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(54) A sheet feed method, a sheet feeder, and an image forming apparatus incorporating the said feeder

(57) The invention pertains to sheet feed method for use in a sheet feeder (400) having a sheet stacking unit (401,451) with a bottom plate (403) to support a sheet bundle (S) comprising blowing air against a side edge of the sheet bundle near the topmost sheets of the bundle, thereby lifting these sheets from the bundle, separating the uppermost sheet from the bundle, conveying this sheet away from the bundle, wherein the method further comprises assisting the said lifting of the sheets when the bundle (S) is nearly depleted by forcing an element (420) situated underneath the bundle to push against the bundle solely when air is blown against the side edge of the bundle. The invention also pertains to a sheet feeder (400) suitable for applying the said method and an imaging apparatus incorporating the said sheet feeder (400).

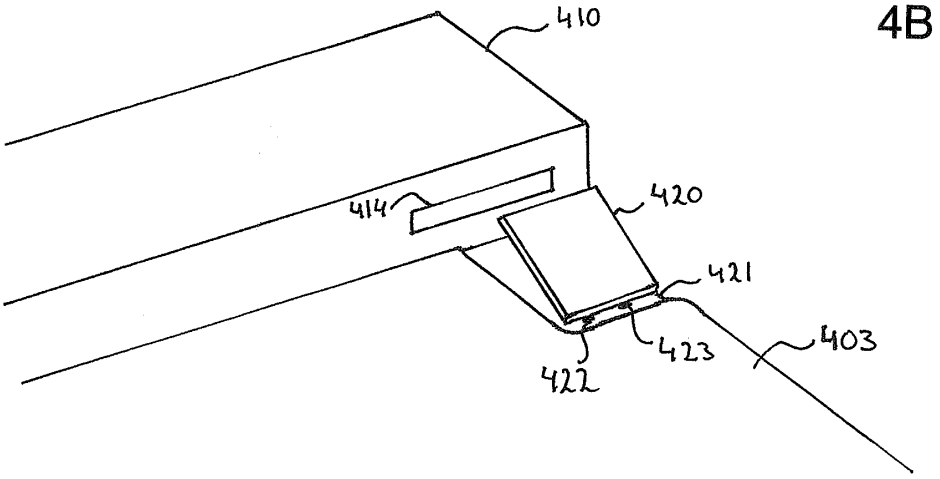

FIG. 4

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Description

[0001] The invention pertains to s sheet feed method for use in a sheet feeder having a sheet stacking unit with a bottom plate to support a sheet bundle comprising blowing air against a side edge of the sheet bundle near the topmost sheets of the bundle, thereby lifting these sheets from the bundle, separating the uppermost sheet from the bundle, and conveying this sheet away from the bundle. The invention also pertains a sheet feeder and an imaging apparatus incorporating the said feeder.

[0002] A sheet feed method according to the preamble is known from US patent application 2004/0089994 A1. This method has been devised in order to be able and reliably feed a very broad range of recording media from the same sheet stacking unit. Nowadays, in printing rooms there are growing requests to form images on cardboard, tracing paper, al sorts of coated media etc. Many of those media have very smooth surfaces and with sheet feeding methods based on friction, mis-feeds and double-feeds occur occasionally. In order to mitigate these problems, the known method handles the sheet feeding by firstly blowing air from a side edge of a paper bundle, causing a lift off of the uppermost sheets of the said bundle. Then, air is injected between the uppermost and the uppermost but one sheet, providing a very reliable separation of the uppermost sheet from the bundle. The actual separation is effected by using a suction unit, followed by conveying the sheet with a conveying belt. Over the friction based methods, the air separation methods has the advantage of a wide setting latitude of paper feed conditions, combined with the adaptability for high-speed processing, high durability and corresponding low running costs.

