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(71) Applicant: **HP PRINTING KOREA CO., LTD.**
[KR/KR]; 129 Samsung-ro, Yeongtong-gu, Suwon-si,
Gyeonggi-do 16677 (KR).

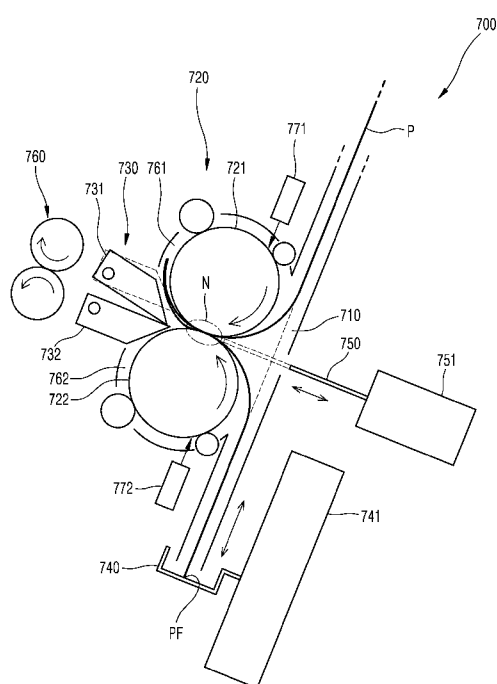
(72) Inventors: **FUKASAWA, Eiji**; 106-605, 363, Hyowon-ro,
Yeongtong-gu, Suwon-si, Gyeonggi-do 16543 (KR). **KIM,
Su Yeon**; 42-9, Yeongwol-ro, Hanbando-myeon, Yeong-
wol-gun, Gangwon-do 26214 (KR). **PARK, Jung Kyu**;
106-202, 36-3, Tapdong-ro 11beon-gil, Gwonseon-gu, Su-
won-si, Gyeonggi-do 16606 (KR). **SHIN, Jae Hyun**;
8504-1403, 50, Wellbeing town-ro, Yeongtong-gu, Su-
won-si, Gyeonggi-do 16223 (KR).

(74) Agent: **Y.P.LEE, MOCK & PARTNERS**; 12F Daelim
Acrotel, 13 Eonju-ro 30-gil, Gangnam-gu, Seoul 06292
(KR).

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(54) Title: SHEET FOLDING BASED ON A SINGLE FOLDING ROLLER



(57) Abstract: Provided is a sheet folding apparatus including a folding path, a positioning member to support a first end of a printing medium which is fed along the folding path and arrange the printing medium in an initial folding location, a folding roller including a pair of rollers rotatably engaging with each other to form a folding nip, a push member to move to an insertion location for pushing the printing medium on the folding path into the folding nip and move to a retreat location for escaping from the folding path, a guide path for returning the printing medium having passed through the folding nip to the folding path, the guide path provided around at least one of the pair of rollers, and a shift member, located at an exit of the folding nip, to selectively guide the printing medium.



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Description

Title of Invention: SHEET FOLDING BASED ON A SINGLE FOLDING ROLLER

Background Art

- [1] A sheet folding apparatus folds a sheet-type medium (hereinafter referred to as 'paper') in various forms. The sheet folding apparatus may be used in a finisher with respect to paper which is discharged from a copier, a printer, etc., or may be a stand-alone apparatus.
- [2] The sheet folding apparatus may fold paper once, or two or more times. Two or more pairs of rollers may be used to fold paper two or more times. Pairs of rollers that number as many as the number of times paper is folded are used.

Disclosure of Invention

Brief Description of Drawings

- [3] These and/or other aspects will become apparent and more readily appreciated from the following description of the examples, taken in conjunction with the accompanying drawings in which:
- [4] FIG. 1 is a schematic configuration diagram of an image forming apparatus according to an example;
- [5] FIG. 2 is a configuration diagram of a sheet folding apparatus according to an example;
- [6] FIG. 3 shows a first shift member in a first shift location;
- [7] FIG. 4 shows a second shift member in a second shift location;
- [8] FIG. 5 shows an example of a V-fold process;
- [9] FIG. 6 shows an example of a 4-fold process;
- [10] FIG. 7 shows an example of a Z-fold or 3-fold outside process;
- [11] FIG. 8 shows an example of a C-fold process;
- [12] FIG. 9 shows an example of a double gate fold process;
- [13] FIG. 10 shows an example of a roll-fold process;
- [14] FIG. 11 shows an example of a W-fold process;
- [15] FIG. 12 shows another example of a W-fold process;
- [16] FIG. 13 is a configuration diagram of a sheet folding apparatus according to an example;
- [17] FIG. 14 is a configuration diagram of a sheet folding apparatus according to an example;
- [18] FIG. 15 is a configuration diagram of a sheet folding apparatus according to an example;

- [19] FIG. 16 shows an example of a double gate fold process using the sheet folding apparatus of FIG. 15; and
- [20] FIG. 17 shows a process of allowing paper folded in the form of a double gate to re-enter a folding nip.

