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(71) Applicant *(for all designated States except US)*: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.** [US/US]; 20555 S.H. 249, Houston, TX 77070 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **SHMAISER, Aron** [IL/IL]; Hameshoreret Rachel Street 60, 75734 Rishon Lezion (IL). **ROSEN, Josef** [IL/IL]; 315 Inbar Street, 76834 Moshav Sitriya (IL).

(74) Agents: **FENSTER, Paul** et al.; Fenster and Company Intellectual Property 2002 Ltd., P.O. Box 10256, 49002 Petach Tikva (IL).

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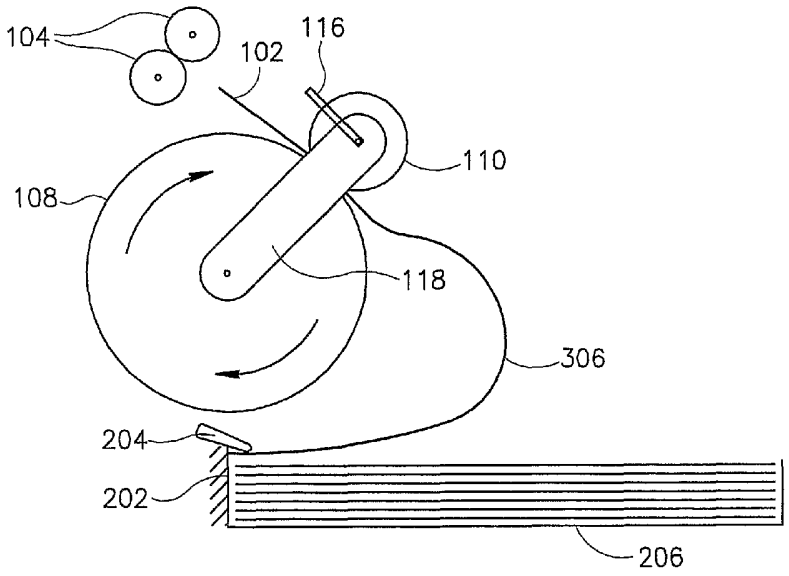
(54) **Title:** PRINT MEDIA FLIPPING MECHANISM AND METHOD



(57) **Abstract:** A method for flipping over a printing media (102), comprising: a) capturing the printing media in a nip between a driver roller (108) and a pinch roller (110); b) turning the driver roller (108) while holding at least a leading portion of the printing media (102) against the driver roller, so that the printing media (102) moves forward around the driver roller; c) releasing the leading portion of the printing media (102) from the driver roller (108); d) changing the forward velocity of the leading portion of the printing media (102), while the driver roller (108) continues to move a trailing portion of the printing media (102) caught in the nip forward, thereby causing the paper to buckle away from the driver roller; e) releasing the trailing portion of the printing media (102) from the nip; and f) allowing the trailing portion of the printing media (102) to fall freely so that it ends up in a flipped over orientation.

WO 2004/069709 A1

PRINT MEDIA FLIPPING MECHANISM AND METHOD

FIELD OF THE INVENTION

The field of the invention is printers and copiers and particularly mechanisms and methods for flipping substrates on which images are printed.

BACKGROUND OF THE INVENTION

When a printer or copier does two-sided copying, it generally prints one side of the paper first, then flips the paper over and prints the other side. A large number of patents and published patent applications exist for paper-flipping mechanisms, including GB 2,168,688 A to Xerox Corp., US 4,969,641 to Fukushima et al., US 5,201,517 to Stemmle, US 5,692,740 to Holtje, US 5,692,747 to Guerrero et al., US 5,720,478 to Carter et al., US 6,199,858 to Wyer, and PCT publication WO 02/060794 A1 to Hallmark Cards Inc. These mechanisms typically work by moving the paper into an intermediate position, and then moving it back out along a different path, so that its orientation is changed. To prevent the paper from going back along the same path when its motion is reversed, something irreversible is done to it before moving it back. In some publications, the irreversible action is falling or sliding under the influence of gravity. Using gravity to move the paper reduces the need for active mechanisms such as motor-driven rollers or pneumatics, reducing cost and increasing reliability. However, the falling or sliding paper must be guided fairly closely to make sure it ends up in the right place without wrinkling or jamming. This leads to the possibility that the first printed side of the paper will be scratched or smudged as a result of rubbing against a surface that is guiding it.

WO 02/060794 A1 discloses a mechanism for flipping card stock for two-sided printing, in which the surface is never rubbed. The card stock is held rigidly in a frame, and the whole frame is flipped over.

US 6,199,858 to Wyer illustrates the difficulty of designing a flipping mechanism using rollers, that does not allow the paper to rub. The device disclosed in Wyer has the primary purpose of forming a shingled stack of paper, but it also flips the paper when forming the stack. In this device, the paper is fed through a first pair of rollers, and the lead end drops straight down to an intermediate position where it is caught between a second pair of rollers. If the paper were very compliant and with no memory of its curvature, then there would be no need for guide walls, and the paper would drop directly between the second pair of rollers without rubbing against anything. But since paper is not completely compliant and does retain a curl, guide walls are needed to make sure the

leading edge of the paper is fed into the gap between the second pair of rollers, and the paper can rub against the guide walls.

Other mechanisms for flipping print media, too numerous to mention, are also known in the art.

SUMMARY OF INVENTION

An aspect of some embodiments of the invention concerns a mechanism which flips paper (or other media, herein referred to as "paper") over without allowing it to rub against any surface. A driver, for example a drive roller in contact with a pinch roller, draws in a piece of paper or other printing media, in such a way that the paper does not rub against any surface of the mechanism. This means that any surface that the paper is in contact with, or might be in contact with, such as the surface of the drive roller, is co-moving with the paper in the entire region of contact, or rolling along the paper. A leading portion of the paper then comes to rest against a stop, while a trailing portion of the paper continues to be drawn into the apparatus, pulled by the driver.

The difference in motion between the leading and trailing portions causes the paper to buckle, so that the paper is no longer in contact with any surface of the mechanism, except for the leading edge that is resting against the stop, and the part that is still being drawn in, which is held in contact with and moving with the driver. When the paper is completely drawn in, and loses contact with the driver, the paper falls, in a flipped over orientation, into output location, without rubbing against any surface. It is generally not necessary to guide the paper while it is falling, since its leading portion is still resting against the stop. Hence the paper ends up in a flipped orientation, without ever rubbing against any part of the mechanism.

Optionally, before the leading edge of the paper has reached the stop, the leading edge, or a portion of the paper close to the leading edge, is held against the drive roller by a holding mechanism such as a gripper, or a suction system. The holding mechanism releases the leading portion of the paper just before it reaches the stop, so that it will not rub against the drive roller.

Alternatively or additionally, the pinch roller travels with the leading portion of the paper around the drive roller, keeping the leading portion of the paper in contact with the drive roller, and guiding it to the location of the stop. Then, when the leading edge of the paper reaches the stop, the pinch roller rolls back along the drive roller to the trailing portion of the paper, in order to hold the trailing portion of the paper against the drive

roller so the drive roller can draw the paper in without allowing it to rub. If the pinch roller moves back quickly enough, then the paper will not buckle too sharply even though the pinch roller stays in contact with the drive roller the whole time.