[0003] The known method however has an important disadvantage. It appears that the reliability of the feeding process decreases significantly when the bundle is nearly depleted, i.e. when less than 25 sheets of receiving media are present, in particular when less than 10 sheets are present. This is not restricted to extraordinary heavy or light media types. For example, with all sorts of plain paper, when less than 5 sheets are present mis-feed occur occasionally. For the lighter types, typically types of less than 100 grams/square meter, the risk of inducing skew increases significantly when less than 5 to 10 sheets are present. Heavier types of media seem to be prone to mis-feeds in particular when narrow paper formats (SEF) are being used. In order to overcome this problem, it is proposed to leave the last few sheets (typically 25 - 50 sheets) in the tray and than denote the tray as "empty". These left-overs however have to be removed from time to time, or immediately when another media type is going to be loaded in the sheet stacking unit. This prior art solution therefore is far from ideal.

[0004] The present invention has as an object to overcome or at least mitigate the above mentioned problems. To this end a method according to the preamble has been invented, characterised in that it in further comprises assisting the said lifting of the sheets when the bundle is nearly depleted by forcing an element situated underneath the bundle to push against the bundle solely when air is blown against the side edge of the bundle. In this method, when the bundle is nearly depleted there is induced an extra force to lift the last few sheets in the direction of the separation unit. Contrary to what one expects, it appears that when only a few sheets are present in the tray, extra help is needed to induce an adequate lift of the sheets in the direction of the separation unit. It is further recognised that this extra help should only be used in connection with the blowing action against the side edge of the bundle. Thus, when the blowing action stops in order to let the remaining sheets fall back to the bottom plate, the element should cease it's lifting action. Therefore, the present invention distincts clearly from prior art feed methods which make use of bottom elements that constantly force a bundle of sheets upwardly in the direction of a separation unit, for example because part of the bottom is forced upwardly with a spring.

[0005] In an embodiment the blowing of the air creates a pressure difference that forces the element to undertake an upward movement. In this embodiment the mere air blowing action causes the element directly to move in an upward direction. This has the advantage that there is no need for an extra process, next to the air blowing, to have the element creating the needed lifting force. Next to this, because in this embodiment the element moves upwardly as a direct result of the air blowing process, the prerequisite of the extra force being present only in concurrence with the air blowing action is automatically fulfilled.

[0006] In another embodiment, the element hinges in the bottom plate. In this embodiment the element is connected to the bottom plate at one end but is able to move upwardly because the connection allows a hinging action of the said element. This appears to markedly increase the reliability of the present feeding method, most probably because the element will always come back to its original position when the air blowing action stops.

[0007] The invention also pertains to the feeder itself. With respect to the above-identified prior art, this feeder is characterised in that it comprises an element that is operatively connected to the stacking unit, the element being constituted such that it undertakes an upward movement solely when air is blown against the side edge of the bundle when it is nearly depleted. The working action of the element has been addressed already hereabove.

[0008] In an embodiment the element is sheet like. This has the advantage that the element does not take too much space, and also, that it can easily be situated between the bottom plate and the sheet bundle. This way, the element will hardly interfere with the process of filling the stacking unit with a new bundle of sheets.

[0009] In a further embodiment the element is a rigid plate that covers a part of the bottom plate. In this embodiment, the element is constituted as a rigid plate in

contrast with an element that is constituted as a flexible sheet. This decreases the risk of the element getting damaged by the multiple actions of stacking new bundles of sheets in the stacking unit. A rigid plate is less prone to damaging, such as inducing wrinkles, folds etc., then a sheet-like element.

[0010] In yet a further embodiment, the rigid plate is situated essentially adjacent the air blowing means. Surprisingly it appears that it is sufficient for the rigid plate to extend only in the direct vicinity of the air blowing means. Thus, there is no need for a large rigid plate that extends substantially over the complete side edge of the bundle of sheets. This makes the construction of the stacking unit more simple.

[0011] As a further improvement, the bottom plate can be provided with a recess wherein the rigid plate is situated. This way, the rigid plate does not constitute an obstruction for the lowermost sheets of a new bundle that is being loaded in the stacking unit. The recess can be made just as deep as the rigid plate is thick such that in essence, the bottom of the stacking unit remains evenly flat. This way, there is hardly any chance that sheets get damaged because of the presence of the rigid plate.

