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Remarks:

Amended claims in accordance with Rule 137(2) EPC.

(54) **Sheet flipping device**

(57) The invention relates to a sheet flipping device, comprising a receiving member (101) for receiving a sheet (111), a flipping volume being the volume which in operation is defined by the flipping movement of the sheet, a flipping element (102) for flipping the sheet around an axis of rotation within the flipping volume onto the receiving member, and further comprises a discharge

element (150,151) arranged adjacent to said flipping volume, the discharge element having a base extending in a direction substantially perpendicular to the direction of the axis of rotation and having multiple electrodes with an end portion extending in a direction towards the flipping volume. The invention also relates to a sheet stacking device and an image reproduction apparatus.

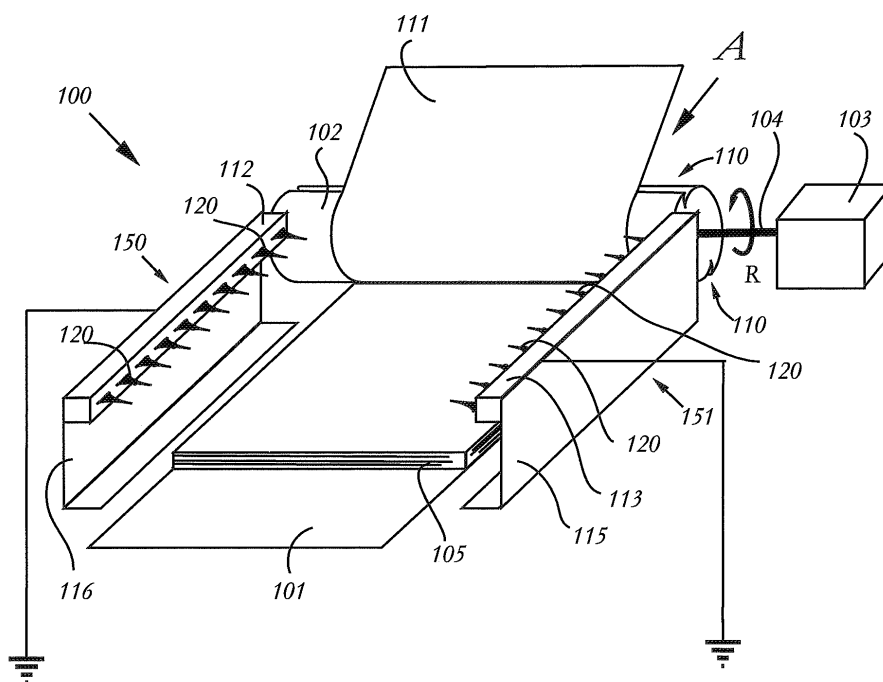


Figure 3A

Description

[0001] The invention relates to a sheet flipping device, comprising a receiving member for receiving a sheet, a flipping volume being substantially the volume which in operation is defined by the flipping movement of the sheet, a flipping element for flipping the sheet around an axis of rotation within the flipping volume onto the receiving member. The invention also relates to a sheet stacking device and a image reproduction apparatus.

[0002] A device of this kind is described in FR 2 760 733. The device uses a flipping wheel to stack sheets on a receiving member in a flipped orientation. The flipping wheel comprises slits at its circumference to accommodate portions of a sheet. An abutment is provided to release the sheets from the slit onto the receiving member. However, it is a disadvantage of this known device that certain types of sheets, in particular floppy sheets with low stiffness in the direction of rotation, do not roll out correctly onto the receiving member, resulting in a less orderly stack or may even result in device blocks, such as paper jams.

[0003] It is an object of the invention to improve the roll out of sheets onto the receiving member for flipping devices. To this end a sheet flipping device is provided which further comprises a discharge element arranged adjacent to said flipping volume, having a base extending in a direction substantially perpendicular to the direction of the axis of rotation said discharge element having multiple electrodes having an end portion extending in a direction towards the flipping volume.

It is observed that the implementation of such a discharge element, which is arranged adjacent to the flipping volume, surprisingly increases the reliability of the flipping device as a result of better roll out of flipped sheets. Even without any physical contact between the discharge elements and the flipping sheets, the roll out of sheets, even of very floppy sheets, improves significantly.

[0004] In another embodiment of the device according to the invention the multiple electrodes each have a sharp ending pointing towards the flipping volume. It has been observed that sharp endings which point towards the flipping volume further increase the reliability of the sheet flipping device by further decreasing the risk of a erroneous roll out of a flipping sheet.

[0005] In a further embodiment of the device according to the invention, the multiple electrodes each have a top angle of less than 30°. It has been found that a top angle of less than 30° is sharp enough for situations in devices as presently presented, i.e. used materials and occurring distances to overcome roll out problems sufficiently. It is preferred to implement top angles of 15° or less.