Optionally, instead of the holding mechanism, or the pinch roller, bringing the leading edge of the paper to rest against a stop, it brings the leading edge of the paper to a position where, once the holding mechanism releases the leading edge or the pinch roller rolls back, the leading edge is taken up by a nip between two rollers.

Optionally, instead of stopping the leading portion of the paper completely, its motion is only slowed down, or its motion is reversed. Optionally, it is not the leading portion of the paper that changes the rate or direction of its motion when it reaches a certain point, but the trailing portion starts to move faster, or both the leading and trailing portions change their motion. All of these options have equivalent effects. As long as the leading and trailing portions of the paper are moving toward each other, the paper will buckle. Having the paper come to rest against a stationary stop is simpler than the other options.

Optionally, when the leading edge of the paper comes to rest against the stop, it is held down, away from the drive roller, by clamp or a roller. This prevents the paper from sliding away from the stop when its trailing edge is released from the drive roller and pinch roller, and it falls down. It also prevents the leading edge of the paper from curling slightly upward and rubbing against the drive roller when the trailing edge of the paper is still held between the drive roller and the pinch roller, and the middle portion of the paper is buckling away from the drive roller. It also assures that the leading edge is at the stop, so that a series of pages are stacked on top of each other.

Optionally, instead of the paper falling directly into the output location when its trailing portion is released from the driver, it falls into a temporary position from which it is conveyed to the output location. The output location of the flipping mechanism is not necessarily the final destination of the paper. For example, the paper may be conveyed from the output location of the flipping mechanism to another location where the other side of the paper is printed, for example, or where some other process takes place. Alternatively, the output location is the final position of the paper in the printer.

There is thus provided, in accordance with an exemplary embodiment of the invention, a method for flipping over a printing media, comprising:

a) capturing the printing media in a nip between a driver roller and a pinch roller;

b) turning the driver roller while holding at least a leading portion of the printing media against the driver roller, so that the printing media moves forward around the driver roller;

c) releasing the leading portion of the printing media from the driver roller;

d) changing the forward velocity of the leading portion of the printing media, while the driver roller continues to move a trailing portion of the printing media caught in the nip forward, thereby causing the paper to buckle away from the driver roller;

e) releasing the trailing portion of the printing media from the nip; and

f) allowing the trailing portion of the printing media to fall freely so that it ends up in a flipped over orientation.

In an embodiment of the invention, holding at least a leading portion of the printing media against the driver roller comprises moving the pinch roller around the driver roller at substantially a same angular speed as the drive roller turns, thereby holding a leading portion of the printing media in the nip between the pinch roller and the driver roller. Optionally, releasing the leading portion of the printing media from the driver roller includes rolling the pinch roller back around the driver roller.

Optionally, changing the forward velocity comprises exerting a force on the leading portion. Optionally, exerting a force comprises guiding the leading edge of the printing media toward a stopping location which exerts said force as the driver roller continues to advance a trailing portion of the printing media.

Optionally, holding a leading portion of the printing media against the driver roller comprises using suction. Alternatively, holding a leading portion of the printing media against the driver roller comprises using a gripper.

In an embodiment of the invention, changing the forward velocity of the leading portion of the printing media comprises stopping the leading portion of the printing media by having the leading edge of the printing media hit a stop. Optionally, the method also includes holding down the leading portion of the printing media with a leading edge clamp at said stop.

Optionally, changing the forward velocity of the leading portion of the printing media comprises capturing the leading portion between two stopping rollers, and slowing down the leading portion by slowing down the turning of the stopping rollers. Optionally, changing the forward velocity of the leading portion comprises stopping the leading portion by stopping the turning of the stopping rollers. Optionally, changing the forward

velocity of the leading portion comprises reversing the direction of motion of the leading portion by reversing the direction of turning of the stopping rollers.

There is further provided, in accordance with an embodiment of the invention, apparatus for transporting a printing media from an input location and delivering it in a flipped over orientation to an output, comprising:

a) a rotating driver roller;

b) a pinch roller, juxtaposed with the driver roller, such that a leading portion of the printing media is captured in a nip between the pinch roller and the driver roller;

c) a stopping element; and

d) an angular driver, which rolls the pinch roller around the driver roller at substantially the speed at which the driver roller turns, thereby bringing the leading portion of the printing media around the driver roller toward the stopping element while the pinch roller holds the leading portion in the nip against the driver roller, and which starts to roll the pinch roller back around the driver roller to a trailing portion of the printing media as the leading portion nears the stopping element;

wherein the stopping element, when the leading portion reaches it, causes the leading portion to move at a lower forward velocity than the forward velocity at which the trailing portion is moving, causing the printing media to buckle away from the driver roller such that the printing media does not contact the driver roller except at the nip, and the printing media falls into the output location after the trailing portion leaves the nip.

Optionally, the apparatus includes a leading edge guide associated with the pinch roller which guides the leading portion of the printing media to the stopping element.

Optionally, the apparatus includes a leading edge sensor which causes the angular driver to start rolling the pinch roller around the driver roller after the sensor detects that the leading edge of the printing media has reached the pinch roller.

There is further provided, in accordance with an embodiment of the invention, apparatus for transporting a printing media from an input location and delivering it in a flipped over orientation to an output location, comprising:

a) a rotating driver roller;

b) a pinch roller, juxtaposed with the driver roller, such that a leading portion of the printing media is captured in a nip between the pinch roller and the driver roller;

c) a stopping element;

d) a holding mechanism which holds the leading portion against the driver roller after the leading portion is captured and when the leading portion reaches the stopping element, releases the leading portion from the driver roller, allowing the leading portion to engage the stopping element, such that the leading element moves at a lower forward velocity than a trailing portion of the printing media, caught in the nip, causing a portion of the printing media intermediate the nip and the leading to buckle away from the driver roller such that it does not contact the driver roller except at the nip.

Optionally, the holding mechanism comprises a suction system.

Optionally, the holding mechanism comprises at least one gripper.

Optionally, the apparatus includes a leading edge sensor, which activates the holding mechanism when the sensor detects that the printing media has been or is about to be captured.

Optionally, the stopping element is fixed in place and causes the leading portion of the printing media to stop moving when the printing media hits the stopping element.

Optionally, the stopping element comprises a pair of stopping rollers which captures the leading portion of the printing media in a stopping nip between the stopping rollers. Optionally, the stopping rollers cause the leading portion of the printing media to stop moving after they capture it. Optionally, the stopping rollers cause the leading portion of the printing media to slow down after they capture it. Optionally, the stopping rollers cause the leading portion of the printing media to reverse direction after they capture it.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 through 5 are schematic cross-sectional views of an exemplary embodiment of the invention, showing a time sequence of five stages in flipping a piece of paper or other printing media; and

Figs. 6 through 9 are schematic cross-sectional views of another exemplary embodiment of the invention, showing a time sequence of four stages in flipping a piece of paper or other printing media, corresponding respectively to Figs. 1, 2, 3 and 4 in that embodiment of the invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Fig. 1 is a cross-sectional view of a paper flipping mechanism 100, according to an exemplary embodiment of the invention. A piece of paper 102, or other printing media, goes through a pair of feeder rollers 104, which direct the paper so that its leading edge

enters a nip 106 between a drive roller 108 and a pinch roller 110. Drive roller 108 is driven in a clockwise direction, optionally at a constant speed, by motor 112.