[0012] The invention will now be exemplified in greater detail by presenting the following figures and accompanying description.

Figure 1 is a sectional view illustrating an imaging apparatus.

Figure 2 is a perspective view representing a sheet stacking and feeding unit.

Figure 3, consisting out of subfigures 3a to 3c, illustrates the lifting and separation action when feeding a single sheet.

Figure 4 shows a part of the bottom plate of the sheet stacking unit according to the present invention.

Figure 1

[0013] Figure represents an imaging device as is for example known from US 2004/0089994 A1 and described elaborately in the paragraphs [0024] to [0034] of this US patent application which paragraphs are incorporated herein be reference. This apparatus includes an image reader 200, a printer 300 and a paper feed section 400. This section has paper decks 401 and 451 that share a paper feeding mechanism.

The image reader is equipped with a so called ADF 100. This ADF automatically feeds original documents to the image reader 200, in particular from tray 101 to glass platen 102. Thereafter, it discharges the sheets to paper discharge tray 112. When the original passes platen 102 it is read by scanner unit 104. This unit comprises lamp 103, light of which is reflected via the original to lens 108 and further through mirrors 105, 106 and 107. Ultimately, the light forms an image on image sensor 109. This sensor converts the optical image into image data which data are outputted from the sensor and subjected to a predetermined processing in an image signal control unit (not shown). Then, the image data are inputted as video signals to an exposure control section 110 of printer 300. The exposure control section 110 modulates laser light and outputs this light on the photosensitive drum 111. The electrostatic latent image on the drum 111 is visualised by application of a developer supplied by a developing device (not shown). A resist roller 115 conveys the sheet fed by the paper decks 401 and 451, between the drum 111 and a transfer section 116 in a timed relation with the laser light. The sheet on which the developer image has been transferred is conveyed to fixing section 117 and than discharged to tray 119 by a first discharge roller 118, or discharged to tray 121 by the second discharge roller 120.

Next, the air sheet feeding and stacking units, i.e. the paper decks 401 and 451 will be described. Here, the paper deck 401 and 451 are only different in the maximum storage number of sheets, and hence, the same reference numbers are used to denote the same or equivalent components. The further description is based on paper deck 401.

Figure 2

[0014] Figure 2 is a perspective view of the air sheet feeding paper deck 401. The paper deck is arranged to stack and store a sheet bundle S on a bottom plate 403. This bottom plate is provided in a repository 402 and is movable up and down. At the respective lower edges on the opposite sides of the repository 402, there are provided rails 404 and 405, which can be drawn to the front side with respect to the imaging apparatus body (i.e. to the operator side of the apparatus). The front end and rear end of the bundle S are fixedly placed on predetermined positions by plates 406 and 412. The opposite side edges are respectively placed on predetermined positions by side regulating plates 410 and 411.

At a position above the sheet bundle S, there is provided a sheet feed section 409 serving as a sheet suction and conveying means for the uppermost sheet of the bundle. The sheet feed section 409 has a suction duct 408 connected to a suction generating unit (not shown) for generating a suction pressure above the sheet bundle. A suction belt 407, being capable of paper feed rotation in the paper feed direction, has a large numbers of holes is provided and surrounds the suction duct 408. The sheet feed section 409 feeds a sheet by causing the uppermost sheet to adhere to the suction belt 407 and rotating this belt in the paper feed direction.

Figure 3

[0015] In figure 3 the construction and operation of the air blowing means and separation action in an embodiment of the present invention will be outlined in greater detail.

Figures 3A to 3C are sectional views when figure 2 is

seen from the paper feed direction. Here the side regulating plate 410 has therein a structure which serves as the air blowing means. This air blowing means includes a blowing fan 417 (see figure 2) serving as the supply source of blown air, and a blowing duct 413 having at one end thereof an opening 414 (see also figure 2) that is opened facing the side edge of the sheet bundle S stacked in the repository 402. There is also provided an air knife 415 which has a very thin elongated opening for blowing air against the front end side of the sheet bundle S, in particular between the two uppermost sheets.