[0006] In another embodiment of the device according to the invention, the discharge element is electrically connected to earth potential. It has been observed that a connection to earth of the discharge element declines the risk of collapsing sheets during roll out after or during flipping.

[0007] In another embodiment of the device according to the invention, said multiple electrodes comprise pin-electrodes. Pin-electrodes are usually relatively stiff with respect to flipping sheets. Discharge elements that are provided with pin-electrodes adjacent to the flipping volume have a positive influence on the reliability of the flipping device. The construction of pin-electrodes can be cost-efficient as they may be constructed from a single workpiece by milling, e.g. stainless steel or any other electrically conductive material or material with an electrically conductive surface.

[0008] In an embodiment of the device according to the invention, each of said multiple electrodes comprise a fibre organ provided with a conductive outer surface. The fibre organ provides a flexible base for the electrically conductive outer surface. The fibre does not need to be electrically conductive itself. The mechanical flexibility of this type of electrodes provides additional flexibility in the positioning of the discharge element with respect to handling different sheet sizes. Although it is preferred to arrange the discharge elements such that the end-portions are positioned just outside of the flipping volume, this type of mechanical flexible electrodes do not disturb the formation of a straight stack when the end-portions are positioned slightly inside the flipping volume. If a sheet touches a small portion of such electrode it will flex automatically and continue its flipping movement almost undisturbed.

The electrically conductive outer surface may comprise carbon or any other suitable conductive material.

[0009] In another embodiment of the device according to the invention, the discharge element is arranged moveably, such that the lateral position with respect to the sheet is adaptable. By enabling a laterally adaptable positioning of the discharge element, in particular of the end-portions of the electrodes thereon, a variety of sheet sizes may be handled. As it is preferred to arrange the end-portions of the electrodes just outside of the flipping volume in order not to disturb the flipping sheets' movement and to be close enough to function efficiently.

The adaptation of lateral position may be manual or automated in accordance with a measurement or other electrical signal, for example a signal from a printer controller of a printer coupled to such a flipping device.

[0010] In another embodiment of the device according to the invention, the sheet flipping device further comprises a module for generating an airflow in the direction of the flipping sheets' movement such that the flipping of the sheet is assisted during at least a part of the flipping movement of the sheet. A module for generating an airflow may for example comprise a ventilator that blows in the direction of the sheet's flipping movement, or a suction device that sucks the sheet during at least a part of the flipping movement in the direction of flipping. A combination of sucking and blowing or other modules for generating airflow are also implementable.

[0011] The invention will now be explained with reference to the following examples and figures.

Fig. 1 is a schematic perspective view showing a sheet stacking device comprising a flipping device;
 Fig. 2 is a schematic perspective view showing a sheet stacking device comprising a flipping device in operation;

Fig. 3A and 4A are schematic perspective views of embodiments of a sheet stacking device comprising a flipping device according to the invention;

Fig. 3B and 4B are schematic top view close-ups of electrodes for use in the embodiments of a sheet stacking device comprising a flipping device according to the invention;

Fig. 5 is a schematic view showing a flipping sheet in the flipping volume;

Fig. 6 is a schematic side view of multiple embodiments of a flipping device according to the invention;

[0012] Fig. 1 is a schematic perspective view showing a sheet stacking device comprising a flipping device. This sheet stacking device 200 comprises a receiving member 201 to receive sheets to form a stack of sheets 205. The sheet stacking device further comprises a rotatable flipping element, such as a flipping wheel 202. This flipping wheel has two slits 210 arranged around its circumference. These slits 210 are devised such that sheets which are fed towards the flipping wheel 202 in input direction I and are at least partly received by the slits 210. The flipping wheel 202 is rotatably driven by means of drive motor 203 and coupled drive shaft 204. By rotating the flipping wheel 202 in rotational direction R, the sheets are flipped over and arranged on top of the receiving member 201 or previously formed stack 205. The sheet stacking device has a relative high degree of erroneous formed stacks.

[0013] Fig. 2 shows a problem during operation of the sheet stacking device resulting in an erroneous formed stack. The leading edge of the sheet has been received by the slit 210 and driven to be flipped. During the final part of the flipping of the sheet, the sheet has a problem rolling out onto the top of the stack 205 formed on the receiving member 201. In particular floppy sheets with relative low stiffness in the direction of rotation tend to collapse onto itself during flipping, preventing a smooth roll out onto the top of the stack 205. This results in a less well-aligned stack of sheets and may even result in the blocking of the device.

