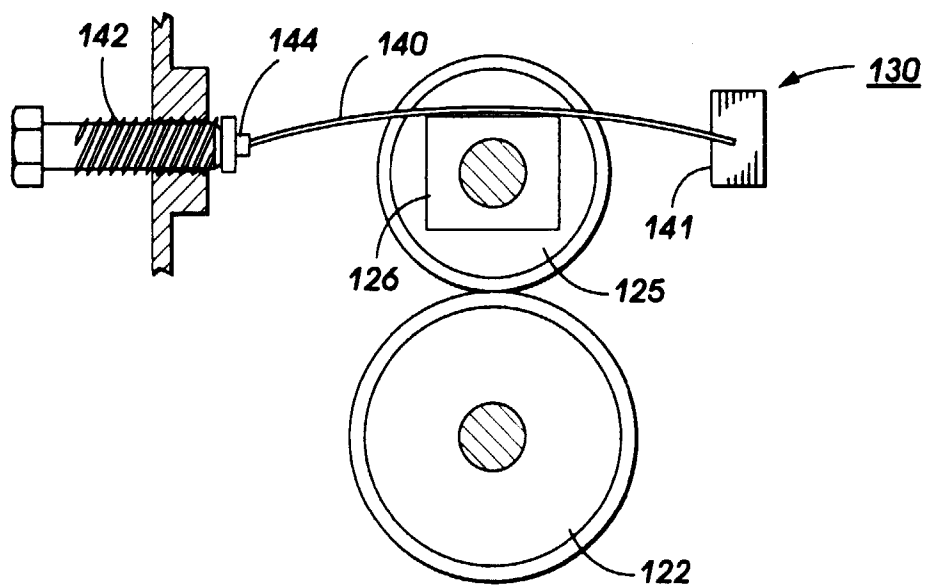


FIG. 4

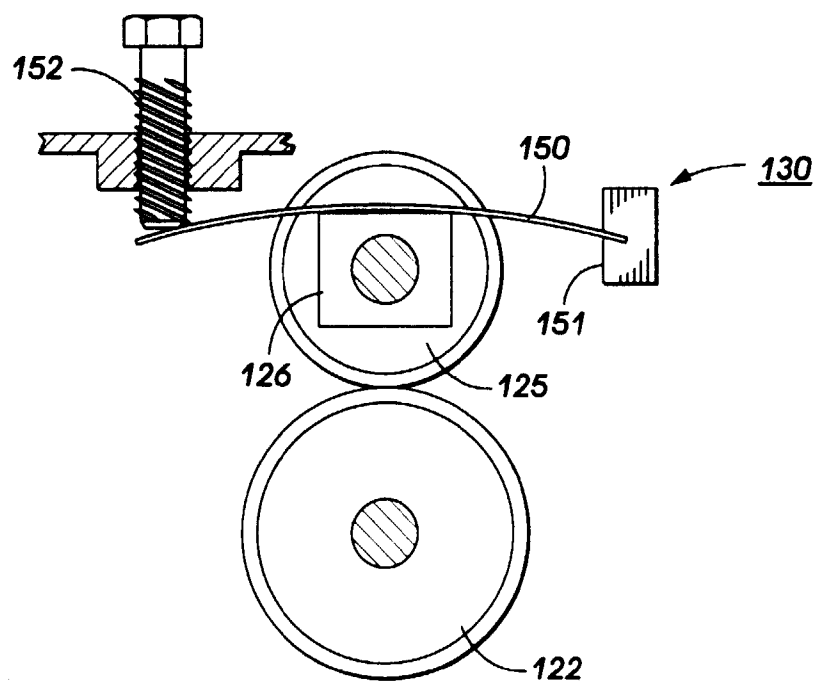


FIG. 5

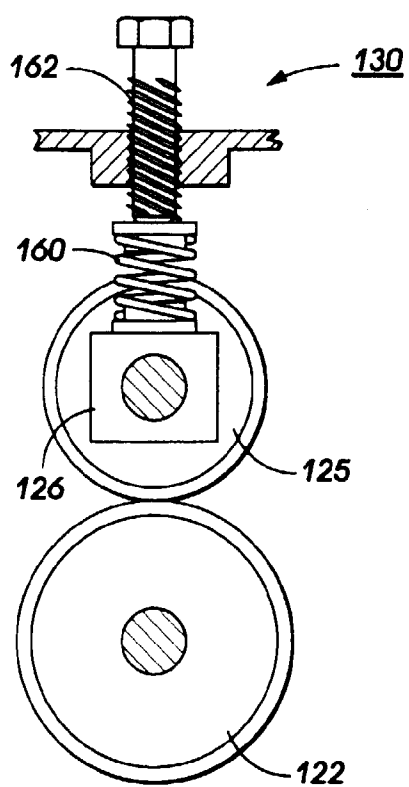


FIG. 6

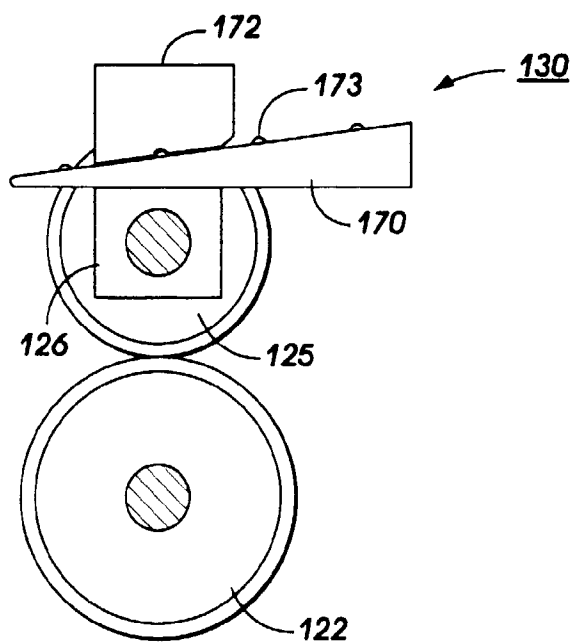


FIG. 7