The operations of the sheet feed method are now described here below. When a sheet bundle is set in deck 401, the bottom plate 403 is lift up to a predetermined height by using sheet height detection means (not shown) and a lift-up motor (not shown). In this embodiment, pressing a start button of the imaging apparatus starts a paper feeding operation.

As illustrated in figure 3B, first the air blowing means 413 starts to blow air against the side edge of bundle S. This creates a lift-up action for the uppermost 5 to 7 sheets (in this particular embodiment). Then, the suction generating unit located at the upper position starts a suction operation, and the suction duct 408 starts a suction action. At the same time air is blown through air knife 415 and injected between the uppermost sheet and the second sheet. This also forces the uppermost sheet to be lifted somewhat more in the direction of suction unit 409. This leads to sheet 416 to be attracted to the suction belt 407. Then, the air knife and air blowing means stop their blowing action so that the all sheets that have been lifted off fall back in the direction of the bottom plate (see figure 3C). By drive-rotating the suction belt 407 in this point of time, sheet 416 is delivered. Repeating this operation allows sheets to be separately fed reliably one by one. In order to provide the same reliability also when the bundle S is nearly depleted, for example because less than 10 sheets are present, there is provided for an extra means to assist in the lifting action caused by the air blowing means 413. Next, the means provided for to create this extra lifting action is outlined in greater detail.

Figure 4

[0016] Figure 4 shows a part of the bottom plate 403 of the sheet stacking unit according to the present invention. In this embodiment plate 403 is provided with a recess 421 adjacent opening 414 in side regulating plate 410. In the recess there is provided for a rigid plate 420, such that the upper surface of the rigid plate coincides with the upper surface of the bottom plate 403. Rigid plate 420 is connected to the bottom plate 403 via hinges 422 and 423. This enables the rigid plate to undertake a predetermined upward movement as is shown in figure 4B. This figure shows the upward movement of rigid plate 420 when the air blowing means blow air through opening 414 in the direction of bottom plate 403. It appears that the upward action of the rigid plate improves the reliability of the sheet separation markedly. The reason for this might be that the rigid plate somehow resembles the lifting action that is also induced when a sufficient amount of sheets are present (i.e. when the sheet bundle is not nearly depleted). Note that the upward action of the rigid plate will only be undertaken when the bundle is nearly depleted. Only then namely, the bottom plate has been lifted far enough to reach the opening 414. It is only then that the rigid plate can be forced to undertake an upward movement due to the pressure difference caused by the air blowing means. Lastly it is noted that the rigid plate can also be part of a small overlay plate, e.g. a plate such as known from US design patent 249,695.

Claims

1. A sheet feed method for use in a sheet feeder (400) having a sheet stacking unit (401, 451) with a bottom plate (403) to support a sheet bundle (S) comprising:

- blowing air against a side edge of the sheet bundle near the topmost sheets of the bundle, thereby lifting these sheets from the bundle,
- separating the uppermost sheet from the bundle,
- conveying this sheet away from the bundle,

characterised in further comprising assisting the said lifting of the sheets solely when the bundle is nearly depleted by forcing an element (420) situated underneath the bundle to push against the bundle solely when air is blown against the side edge of the bundle.

2. A method according to claim 1, **characterised in that** blowing of the air creates a pressure difference that forces the element to undertake an upward movement.

3. A method according to any of the preceding claims, **characterised in that** the element (420) hinges in the bottom plate (403).

4. A sheet feeder (400) comprising a sheet stacking unit (401, 451) with a bottom plate (403) to support a sheet bundle (S), air blowing means (413, 414) for blowing air against a side edge of the sheet bundle, sheet conveying means (409) for conveying sheets one by one from the bundle (S), the conveyance being of an uppermost sheet (416) of the bundle, **characterised in that** the feeder comprises an element (420) that is operatively connected to the stacking unit (401, 451), the element (420) being constituted such that it undertakes an upward movement thereby lifting the bundle (S) solely when air is blown against the side edge of the bundle (S) and solely

when the bundle (S) is nearly depleted.