Mode for the Invention

- [21] Hereinafter, examples of a sheet folding apparatus and method and a finisher and image forming apparatus using the sheet folding apparatus and method will be described with reference to the accompanying drawings. In the drawings, like reference numerals denote like elements, and a size or thickness of each component may be exaggerated for clarity of description.
- [22] FIG. 1 is a schematic configuration diagram of an image forming apparatus according to an example.
- [23] Referring to FIG. 1, the image forming apparatus may include a printer 100 and a finisher 400. The printer 100 prints an image on a printing medium such as a sheet-type medium (hereinafter referred to as 'paper') supplied from a paper feeder. The paper feeder may be, for example, a main cassette feeder 210 which is installed under the printer 100, a secondary cassette feeder 220 which is installed under the main cassette feeder 210, a high capacity feeder 230 which is installed under the main cassette feeder 210 or under the secondary cassette feeder 220, a high capacity feeder 240 which is installed at a side of the printer 100, or the like. Although not shown, the paper feeder may be a multi-purpose tray (MPT).
- [24] The printer 100 may print an image on paper P by using various printing methods such as an electrophotography method, an inkjet method, a thermal transfer method, or a thermal sublimation method. For example, the image forming apparatus according to the present example prints a color image on the paper P by using an electrophotography method. The above printing methods are well-known in the art, and thus, a detailed description thereof will be omitted herein.
- [25] The image forming apparatus may further include a scanner 300 for reading an image recorded on a document. The scanner 300 may have various structures such as a flatbed mechanism where a document is located at a fixed position and an image is read while a reading member moves, a document feeding mechanism where a reading member is located at a fixed position and a document is fed, or a combination structure thereof. The principle and structure of the scanner 300 are well-known in the art, and thus, a detailed description thereof will be omitted herein.
- [26] The finisher 400 may include a sheet folding apparatus 700 for folding, one or more times, the paper P discharged from the printer 100. The finisher 400 may further include an alignment apparatus 500 for aligning the paper P discharged from the

printer 100. The alignment apparatus 500 may have a structure for stapling the paper P at an end portion thereof or punching a hole in an end portion of the paper P. The finisher 400 may further include a middle stapler 600 for stapling the paper P at a center portion thereof. Structures of the alignment apparatus 500 and the middle stapler 600 are well-known in the art, and thus, a detailed description thereof will be omitted herein.

[27] Hereinafter, examples of a sheet folding apparatus will be described.

[28] FIG. 2 is a configuration diagram of a sheet folding apparatus 700 according to an example.

[29] FIG. 2 shows a folding path 710 and a folding roller 720. The folding roller 720 is on the folding path 710. The folding roller 720 includes first and second rollers 721 and 722 rotatably engaging with each other to form a folding nip N. The first roller 721 is at an upstream side of the folding path 710, and the second roller 722 is at a downstream side thereof.

[30] A push member 750, which may be moved from an insertion location (dashed line of FIG. 2) for pushing paper P on the folding path 710 into the folding nip N to a retreat location (solid line of FIG. 2) for escaping from the folding path 710, is positioned at an entrance of the folding nip N. The push member 750 may comprise a rod, a shaft, a dowel, or similar structure and be moved between the insertion location and the retreat location, for example, by an actuator 751. The actuator 751 may be, for example, a linear motor. In FIG. 2, the push member 750 linearly moves to the insertion location and the retreat location. However, the present disclosure is not limited thereto, and the push member 750 may rotate to the insertion location and the retreat location.

[31] A positioning member 740 arranges the paper P on the folding path 710 in an initial folding location. A first end (e.g., a fore-end) PF of the paper P fed along the folding path 710 is supported by the positioning member 740. The positioning member 740 is moved along the folding path 710 by an escalating member 741. At least the initial folding location of the paper P is determined by a location of the positioning member 740. The location of the positioning member 740 may be detected by a location detecting sensor (not shown). The positioning member 740 may be implemented by various structures, for example, a plate, a bracket having at least one retaining side, an indentation, or the like. The escalating member 741 may be implemented by various structures, for example, a linear motor, a combination of a rotation motor and a linear movement mechanism, a combination of a rotation motor and a rotary belt or chain, or the like.