Optionally, feeder rollers 104 are an integral part of flipping mechanism 100. Alternatively, feeder rollers 104 are the output of another mechanism which performs some process before the paper is flipped over, for example printing a first side of the paper. Optionally, at least one of feeder rollers 104 is motor driven, turning at the same surface speed as drive roller 108. Alternatively, feeder rollers 104 are passive, or their speed easily changes in response to any torque exerted on them by paper 102, so their speed adjusts to match the speed of drive roller 108 once paper 102 is taken up by drive roller 108. Alternatively, feeder rollers 104 are motor driven until paper 102 is taken up by drive roller 108, at which time feeder rollers 104 are decoupled from the motor driving them and then move passively at the speed that paper 102 is moving. In some embodiments of the invention, there are no feeder rollers 104, and there is another mechanism for feeding the paper into flipping mechanism 100, for example, a pneumatic mechanism.

To avoid damaging a printed image on one side of the paper, feeder rollers 104, or an alternative mechanism, are optionally positioned close enough to nip 106, and at an orientation, such that the leading edge of paper 102 finds nip 106 and is taken up by drive roller 108 and pinch roller 110, without ever rubbing against drive roller 108 or pinch roller 110. Alternatively, paper 102 does not find the exact position of nip 106 every time, but paper 102 is moving at the same speed as the surface of drive roller 108 and pinch roller 110, due to feeder rollers 104, so even if drive roller 108 or pinch roller 110 has to deflect the leading edge of paper 102 to guide it into nip 106, the paper will not rub against drive roller 108 or pinch roller 110.

A sensor 114, located just past nip 106, senses when the lead edge of paper 102 has passed through nip 106. Optionally, there is a leading edge guide 116 attached to pinch roller 110, and sensor 114 is located just past the leading edge guide. Pinch roller 110 is attached to an angular driver 118, which is capable of moving pinch roller 110 back and forth around drive roller 108. Optionally, angular driver 118 is driven by its own motor, not shown in Fig. 1, separate from motor 112. Alternately, angular driver 118 is driven by motor 112, the same motor which drives drive roller 108, but there are gears and/or cams, not shown in Fig. 1, which allow angular driver 118 to disengage from motor 112, or to be

driven in reverse by motor 112. Optionally, the gears also allow angular driver to be driven at different speeds, without changing the speed of drive roller 108.

In an exemplary embodiment of the invention, drive roller 108 rotates at a constant speed. When sensor 114 senses that the leading edge of paper 102 has passed nip 106 and/or leading edge guide 116, then sensor 114 sends a signal to a controller, not shown in Fig. 1, which causes angular driver 118 to start rotating at the same angular speed and direction as drive roller 108. Hence, pinch roller 110 and leading edge guide 116 (if leading edge guide 116 exists) stay close to the leading edge of paper 102, as drive roller 108 turns.

Alternatively, drive roller 108 starts to rotate only when the paper approaches the nip between the drive roller and the pinch roller. However, this alternative is less advantageous than having the drive roller rotating continuously, since it requires control of and quick changes in the rotational velocity of the drive roller.

Eventually, as shown in Fig. 2, pinch roller 110 and the leading edge of paper 102 are near the bottom of drive roller 108. When the leading edge of paper 102 reaches a stop 202, optionally guided into the narrow space beneath drive roller 108 by leading edge guide 116, then the leading edge of paper 102 cannot go any further. At this time, an optional leading edge clamp 204 pushes paper 102 down, holding paper 102 at a point close to its leading edge, pulling paper 102 away from contact with drive roller 108, at least in the region between pinch roller 110 and the leading edge of paper 102. Leading edge clamp 204 holds this leading portion of paper 102 down against the bottom of an output tray 206, or against the top paper in a stack of papers that are already resting in output tray 206. This prevents paper 102 from rubbing against drive roller 108. Alternatively, there is no leading edge clamp 204, and the leading portion of paper 102 simply falls away from drive roller 108, once the leading edge of paper 102 reaches stop 202. Having the leading portion of paper 102 fall away from drive roller 108 is optionally facilitated if, as explained below, pinch roller 110 starts to move back up drive roller 108 even before the leading edge of paper 102 has quite reached stop 202, but when the leading edge of paper 102 is close enough to stop 202 that pinch roller 110 and optionally leading edge guide 116 are no longer needed to guide the leading edge of paper 102 toward stop 202.

At the same time as the leading edge of paper 102 reaches stop 202, or optionally slightly before as discussed above, angular driver 118 reverses direction, bringing pinch

roller 110 back up drive roller 108, as shown in Fig. 3. The motion of the pinch roller is preferably a rolling motion along paper 102 so that there is no rubbing of the paper on the pinch roller. Optionally, angular driver 118 goes back up drive roller 108 at a different angular speed than drive roller 108, for example it goes at a faster angular speed than drive roller 108. A trailing portion 302 of the paper, up to pinch roller 110, continues to move at the speed of drive roller 108, while a leading portion 304, between clamp 204 and the leading edge, is not moving. As a result, a middle portion 306 of the paper begins to buckle, separating from drive roller 108 between pinch roller 110 and clamp 204.

At first, shortly after the leading edge has stopped moving, middle portion 306 is very short, and cannot buckle very much without creasing. At this time, however, the paper has only been buckling for a short time, so the degree of buckling is small, and can be accommodated within the short distance of middle portion 306 without bending too sharply and creasing. As the paper continues to buckle, it needs a greater length to accommodate the buckling, but a greater length is available in middle portion 306 because pinch roller 110 is moving away from the leading edge. Depending on the characteristics of the paper, creasing can be avoided if pinch roller 110 is moving back up drive roller 108 faster than some minimum speed, for example at least as fast as drive roller 108 is turning.

Optionally, leading edge guide 116, if it exists, moves back out of the way as pinch roller 110 moves back up drive roller 108, as seen in Fig. 3 and Fig. 4. In this way, leading edge guide 116 does not rub against the back of the paper as it buckles and moves further away from drive roller 108. For example, the angular guide rotates counterclockwise around the axis of pinch roller 110, so that it clears the stack of papers.

Alternatively, leading edge guide 116 is fixed in position relative to angular driver 118, at a position such that it effectively guides the leading edge of paper 102 to stop 202, but does not rub against middle portion 306 of the paper as it buckles.

When the trailing edge of paper 102 goes through nip 106 and is free of drive roller 108, the trailing portion of the paper falls down, as shown in Fig. 5. Optionally, instead of the trailing portion of the paper falling under the influence of gravity, it is forced downward by other means, for example by moving air. If gravity is not used, then the direction shown as down in the drawings need not be directly down. It should be understood that references herein to the paper falling may also refer to these other means of moving the paper.