5. A sheet feeder (400) according to claim 4, **characterised in that** the element (420) is sheet like.

6. A sheet feeder (400) according to claim 5, **characterised in that** the element (420) is a rigid plate (420) that covers a part of the bottom plate (403).

7. A feeder (400) according to claim 6, **characterised in that** the rigid plate (420) is situated essentially adjacent the air blowing means (413, 414).

8. A sheet feeder (400) according to claim 7, **characterised in** the bottom plate (403) has a recess (421) wherein the rigid plate (420) is situated.

9. A sheet feeder (400) according to any of the claims 4 to 8, **characterised in that** the element (420) is connected to the bottom plate (403) and hinges therein.

10. An imaging apparatus (1) incorporating a sheet feeder (400) according to any of the claims 4 to 9.

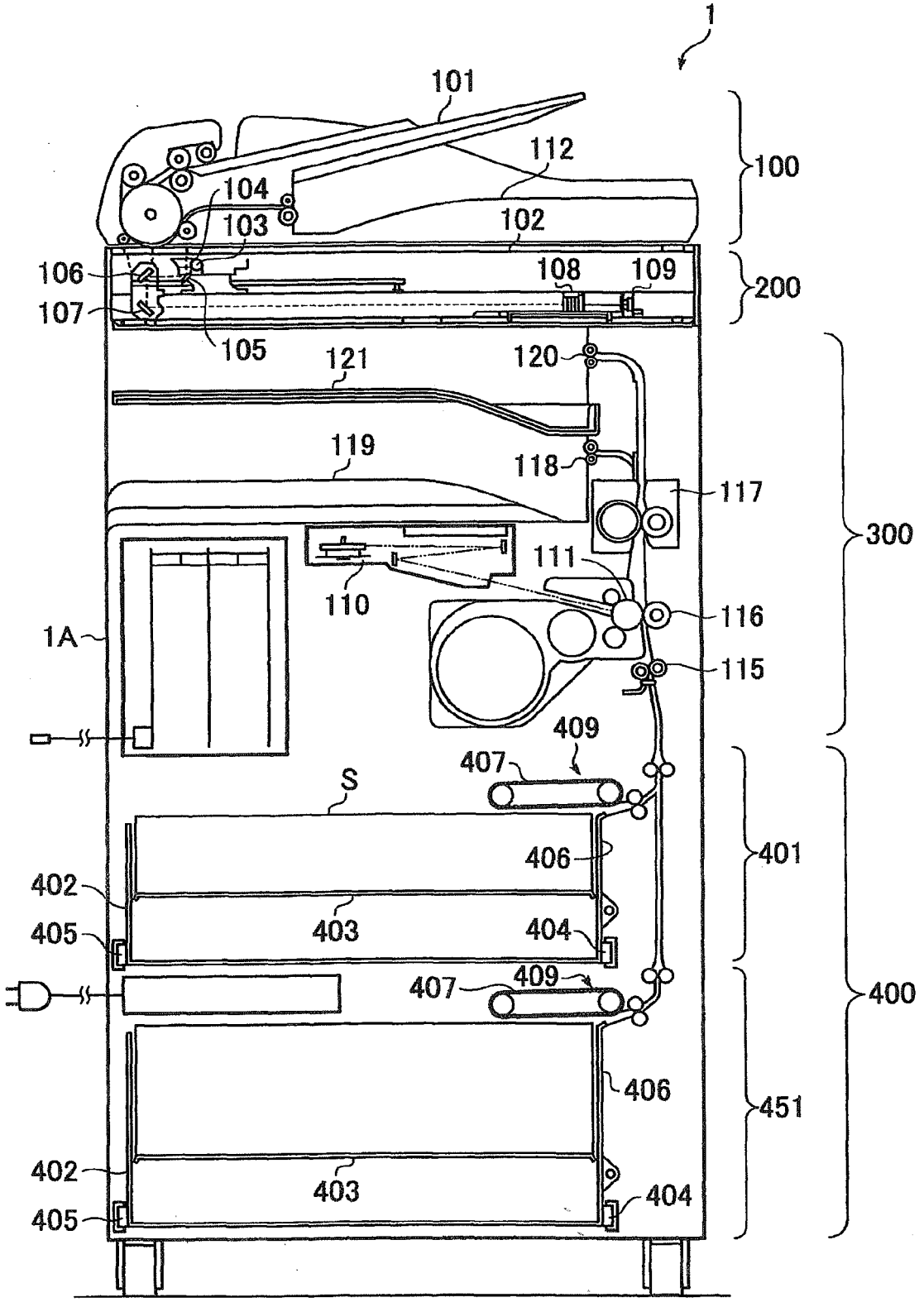
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FIG. 1