[0014] Fig. 3A is a schematic perspective view of an embodiment of a sheet stacking device comprising a flipping device according to the invention. The stacking device 100 comprises a rotatable sheet flipping wheel 102 as a sheet flipping element. This sheet flipping wheel 102 has two slits 110 at its circumference to accommodate at least a portion of an incoming sheet. The sheet flipping wheel 102 is connected to a drive motor 103 via a drive shaft 104. A sheet receiving member 101 is provided to accommodate a sheet of a stack of sheets 105. The height of the sheet receiving member 101 relative to the flipping wheel 102 is adaptable to enable an enlarged

sheet accommodation capacity while sheets are controllably released onto the top of the receiving member 101 or an already formed stack of sheets 105. Alternatively the sheet receiving member 101 may have a fixed height relative to the flipping wheel 102.

The sheet flipping device is further provided with two discharge elements 150, 151 arranged adjacent to the flipping volume. This flipping volume is substantially the volume through which the sheet 111 is actually moved during its flipping movement in operation from its initial position to its flipped position on top of the receiving member 101 or the previously formed stack 105. The discharge elements 150, 151 have bases 112, 113 extending in a direction substantially perpendicular to the direction of the axis of rotation of the flipping wheel 102. The discharge elements 150, 151 have multiple electrodes 120 arranged on the bases 112, 113 having an end portion extending in a direction towards the flipping volume. The discharge elements 150, 151 are mounted on an apparatus frame (not shown) via frame mounts 115, 116.

In operation an incoming sheet is fed towards the sheet flipping wheel 102 in direction A from a supply or any sheet processing unit (not shown). In the illustrated situation, the leading edge portion of sheet 111 has been accommodated in slit 110, rotated in direction of rotation R by driving the driving motor 103 for approximately a half revolution. At this point the leading edge portion of the sheet 111 is released from the slit 110 by means of an abutment (not shown) which is arranged between two segments of the flipping wheel 102. By rotating the flipping wheel 102 further, the sheet 111 will be released and accommodated on top of the previously formed stack 105 in a flipped orientation with respect to its original orientation.

The electrodes 120 of the discharge elements 150, 151 have a sharp ending, pointing towards the flipping volume to enable a discharge during the flipping of a sheet 111. The electrodes 120 are electrically conductive. Electrically conductive electrodes 120 are electrically connected to the bases 112, 113. The bases 112, 113 are connected to earth potential. The discharge element 150, 151 is constructed as an integral element formed from a single workpiece, e.g. stainless steel or any other electrical conductive material but may alternatively also be constructed as a modular assembly wherein the electrodes 120 are individually mounted on the base 112, 113.

[0015] Fig. 3B is a schematic top view close-up of an electrode for use in the sheet stacking device of Fig. 3A. The electrode 120 and base 113 are formed from a single piece of stainless steel by milling. The top angle α must be highly curved, such that it is sharp enough to enable a discharge, in this case smaller than 30° , but preferably less than 15° .

[0016] Fig. 4A is a schematic perspective view of an embodiment of a sheet stacking device comprising a flipping device according to the invention. It generally equals the device as presented in Fig. 3, but in particular the

discharge elements are implemented with fibre electrodes 130. The fibre electrodes 130 are mounted on the bases 112, 113 of the discharge elements 150, 160. Each fibre electrode 130 comprises a flexible fibre organ provided with a conductive outer surface. Fibre electrodes 130 may be mounted on the bases 112, 113 individually or in groups.

[0017] Fig. 4B is a schematic top view close-up of an electrode for use in the sheet stacking device of Fig. 4A. The fibre electrode 130 is mounted on base 113 by means of a fibre organ 131, which is anchored in the base 113. The flexible fibre organ 131 is provided with an electrically conductive surface layer 135. The electrically conductive outer surface 135 is connected to earth potential. In practise the fibre electrode 130 is taller than illustrated in Fig. 4B, similar to a flexible needle or hair-like object. The fibre electrode 130 is mounted individually on the base 113, but may alternatively be mounted in groups of clusters of fibre electrodes 130. In that case the connection with earth potential may also be collectively.

[0018] Fig. 5 is a schematic view showing a flipping sheet in the flipping volume. A sheet 11 that is flipped using a sheet flipping device according to the invention (not shown) is moved through a flipping volume 10. This flipping volume 10 is substantially the volume through which the sheet 11 is actually moved during its flipping movement in operation from its initial position 11 to its flipped position 11'. The flipping element (not shown) flips the sheet 11 around axis of rotation, indicated as the dashed bold line in rotational direction R. The flipping volume 10 is span by the accumulated positions of the sheet 11 during its flipping movement towards position 11'. The flipping volume 10 is indicated by means of the dashed lined volume.

In the flipping device according to the invention, the discharge elements are arranged adjacent to the flipping volume. In practise a variety of sheet sizes may be processed and stacked. Therefore the discharge elements are generally arranged adjacent to the flipping volume of the sheet size with the largest width. If the end portions of the electrodes are sharp enough, the electrodes will still enable a discharge to smaller sheet sizes.

Alternatively, the discharge elements may be arranged in a moveable fashion, such that the lateral position of the discharge elements may vary in dependence with the actual sheet size.