Because the leading portion of the paper is resting against stop 202, there is no need to guide the paper into a correct position as it falls, so there is nothing for the trailing portion of the paper to rub against as it falls. If leading edge clamp 204 exists and is holding down the leading portion of paper 102, this prevents the leading edge of paper 102 from drifting even slightly away from stop 202 as it falls. After falling, the paper lies in output tray 206 in a flipped over orientation, relative to its orientation before feeding into the flipping mechanism. From output tray 206, paper 102 is optionally moved to a place where it is further processed, for example the other side of the paper is printed. Optionally, a plurality of papers are stacked in the output tray, with the bottom of the output tray moving down to accommodate the stack, before any papers are moved out of the output tray. Alternatively, flipping the paper is the last process done to the paper, and paper 102, or a stack of flipped papers, remains in the output tray.

Figs. 6, 7, 8 and 9 show a time sequence, corresponding to Figs. 1, 2, 3 and 4, according to another exemplary embodiment of the invention. This embodiment of the invention differs from the embodiment described above, because pinch roller 110 may be fixed in position near the top of drive roller 108, and there is no angular driver 118 which moves pinch roller 110 around drive roller 108. Pinch driver 110 is, of course, free to rotate on its axis. Instead of using pinch roller 110 to hold the leading portion of paper 102 against drive roller 108 as drive roller 108 turns, there is a holder for the leading edge of paper 102, such as a suction system 616 inside drive roller 108, which holds the leading portion of paper 102 against drive roller 108.

In one embodiment of the invention, drive roller 108 rotates continuously and the feeding of the paper is synchronized with the arrival of the suction system at the nip 106, between drive roller 108 and pinch roller 110.

In some embodiments of the invention, suction system 616 is activated when sensor 114 detects the leading edge of the paper passing through nip 106. Alternatively, suction system 616 is active even before the leading edge of paper 102 is picked up by nip 106, or suction system 616 is turned on at a time when the leading edge of paper 102 is expected to go past nip 106. In these cases, optionally there is no need for sensor 114. Although Fig. 6 shows an opening in suction system 616 only at one azimuthal position at the surface of drive roller 108, optionally there are openings at the surface of drive roller 108 to provide suction at more than one azimuthal position around drive roller 108, since the leading edge of paper 102 optionally does not always contact drive roller 108 at the

same azimuthal position. Just before the leading edge of paper 102 reaches stop 202, suction system 616 releases paper 102, and the leading portion of paper 102 falls away from drive roller 108, preventing paper 102 from rubbing against drive roller 108 after the leading edge of paper 102 comes to rest against stop 202.

Alternatively, instead of or in addition to suction system 616, there are grippers, not shown in the drawings, which hold the leading portion of paper 102 against drive roller 108. However, using a suction system instead of grippers has the advantage that it is not necessary to get the grippers out of the way of stop 202 as drive roller 108 continues to turn after the leading portion of paper 102 is released.

Fig. 7 shows the leading edge of paper 102 being released by suction system 616 from drive roller 108 as the leading edge of paper 102 reaches stop 202. Fig. 8 shows paper 102 beginning to buckle drive roller 108 continues to turn, and Fig. 9 shows the paper buckling further as drive roller 108 continues to turn. The last step of the time sequence looks the same as Fig. 5, but without leading edge guide 116 or angular driver 118, showing the trailing edge of the paper released from nip 106, and the paper falling down.

Although this description and the claims refer sometimes to paper, the invention may also be used with any other printing media, and the claims cover the apparatus and the method when any printing media is used. The invention has been described in the context of the best mode for carrying it out. It should be understood that not all features shown in the drawings or described in the associated text may be present in an actual device, in accordance with some embodiments of the invention. Furthermore, variations on the method and apparatus shown are included within the scope of the invention, which is limited only by the claims. Also, features of one embodiment may be provided in conjunction with features of a different embodiment of the invention. As used herein, the terms "have", "include" and "comprise" or their conjugates mean "including but not limited to."

CLAIMS

1. A method for flipping over a printing media, comprising:

a) capturing the printing media in a nip between a driver roller and a pinch roller;

b) turning the driver roller while holding at least a leading portion of the printing media against the driver roller, so that the printing media moves forward around the driver roller;

c) releasing the leading portion of the printing media from the driver roller;

d) changing the forward velocity of the leading portion of the printing media, while the driver roller continues to move a trailing portion of the printing media caught in the nip forward, thereby causing the paper to buckle away from the driver roller;

e) releasing the trailing portion of the printing media from the nip; and

f) allowing the trailing portion of the printing media to fall freely so that it ends up in a flipped over orientation.

2. A method according to claim 1, wherein holding at least a leading portion of the printing media against the driver roller comprises moving the pinch roller around the driver roller at substantially a same angular speed as the drive roller turns, thereby holding a leading portion of the printing media in the nip between the pinch roller and the driver roller.

3. A method according to claim 2, wherein releasing the leading portion of the printing media from the driver roller includes rolling the pinch roller back around the driver roller.

4. A method according to claim 2 or claim 3, wherein changing the forward velocity comprises exerting a force on the leading portion.

5. A method according to claim 4 wherein exerting a force comprises guiding the leading edge of the printing media toward a stopping location which exerts said force as the driver roller continues to advance a trailing portion of the printing media.

6. A method according to claim 1, wherein holding a leading portion of the printing media against the driver roller comprises using suction.

7. A method according to claim 1, wherein holding a leading portion of the printing media against the driver roller comprises using a gripper.

8. A method according to any of the preceding claims, wherein changing the forward velocity of the leading portion of the printing media comprises stopping the leading portion of the printing media by having the leading edge of the printing media hit a stop.

9. A method according to claim 8, also including holding down the leading portion of the printing media with a leading edge clamp at said stop.

10. A method according to any of claims 1-7, wherein changing the forward velocity of the leading portion of the printing media comprises capturing the leading portion between two stopping rollers, and slowing down the leading portion by slowing down the turning of the stopping rollers.

11. A method according to claim 10, wherein changing the forward velocity of the leading portion comprises stopping the leading portion by stopping the turning of the stopping rollers.

12. A method according to claim 11, wherein changing the forward velocity of the leading portion comprises reversing the direction of motion of the leading portion by reversing the direction of turning of the stopping rollers.

13. Apparatus for transporting a printing media from an input location and delivering it in a flipped over orientation to an output, comprising:

a) a rotating driver roller;

b) a pinch roller, juxtaposed with the driver roller, such that a leading portion of the printing media is captured in a nip between the pinch roller and the driver roller;

c) a stopping element; and

d) an angular driver, which rolls the pinch roller around the driver roller at substantially the speed at which the driver roller turns, thereby bringing the leading portion of the printing media around the driver roller toward the stopping element while the pinch roller holds the leading portion in the nip against the driver roller, and which starts to roll the pinch roller back around the driver roller to a trailing portion of the printing media as the leading portion nears the stopping element;

wherein the stopping element, when the leading portion reaches it, causes the leading portion to move at a lower forward velocity than the forward velocity at which the trailing portion is moving, causing the printing media to buckle away from the driver roller such that the printing media does not contact the driver roller except at the nip, and the printing media falls into the output location after the trailing portion leaves the nip.