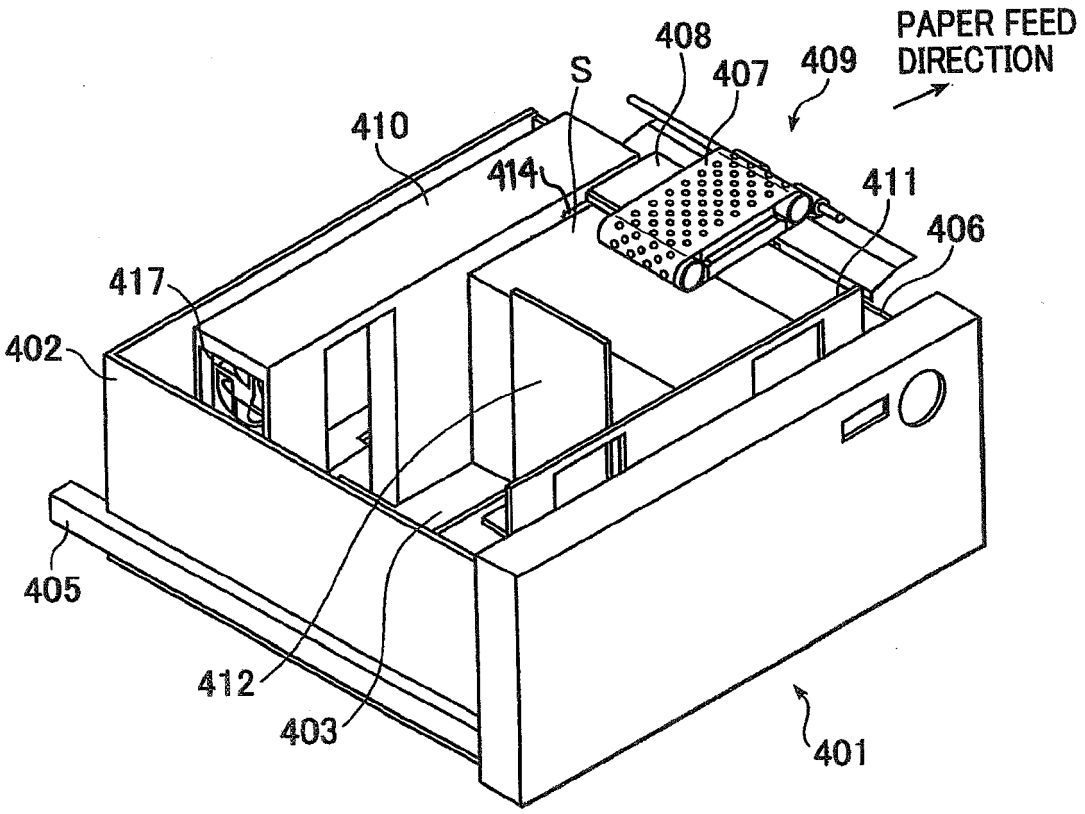
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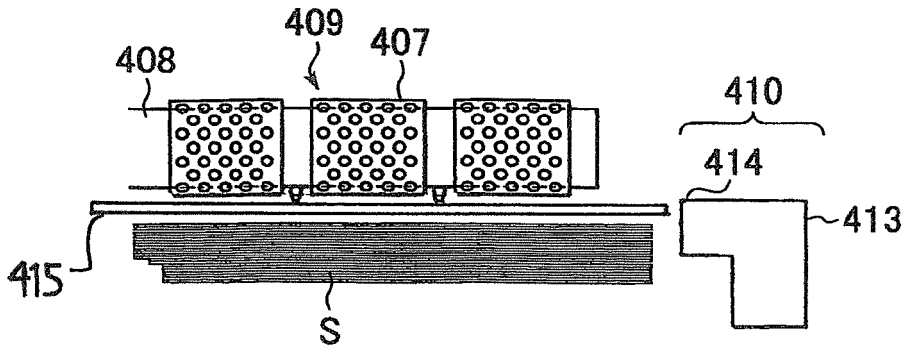
FIG. 2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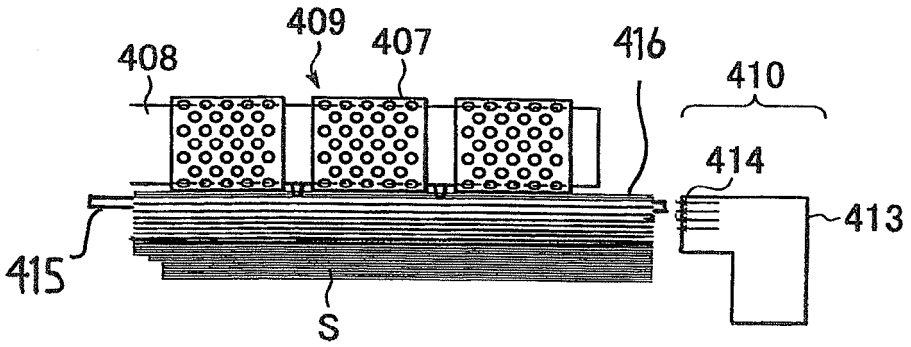