[32] By the above configuration, the paper P may be folded once. For example, one piece or a plurality of pieces of paper P is fed along the folding path 710, and the first end PF thereof is supported by the positioning member 740. As the push member 750 moves

to the insertion location, the push member 750 pushes a center portion of the paper P into the folding nip N. The paper P is folded once while being pushed into the folding nip N and is pushed out through an exit of the folding nip N. The folded paper P is externally discharged by a discharge roller 760. Thus, a V-fold may be performed. A folding location may be determined by the positioning member 740.

[33] The sheet folding apparatus 700 according to the present example may perform folding two or more times by using one folding roller 720. To achieve this, the sheet folding apparatus 700 includes a guide path for guiding the paper P having passed through the folding nip N to the folding path 710 again and returning the paper P to the entrance of the folding nip N, and a shift member 730 for selectively guiding the paper P to the discharge roller 760 or the guide path, the shift member 730 located at the exit of the folding nip N. The guide path is provided around at least one of the first roller 721 or the second roller 722. In the present example, the guide path includes a first guide path 761 and a second guide path 762 respectively provided around the first roller 721 and the second roller 722, and the shift member 730 includes a first shift member 731 for selectively guiding the paper P to the first guide path 761, and a second shift member 732 for selectively guiding the paper P to the second guide path 762. Although not illustrated, an actuator for driving the first and second shift members 731 and 732 may be provided. The actuator may be, for example, a solenoid actuator. First and second sensors 771 and 772 for detecting the paper P may be respectively arranged in the first and second guide paths 761 and 762. The first and second sensors 771 and 772 provide a reference for determining second, third, or subsequent folding timing, that is, driving timing of the push member 750. Although not denoted by reference numerals, driven rollers engaging with the first and second rollers 721 and 722 to feed the paper P may be provided in the first and second guide paths 761 and 762. In the present example, the first roller 721 and the second roller 722 define side guides (inner guides) of the first and second guide paths 761 and 762. That is, the paper P having passed through the folding nip N is fed along the first and second guide paths 761 and 762 in a direction winding around the first and second rollers 721 and 722 and is returned in a direction toward the entrance of the folding nip N.

[34] Referring to FIG. 2, the first and second shift members 731 and 732 are in discharge locations for guiding the paper P to the discharge roller 760. FIGS. 3 and 4 show states of the shift member 730. Referring to FIG. 3, the first shift member 731 is in a first shift location. The paper P having come out from the folding nip N is guided to the first guide path 761 by the first shift member 731. Referring to FIG. 4, the second shift member 732 is in a second shift location. The paper P having come out from the folding nip N is guided to the second guide path 762 by the second shift member 732.

[35] By the above configuration, folding may be performed twice by returning the paper P

folded once to the entrance of the folding nip N via the first guide path 761 or the second guide path 762 and pushing the paper P into the folding nip N by using the push member 750 again. A 4-fold may be performed by once again folding a central portion of the paper P that has already been folded once. Also, a C-fold or a Z-fold, which is a 3-fold outside, may be performed by performing folding twice by using the first guide path 761 or the second guide path 762. Also, a double gate fold, a roll-fold, a W-fold, etc. may be performed by performing folding three times while allowing the paper P to sequentially pass through the first guide path 761 and the second guide path 762.

[36] Hereinafter, paper folding methods according to the examples illustrated in FIGS. 2 to 4 will be described.

[37] [V-fold]

[38] FIG. 5 shows an example of a V-fold process. In FIG. 5, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, and the first and second shift members 731 and 732 are illustrated.

[39] As illustrated in FIG. 5(a), the positioning member 740 is located such that a central portion of the paper P is located at an entrance of the folding nip N. That is, a distance from the folding nip N to the positioning member 740 is $1/2$ of a length L of the paper P. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. A $1/2L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 5(b)). As the paper P passes through the folding nip N, the $1/2L$ point is folded. The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P folded in the form of a V is discharged by the discharge roller 760 (FIG. 5(c)).