14. Apparatus according to claim 13, and including a leading edge guide associated with the pinch roller which guides the leading portion of the printing media to the stopping element.

15. Apparatus according to claim 13 or claim 14, and including a leading edge sensor which causes the angular driver to start rolling the pinch roller around the driver roller after the sensor detects that the leading edge of the printing media has reached the pinch roller.

16. Apparatus for transporting a printing media from an input location and delivering it in a flipped over orientation to an output location, comprising:

a) a rotating driver roller;

b) a pinch roller, juxtaposed with the driver roller, such that a leading portion of the printing media is captured in a nip between the pinch roller and the driver roller;

c) a stopping element; and

d) a holding mechanism which holds the leading portion against the driver roller after the leading portion is captured and when the leading portion reaches the stopping element, releases the leading portion from the driver roller, allowing the leading portion to engage the stopping element, such that the leading element moves at a lower forward velocity than a trailing portion of the printing media, caught in the nip, causing a portion

of the printing media intermediate the nip and the leading to buckle away from the driver roller such that it does not contact the driver roller except at the nip.

17. Apparatus according to claim 16, wherein the holding mechanism comprises a suction system.

18. Apparatus according to claim 16, wherein the holding mechanism comprises at least one gripper.

19. Apparatus according to any of claims 16-18, and including a leading edge sensor, which activates the holding mechanism when the sensor detects that the printing media has been or is about to be captured.

20. Apparatus according to any of claims 13-19, wherein the stopping element is fixed in place and causes the leading portion of the printing media to stop moving when the printing media hits the stopping element.

21. Apparatus according to any of claims 13-19 wherein the stopping element comprises a pair of stopping rollers which captures the leading portion of the printing media in a stopping nip between the stopping rollers.

22. Apparatus according to claim 21 wherein the stopping rollers cause the leading portion of the printing media to stop moving after they capture it.

23. Apparatus according to claim 21, wherein the stopping rollers cause the leading portion of the printing media to slow down after they capture it.

24. Apparatus according to claim 21, wherein the stopping rollers cause the leading portion of the printing media to reverse direction after they capture it.

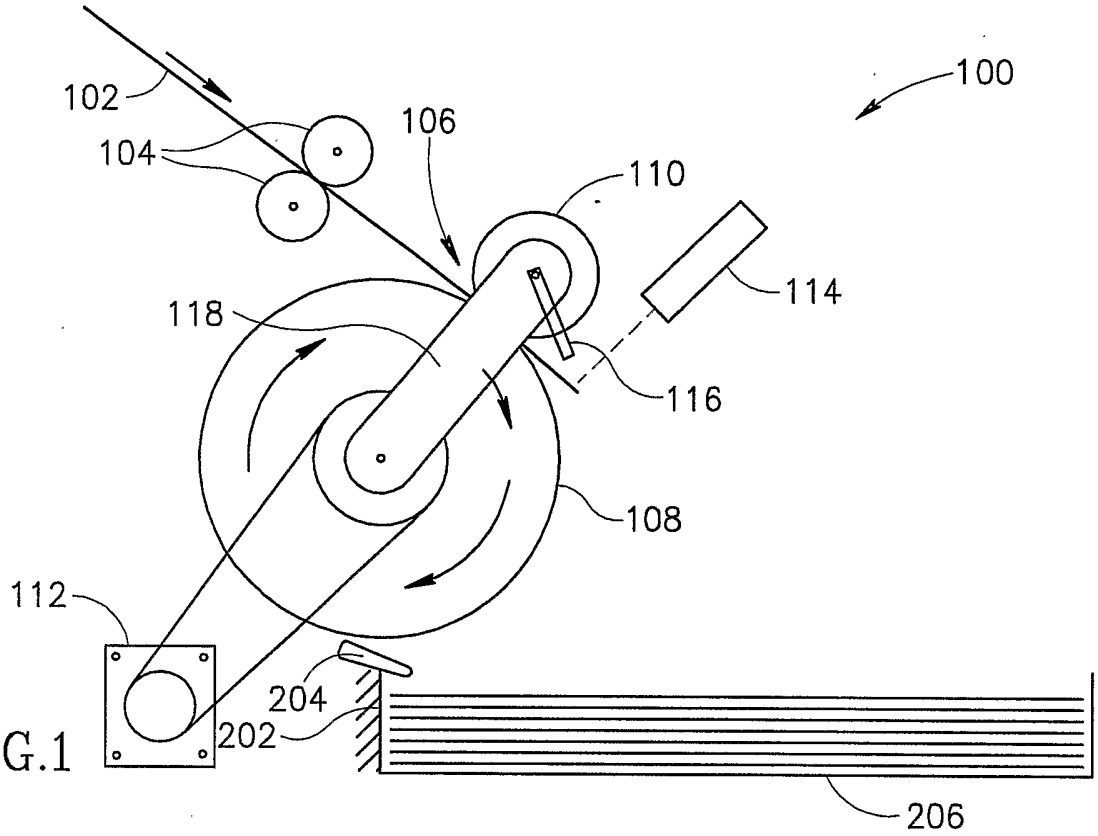

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FIG.1

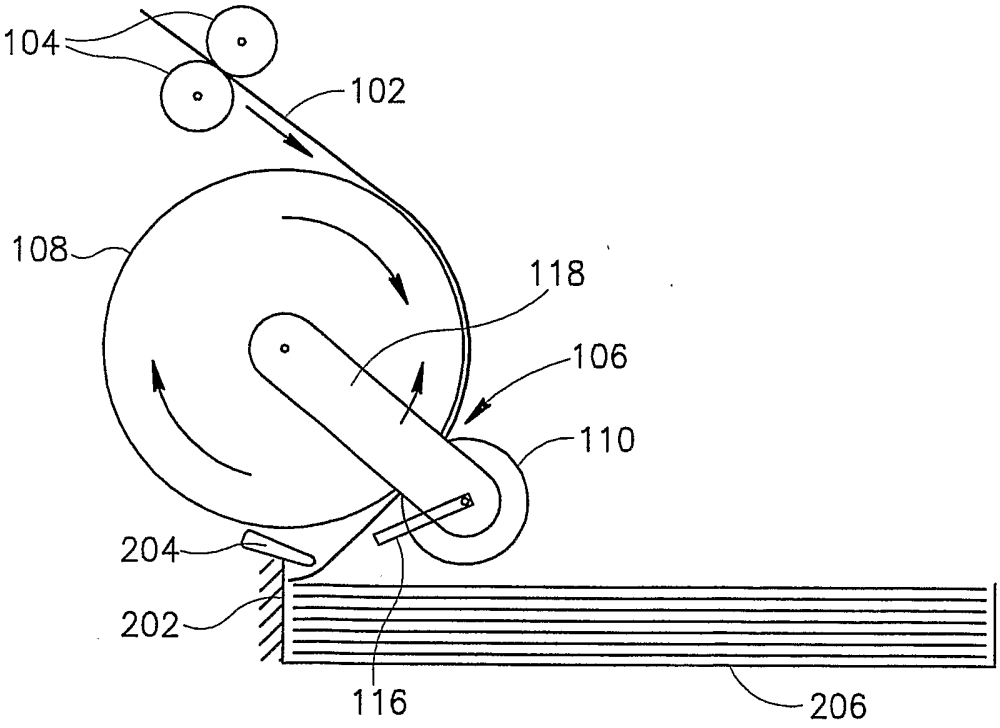
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FIG.2