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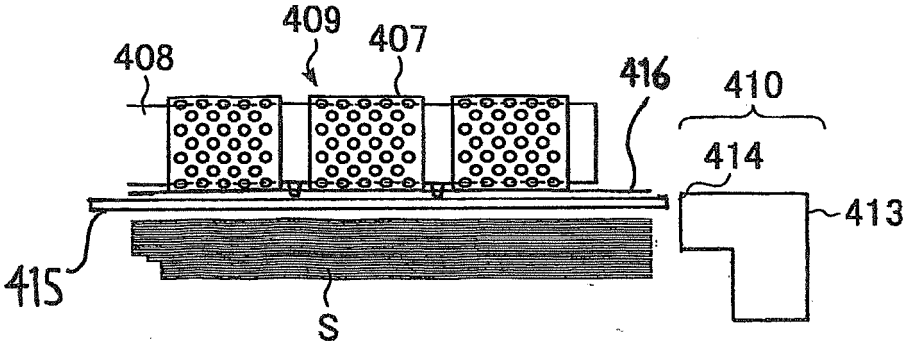
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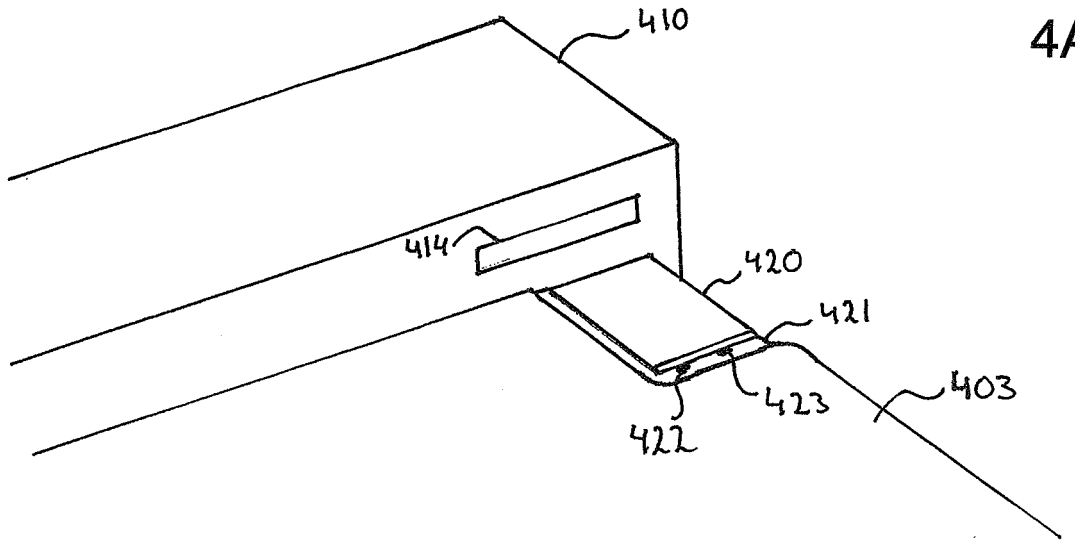
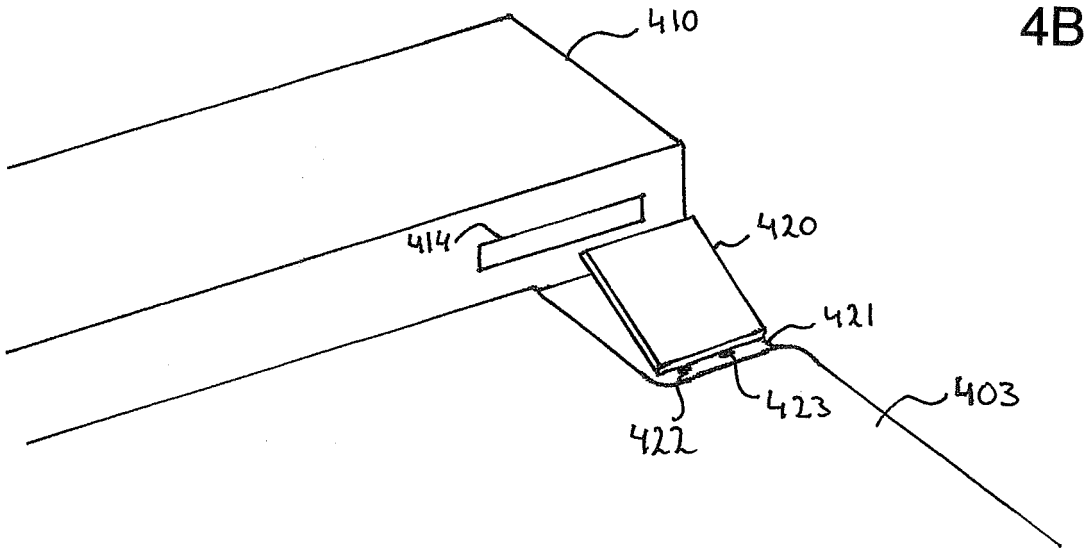
3C