[0019] Fig. 6 is a schematic side view of multiple embodiments of a flipping device according to the invention. Fig. 6A illustrates the embodiment wherein the discharge element 150 is arranged along a substantial length of the receiving member 101. This embodiment is further illustrated in Fig. 3.

Fig. 6B illustrates the embodiment wherein the discharge element 150 is arranged on a relatively short stretch on a relatively high position with respect to the flipping volume 10.

Fig. 6C illustrates the embodiment wherein the discharge

element 150 is arranged along a substantial length of the receiving member 101 at a downward slope with respect to the receiving member 101. This embodiment is further illustrated in Fig. 4.

Fig. 6C illustrates the embodiment wherein the discharge element 150 is arranged along a substantial length of the receiving member 101 at an upward slope with respect to the receiving member 101.

[0020] The illustrated embodiments of Fig. 6 A-D may be implemented with any of the previously described electrodes. It will be clear for the person skilled in the art that any combination or iteration of the presented embodiments may produce a working embodiment.

[0021] End-portions of electrodes may extend slightly into the flipping volume 10 thereby slightly toughing the flipping sheets, but preferably the end-portions are arranged just outside adjacent to the flipping volume.

Claims

1. Sheet flipping device, comprising a receiving member for receiving a sheet, a flipping volume being substantially the volume which in operation is defined by the flipping movement of the sheet, a flipping element for flipping the sheet around an axis of rotation within the flipping volume onto the receiving member, **characterised in that** it further comprises a discharge element arranged adjacent to said flipping volume, the discharge element having a base extending in a direction substantially perpendicular to the direction of the axis of rotation and having multiple electrodes with an end portion extending in a direction towards the flipping volume.
2. Sheet flipping device according to claim 1, wherein the multiple electrodes each have a sharp ending pointing towards the flipping volume.
3. Sheet flipping device according to claim 2, wherein the multiple electrodes each have a top angle of less than 30°.
4. Sheet flipping device according to any one of preceding claims, wherein the discharge element is electrically connected to earth potential.
5. Sheet flipping device according to any one of preceding claims, wherein said multiple electrodes comprise pin-electrodes.
6. Sheet flipping device according to any one of preceding claims, wherein each of said multiple electrodes comprise a fibre organ provided with a conductive outer surface.
7. Sheet flipping device according to claim 6, wherein the conductive outer surface comprises carbon.

8. Sheet flipping device according to any one of preceding claims, wherein the discharge element is arranged moveably, such that the lateral position with respect to the sheet is adaptable. 5
9. Sheet stacking device, comprising a sheet flipping device according to any one of claims 1 - 8.
10. Image reproduction apparatus comprising a sheet stacking device according to claim 9. 10

9. Sheet stacking device (100), comprising a sheet flipping device according to any one of claims 1 - 8.
10. Image reproduction apparatus comprising a sheet stacking device according to claim 9.

Amended claims in accordance with Rule 137(2) EPC.

1. Sheet flipping device, comprising a receiving member (110) for receiving a sheet, a flipping volume (10) being substantially the volume which in operation is defined by the flipping movement of the sheet, a flipping element (102) for flipping the sheet around an axis of rotation (R) within the flipping volume onto the receiving member (101), **characterised in that** it further comprises a discharge element arranged adjacent to said flipping volume, the discharge element having a base (113) extending in a direction substantially perpendicular to the direction of the axis of rotation and having multiple electrodes (130) with an end portion extending in a direction towards the flipping volume. 15 20 25 30
2. Sheet flipping device according to claim 1, wherein the multiple electrodes (130) each have a sharp ending pointing towards the flipping volume (10). 35
3. Sheet flipping device according to claim 2, wherein the multiple electrodes each have a top angle of less than 30°. 40
4. Sheet flipping device according to any one of preceding claims, wherein the discharge element is electrically connected to earth potential. 45
5. Sheet flipping device according to any one of preceding claims, wherein said multiple electrodes comprise pin-electrodes. 50
6. Sheet flipping device according to any one of preceding claims, wherein each of said multiple electrodes comprise a fibre organ (131) provided with a conductive outer surface (135). 55
7. Sheet flipping device according to claim 6, wherein the conductive outer surface comprises carbon.
8. Sheet flipping device according to any one of preceding claims, wherein the discharge element is arranged moveably, such that the lateral position with respect to the sheet is adaptable.