[40] A plurality of pieces of paper P may be in a state of being stapled at a central portion thereof by a stapler, such as the middle stapler 600. In this case, the positioning member 740 is moved to a location denoted by dashed lines in FIG. 5(a). When, in this state, the first end PF of the plurality of pieces of paper P is supported by the positioning member 740, a $1/2L$ point of the plurality of pieces of paper P is placed at the stapler. The plurality of pieces of paper P may be stapled at the $1/2L$ point thereof by using the stapler. The positioning member 740 is moved to a location denoted by solid lines in FIG. 5(a). The $1/2L$ point of the plurality of pieces of paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 5(b)). The push member 750 returns to a retreat location. As the plurality of pieces of paper P pass through the folding nip N, the $1/2L$ point is folded. The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the plurality of

pieces of paper P folded in the form of a V are discharged by the discharge roller 760 (FIG. 5(c)).

[41] [4-fold]

[42] FIG. 6 shows an example of a 4-fold process. In FIG. 6, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, and the first and second shift members 731 and 732 are illustrated.

[43] As illustrated in FIG. 6(a), the positioning member 740 is located such that a $\frac{1}{2}L$ point of the paper P is located at an entrance of the folding nip N. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. The $\frac{1}{2}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 6(b)). As the paper P passes through the folding nip N, the $\frac{1}{2}L$ point is folded. The push member 750 returns to a retreat location.

[44] The paper P having passed through the folding nip N is fed along the first guide path 761 or the second guide path 762 and is returned to the entrance of the folding nip N. In the present example, the second shift member 732 is placed in a second shift location, and the paper P having passed through the folding nip N is returned to the entrance of the folding nip N along the second guide path 762 (FIG. 6(c) and FIG. 6(d)). When the paper P is fed along the folding path 710 in a reverse direction, and a central portion of the paper P that is folded once, that is, a $\frac{1}{4}L$ point of the paper P, reaches the vicinity of the folding nip N (FIG. 6(e)), the $\frac{1}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 6(f)). The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P that is folded twice is discharged by the discharge roller 760 (FIG. 6(g)). The push member 750 returns to the retreat location.

[45] [Z-fold or 3-fold outside]

[46] FIG. 7 shows an example of a Z-fold or 3-fold outside process. In FIG. 7, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, and the first and second shift members 731 and 732 are illustrated.

[47] As illustrated in FIG. 7(a), the positioning member 740 is located such that a $\frac{1}{4}L$ point (in the case of the 3-fold outside, a $\frac{1}{3}L$ point) of the paper P is located at an entrance of the folding nip N. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. The $\frac{1}{4}L$ point (in the case of the 3-fold outside, the $\frac{1}{3}L$ point) of the paper P is pushed into the folding nip N by moving

the push member 750 to an insertion location (FIG. 7(b)). As the paper P passes through the folding nip N, the $\frac{1}{4}L$ point (in the case of the 3-fold outside, the $\frac{1}{3}L$ point) is folded. The push member 750 returns to a retreat location.

- [48] The paper P having passed through the folding nip N is fed around a roller on a side of the first end PF of the paper P from among the first and second rollers 721 and 722, that is, the second roller 722, and is returned to the entrance of the folding nip N. To achieve this, the second shift member 732 is placed in a second shift location, and the paper P having passed through the folding nip N is returned to the entrance of the folding nip N along the second guide path 762 (FIG. 7(C) and FIG. 7(d)). When the paper P is fed along the folding path 710 in a reverse direction, and a $\frac{1}{2}L$ point (in the case of the 3-fold outside, a $\frac{2}{3}L$ point) of the paper P reaches the vicinity of the folding nip N (FIG. 7(e)), the $\frac{1}{2}L$ point (in the case of the 3-fold outside, the $\frac{2}{3}L$ point) of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 7(f)). The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P folded in the form of a Z (in the form of a 3-fold) is discharged by the discharge roller 760 (FIG. 7(g)). The push member 750 returns to the retreat location.

- [49] [C-fold]

- [50] FIG. 8 shows an example of a C-fold process. In FIG. 8, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, and the first and second shift members 731 and 732 are illustrated.

- [51] As illustrated in FIG. 8(a), the positioning member 740 is located such that a $\frac{1}{3}L$ point of the paper P is located at an entrance of the folding nip N. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. The $\frac{1}{3}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 8(b)). As the paper P passes through the folding nip N, the $\frac{1}{3}L$ point is folded. The push member 750 returns to a retreat location.

- [52] The paper P having passed through the folding nip N is fed around a roller on an opposite side of the first end PF of the paper P from among the first and second rollers 721 and 722, that is, the first roller 721, and is returned to the entrance of the folding nip N. To achieve this, the first shift member 731 is placed in a first shift location, and the paper P having passed through the folding nip N is returned to the entrance of the folding nip N along the first guide path 761 (FIG. 8(c) and FIG. 8(d)). When the paper P is fed along the folding path 710 in a forward direction, and a $\frac{2}{3}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 8(e)), the $\frac{2}{3}L$ point of the paper P is

pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 8(f)). The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P folded in the form of a C is discharged by the discharge roller 760 (FIG. 8(g)). The push member 750 returns to the retreat location.