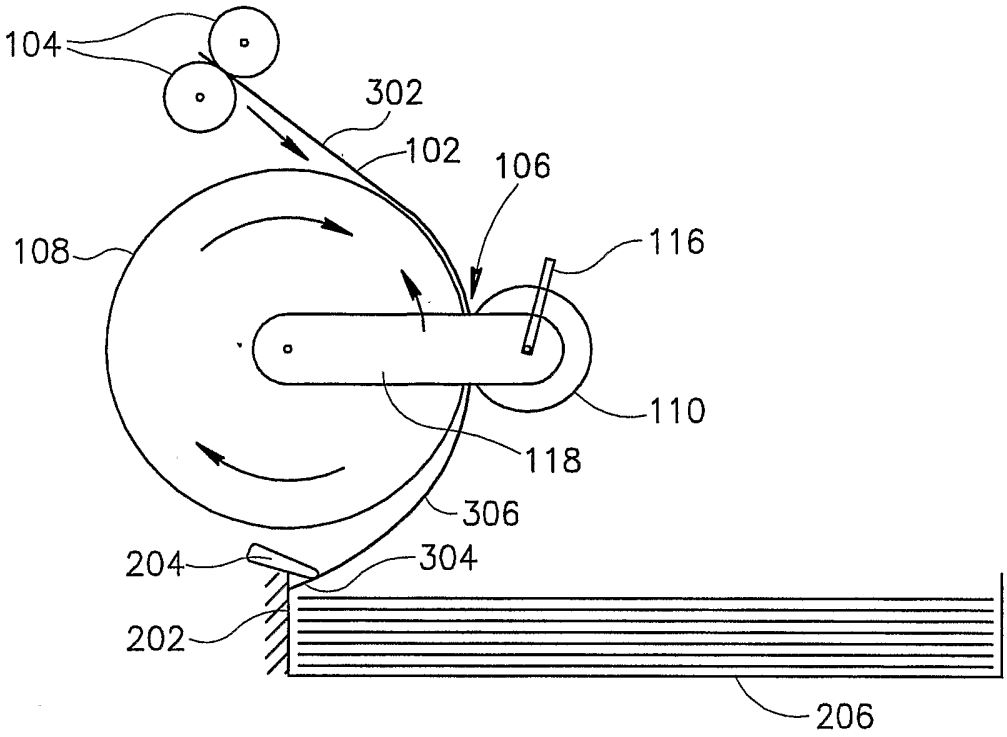
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FIG.3

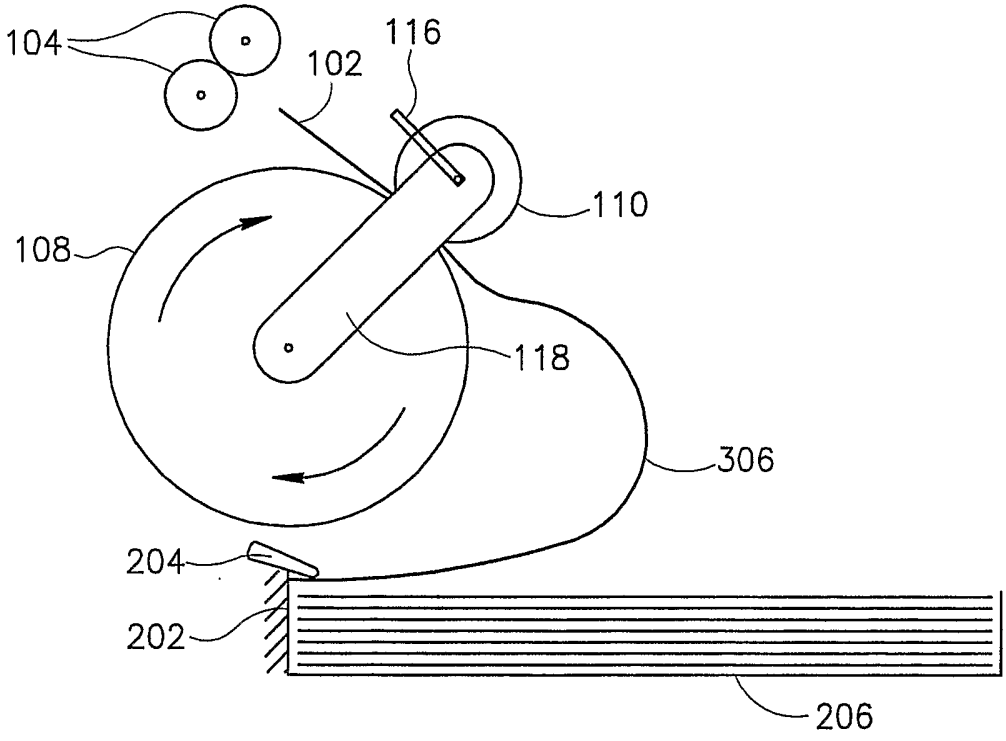
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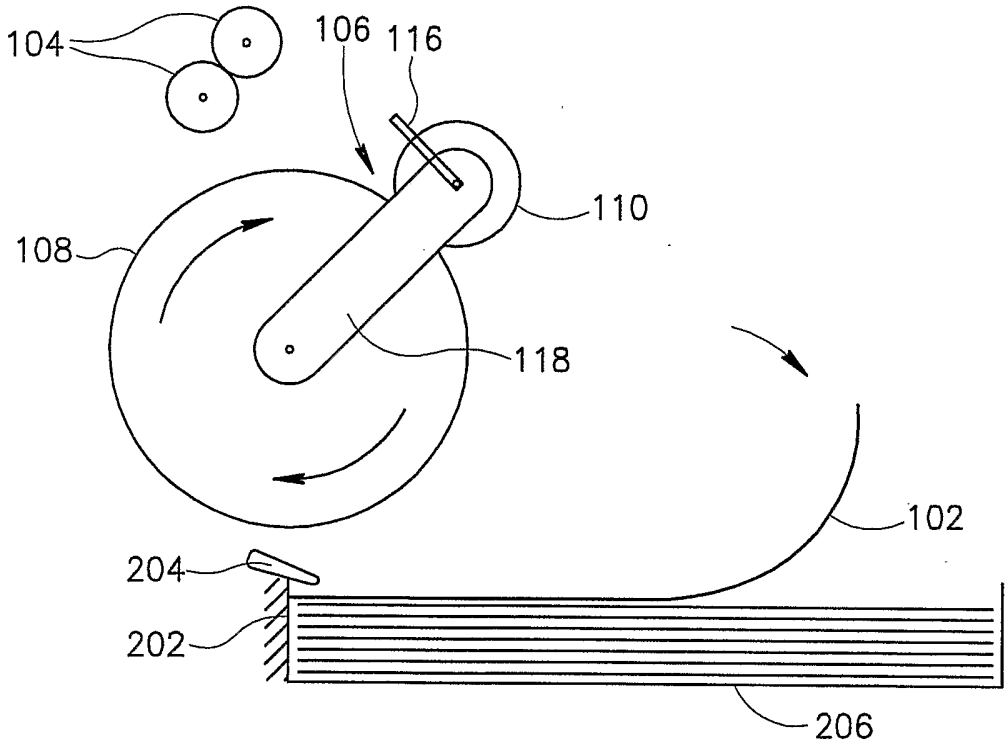
FIG.4