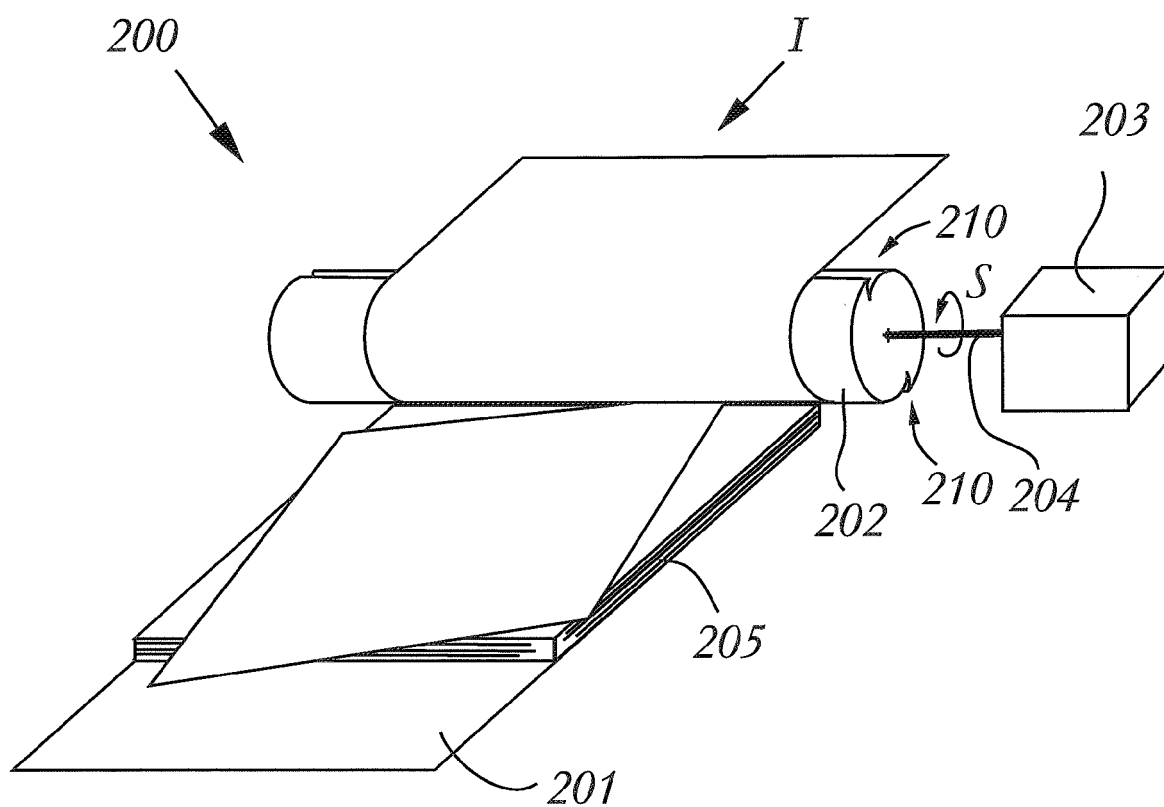


Figure 1

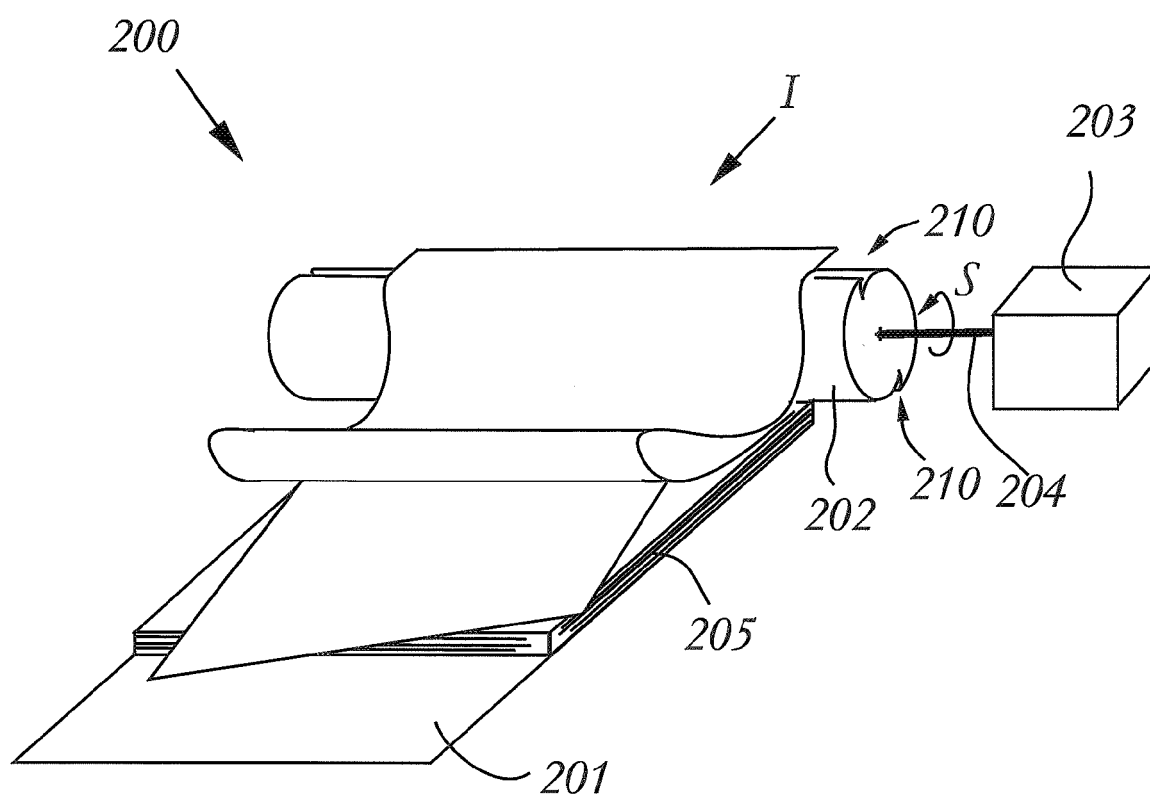


Figure 2

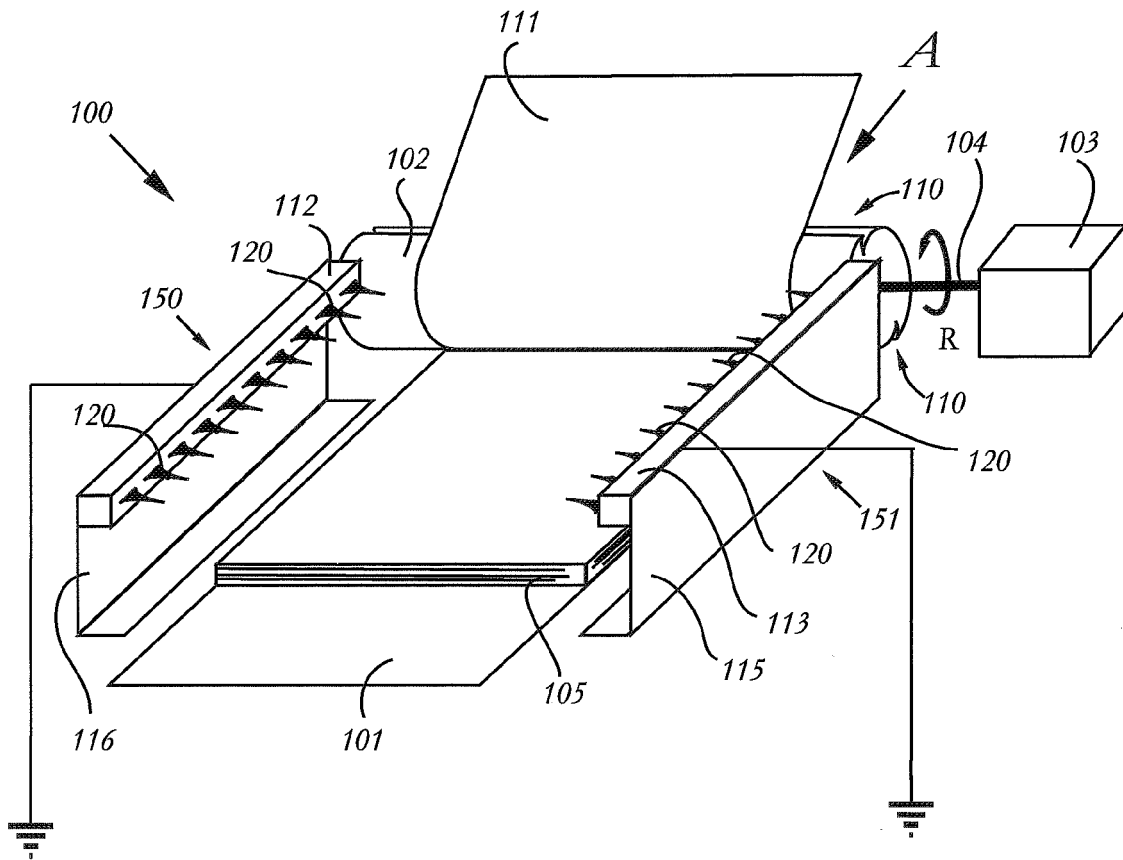


Figure 3A

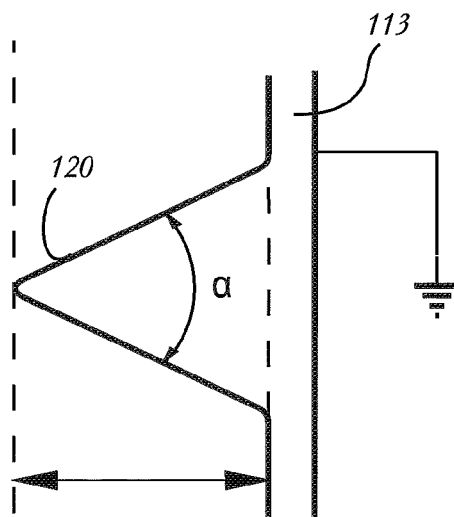


Figure 3B

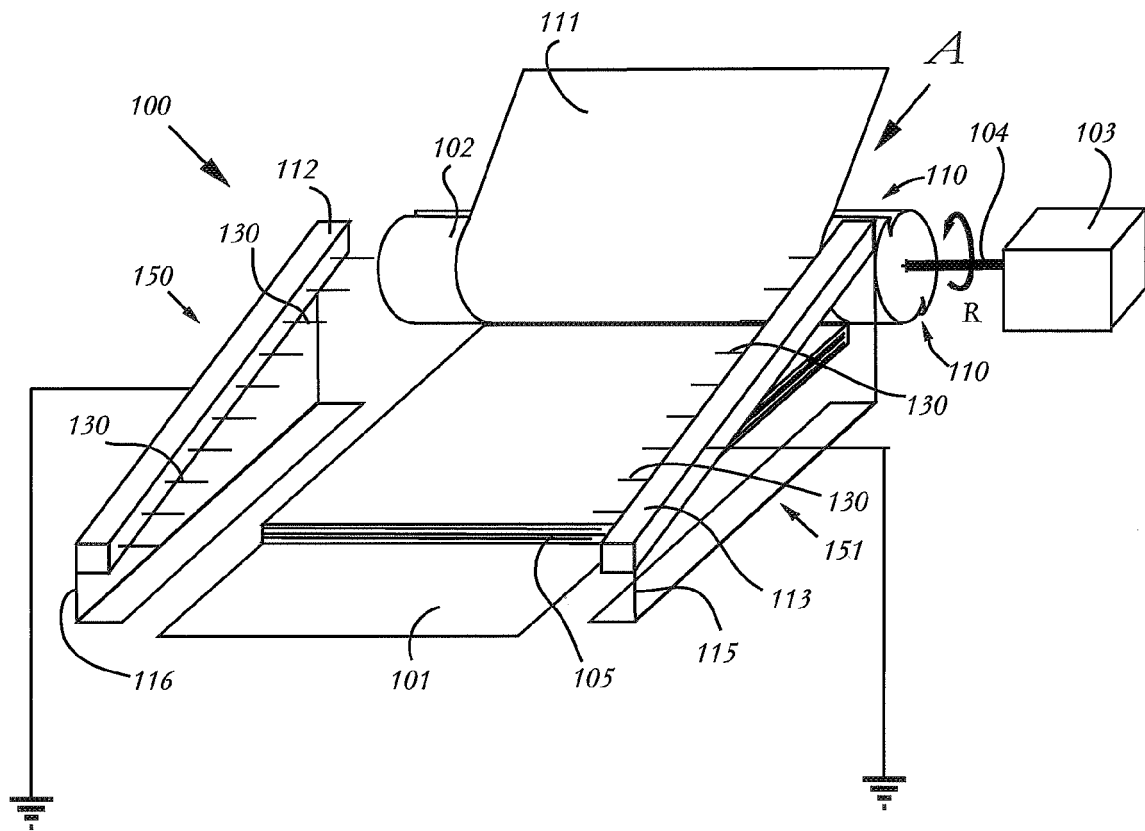


Figure 4A

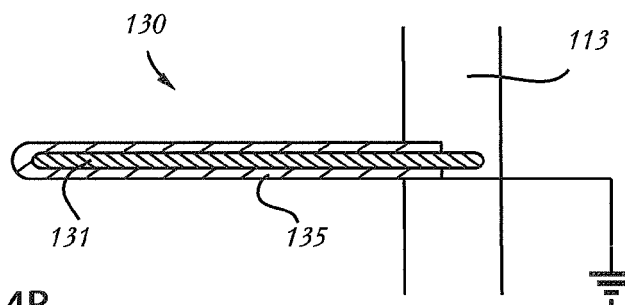


Figure 4B