FIG. 3



4A



4B

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 06 12 0040

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 12, 29 October 1999 (1999-10-29) -& JP 11 193138 A (CANON INC), 21 July 1999 (1999-07-21) * abstract * -----	1,3-10	INV. B65H3/48 B65H3/14 B65H1/16
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) -& JP 2004 043186 A (KYOCERA MITA CORP), 12 February 2004 (2004-02-12) * abstract * -----	1,4-7,10	
X	DE 195 36 425 A1 (TOSHIBA KAWASAKI KK [JP]) 4 April 1996 (1996-04-04) * column 16, line 29 - line 68; figure 14 * -----	1,3,4, 6-8	
A,D	US 2004/089994 A1 (KOGA HIROTO ET AL) 13 May 2004 (2004-05-13)	1	TECHNICAL FIELDS SEARCHED (IPC)
X	* paragraph [0034] - paragraph [0045]; figures 2,3 * -----	4,10	B65H G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 December 2006	Rupprecht, Anja

CATEGORY OF CITED DOCUMENTS

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15-12-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 11193138 A	21-07-1999	NONE	
JP 2004043186 A	12-02-2004	NONE	
DE 19536425 A1	04-04-1996	NONE	
US 2004089994 A1	13-05-2004	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- US 20040089994 A1 **[0002] [0013]**