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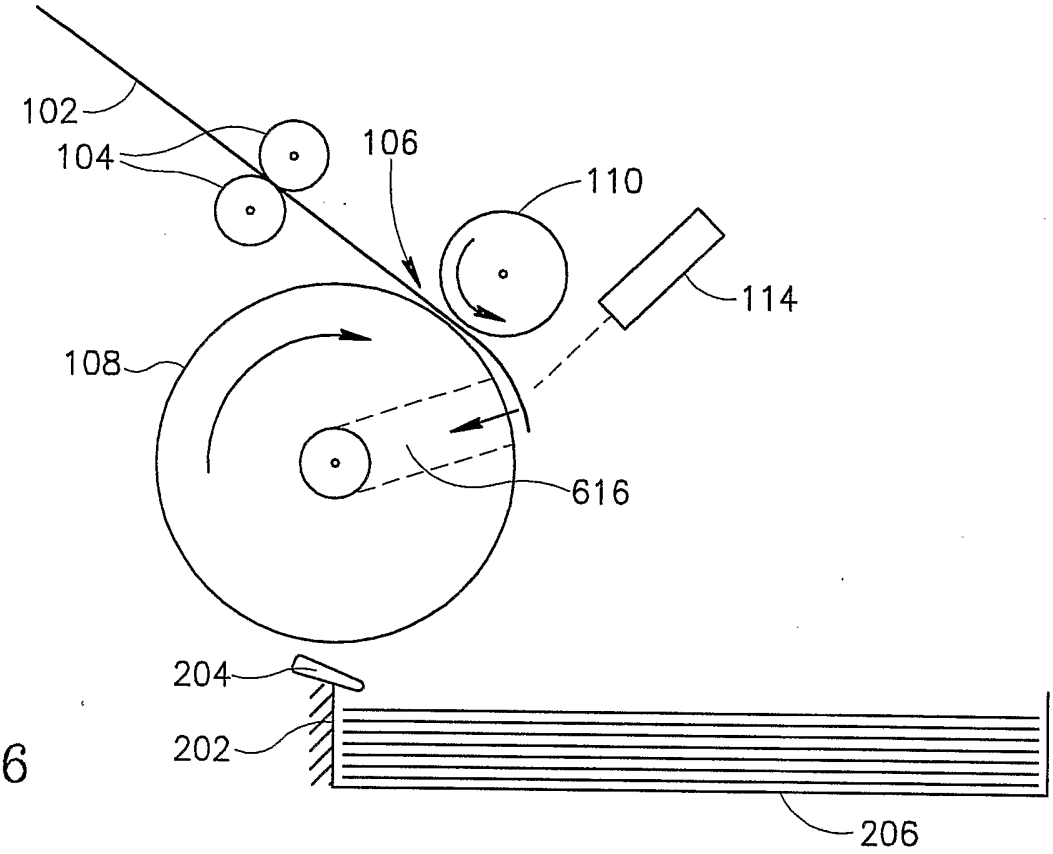
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FIG.6

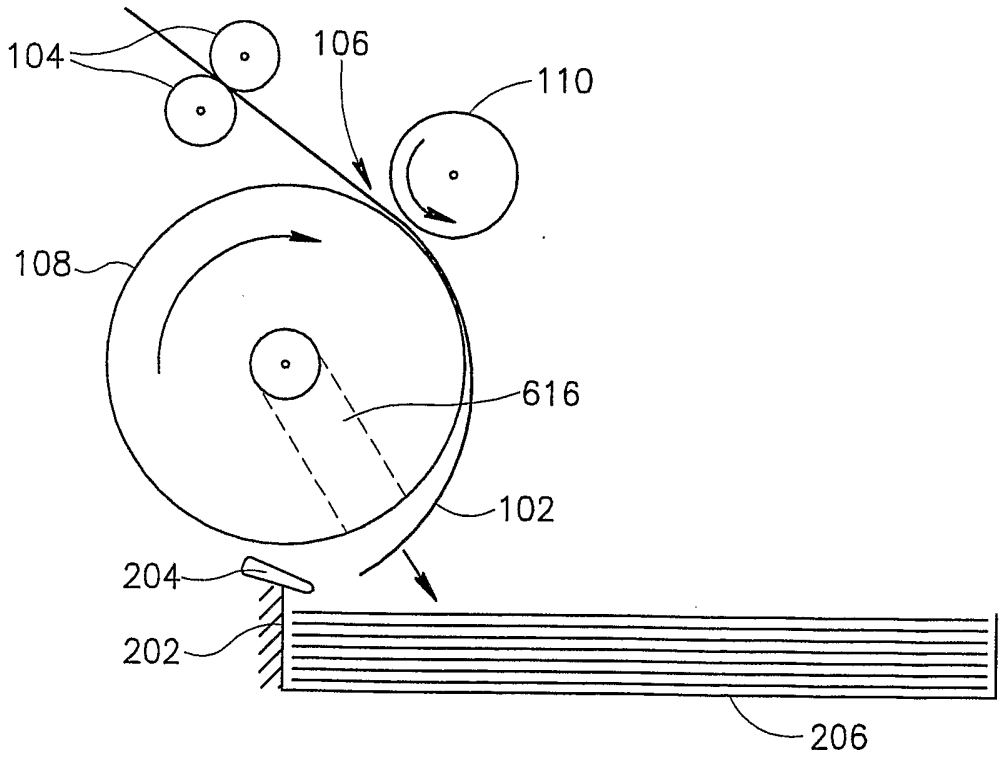
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FIG.7