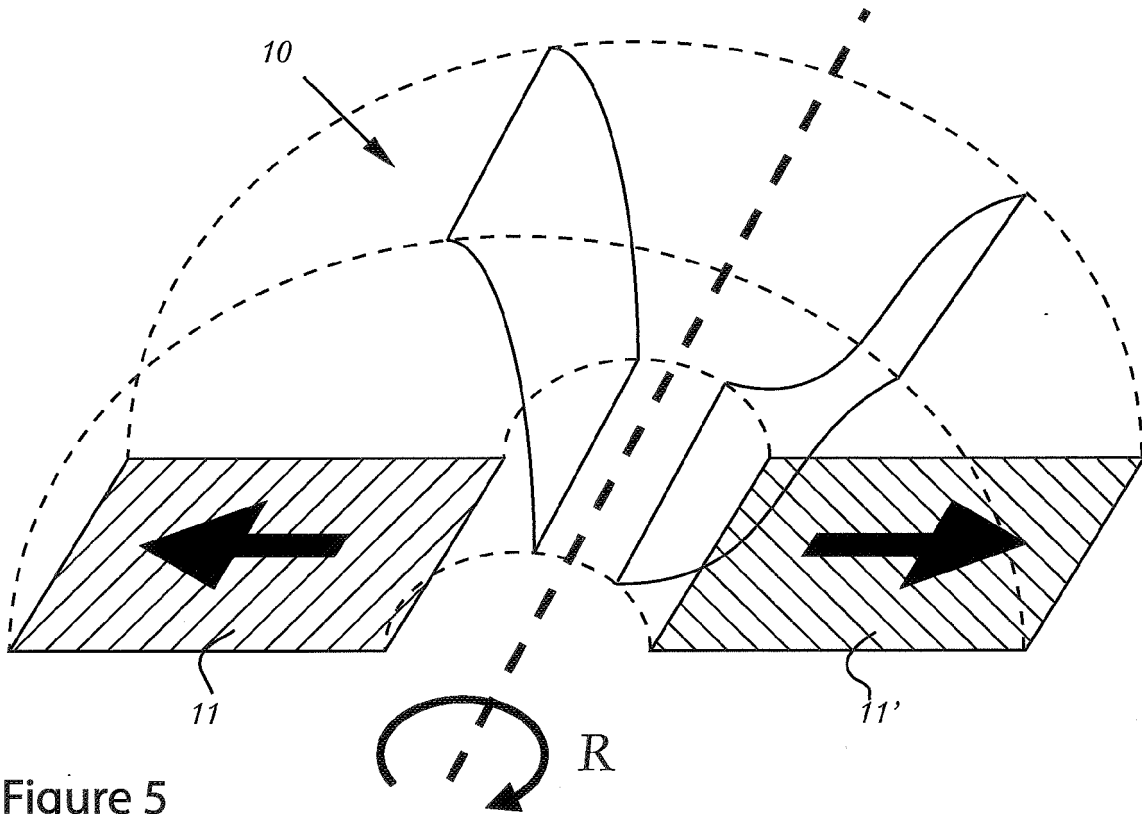


Figure 5

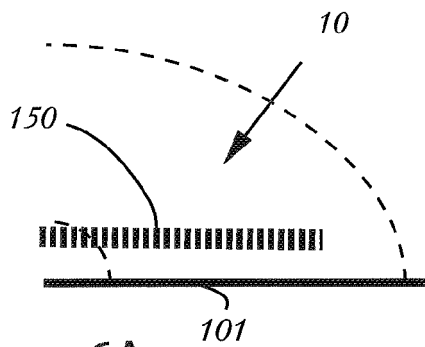


Figure 6A

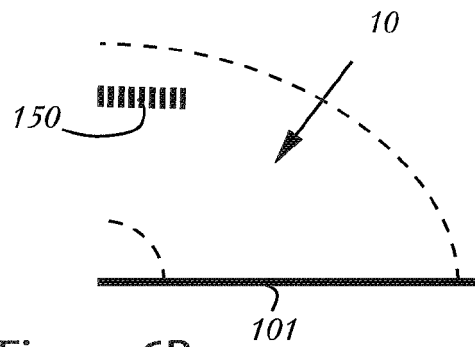


Figure 6B

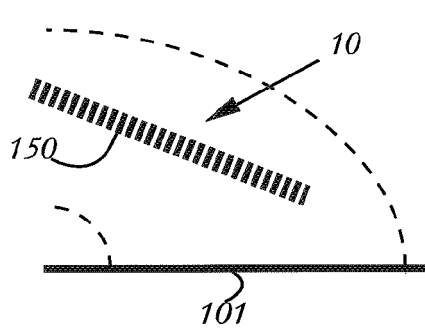


Figure 6C

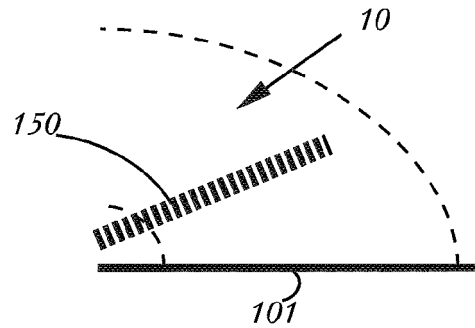


Figure 6D



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 07 12 1094

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 57 145765 A (TOKYO SHIBAURA ELECTRIC CO) 8 September 1982 (1982-09-08) * abstract *	1,4	INV. B65H29/40
A	US 4 501 418 A (ARIGA YOSHIO [JP] ET AL) 26 February 1985 (1985-02-26) * column 4, lines 55-60; figure 3 *	1,4	
D,A	FR 2 760 733 A1 (C P BOURG SA [BE]) 18 September 1998 (1998-09-18) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 January 2008	Examiner Stroppa, Giovanni
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EP 07 12 1094

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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