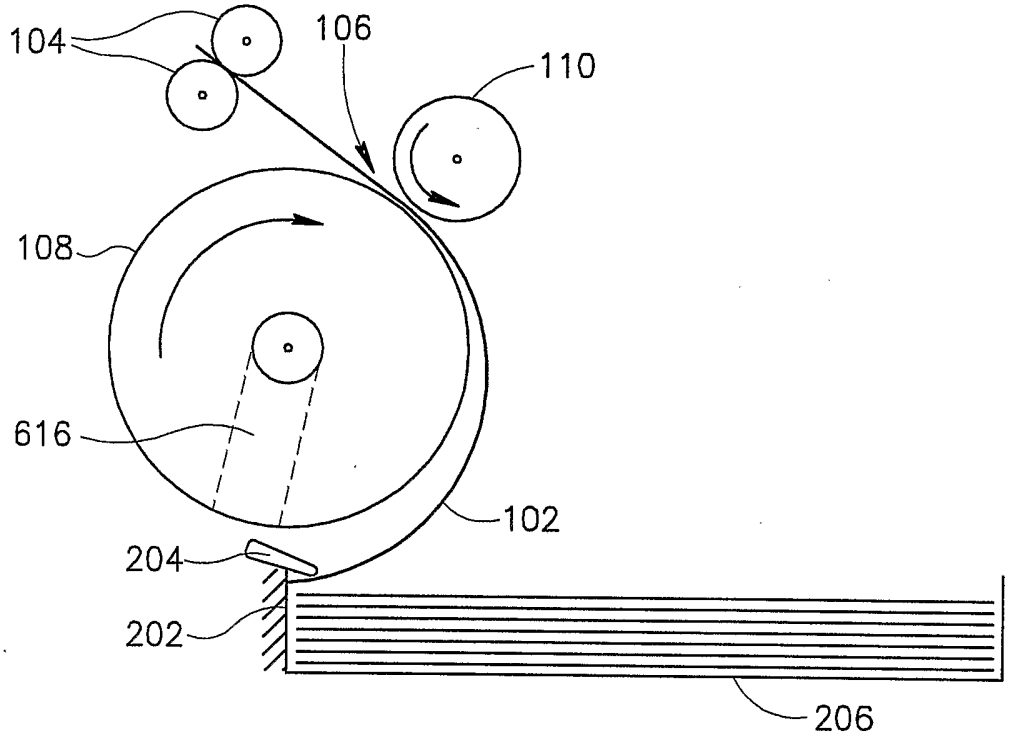
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FIG.8

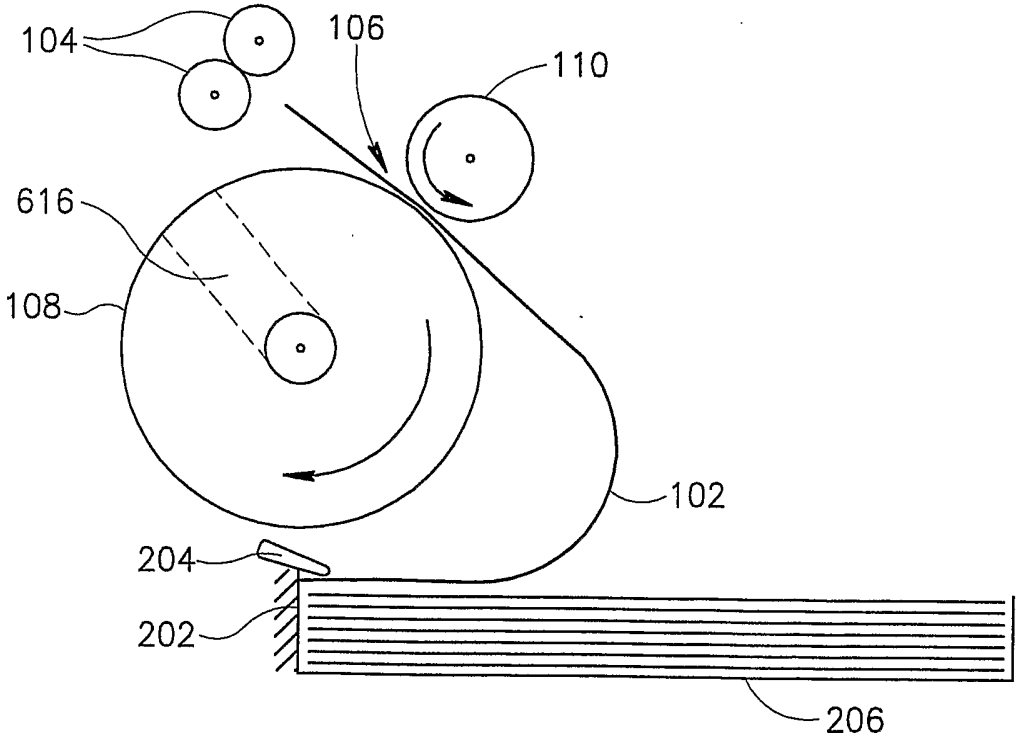
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FIG.9

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL 03/00086

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65H29/06 B65H29/24 B65H29/12 B65H29/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 858 909 A (STEMMLE DENIS J) 22 August 1989 (1989-08-22)	1-5,8, 13,15, 16,19,20
Y	column 2, line 48 -column 6, line 54; claims; figures	9
Y	US 5 409 202 A (KRAMER WILLIAM E ET AL) 25 April 1995 (1995-04-25) column 8, line 45 - line 63; figure 3	9
Y	US 5 215 298 A (DERRICK JOHN F ET AL) 1 June 1993 (1993-06-01) figure 1	9,11,12, 21-24
Y	US 5 356 263 A (MILLER CARL A) 18 October 1994 (1994-10-18) column 3, line 7 - line 26; claim 9; figures 2,2A,3C	9,11,12, 21-24

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 July 2003	12/09/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Uhlig, R

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL 03/00086

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 4 466 605 A (HABERSTROH MARKUS ET AL) 21 August 1984 (1984-08-21) column 3, line 55 -column 4, line 10; figures 3A,3B,3C	1,6,8, 16,17,20 7,18
Y	DE 43 24 382 A (B & B MASCHINENBAU GMBH) 26 January 1995 (1995-01-26) figures 3,4	7,18
A	US 6 302 393 B1 (HARTY MICHAEL J ET AL) 16 October 2001 (2001-10-16) column 18, line 36 - line 58; figures 21,22	12,22-24

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL 03/00086

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4858909 A	22-08-1989	NONE	
US 5409202 A	25-04-1995	BR 9501119 A	26-12-1995
		CA 2140413 A1	19-09-1995
		DE 69507354 D1	04-03-1999
		DE 69507354 T2	17-06-1999
		EP 0673868 A2	27-09-1995
		ES 2126213 T3	16-03-1999
		JP 2821097 B2	05-11-1998
		JP 8085663 A	02-04-1996
US 5215298 A	01-06-1993	JP 3400490 B2	28-04-2003
		JP 6056325 A	01-03-1994
		JP 6080293 A	22-03-1994
		US 5263703 A	23-11-1993
US 5356263 A	18-10-1994	NONE	
US 4466605 A	21-08-1984	DE 3131388 A1	24-02-1983
		AT 382846 B	10-04-1987
		AT 303082 A	15-09-1986
		CH 657348 A5	29-08-1986
		FR 2510979 A1	11-02-1983
		GB 2103587 A ,B	23-02-1983
		IT 1152341 B	31-12-1986
		JP 1518596 C	07-09-1989
		JP 58036850 A	03-03-1983
		JP 63065579 B	16-12-1988
		SE 452741 B	14-12-1987
		SE 8204534 A	02-08-1982
DE 4324382 A	26-01-1995	DE 4324382 A1	26-01-1995
US 6302393 B1	16-10-2001	BR 9913845 A	12-06-2001
		CA 2343765 A1	23-03-2000
		CN 1106336 B	23-04-2003
		EP 1149038 A1	31-10-2001
		PL 346560 A1	11-02-2002
		RU 2200695 C2	20-03-2003
		WO 0015530 A1	23-03-2000
		US 6331000 B1	18-12-2001
		US 2002033359 A1	21-03-2002