[53] [Double gate fold]

[54] FIG. 9 shows an example of a double gate fold process. In FIG. 9, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, and the first and second shift members 731 and 732 are illustrated.

[55] As illustrated in FIG. 9(a), the positioning member 740 is located such that a $\frac{1}{4}L$ point of the paper P is located at an entrance of the folding nip N. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. The $\frac{1}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 9(b)). As the paper P passes through the folding nip N, the $\frac{1}{4}L$ point is folded. The push member 750 returns to a retreat location.

[56] The paper P having passed through the folding nip N is fed around a roller on an opposite side of the first end PF of the paper P from among the first and second rollers 721 and 722, that is, the first roller 721, and is returned to the entrance of the folding nip N. To achieve this, the first shift member 731 is placed in a first shift location, and the paper P having passed through the folding nip N is returned to the entrance of the folding nip N along the first guide path 761 (FIG. 9(c) and FIG. 9(d)). When the paper P is fed along the folding path 710 in a forward direction, and a $\frac{3}{4}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 9(e)), the $\frac{3}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 9(f)). The push member 750 returns to the retreat location.

[57] The paper P having passed through the folding nip N for the second time is fed around a roller on an opposite side of the first end PF of the paper P from among the first and second rollers 721 and 722, that is, the second roller 722, and is returned to the entrance of the folding nip N. To achieve this, the second shift member 732 is placed in a second shift location, and the paper P having passed through the folding nip N for the second time is returned to the entrance of the folding nip N along the second guide path 762 (FIG. 9(g)). When the paper P is fed along the folding path 710 in a reverse direction, and a $\frac{1}{2}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 9(h)), the $\frac{1}{2}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 9(i)). The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P

folded in the form of a double gate is discharged by the discharge roller 760 (FIG. 9(j)). The push member 750 returns to the retreat location.

[58] [Roll-fold]

[59] FIG. 10 shows an example of a roll-fold process. In FIG. 10, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, and the first and second shift members 731 and 732 are illustrated.

[60] As illustrated in FIG. 10(a), the positioning member 740 is located such that a $\frac{1}{4}L$ point of the paper P is located at an entrance of the folding nip N. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. The $\frac{1}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 10(b)). As the paper P passes through the folding nip N, the $\frac{1}{4}L$ point is folded. The push member 750 returns to a retreat location.

[61] The paper P having passed through the folding nip N is fed around a roller on an opposite side of the first end PF of the paper P from among the first and second rollers 721 and 722, that is, the first roller 721, and is returned to the entrance of the folding nip N. To achieve this, the first shift member 731 is placed in a first shift location, and the paper P having passed through the folding nip N is returned to the entrance of the folding nip N along the first guide path 761 (FIG. 10(c) and FIG. 10(d)). When the paper P is fed along the folding path 710 in a forward direction, and a $\frac{1}{2}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 10(e)), the $\frac{1}{2}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 10(f)). The push member 750 returns to the retreat location.

[62] The paper P having passed through the folding nip N for the second time is fed around the first roller 721 again, and is returned to the entrance of the folding nip N. To achieve this, the first shift member 731 is maintained at the first shift location. The paper P having passed through the folding nip N for the second time is returned to the entrance of the folding nip N along the first guide path 761 (FIG. 10(g)). When the paper P is fed along the folding path 710 in the forward direction, and a $\frac{3}{4}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 10(h)), the $\frac{3}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 10(i)). The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P folded in the form of a roll is discharged by the discharge roller 760 (FIG. 10(j)). The push member 750 returns to the retreat location.

[63] [W-fold]

- [64] FIG. 11 shows an example of a W-fold process. In FIG. 11, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, and the first and second shift members 731 and 732 are illustrated.
- [65] As illustrated in FIG. 11(a), the positioning member 740 is located such that a $\frac{1}{4}L$ point of the paper P is located at an entrance of the folding nip N. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. The $\frac{1}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 11(b)). As the paper P passes through the folding nip N, the $\frac{1}{4}L$ point is folded. The push member 750 returns to a retreat location.
- [66] The paper P having passed through the folding nip N is fed around a roller on an opposite side of the first end PF of the paper P from among the first and second rollers 721 and 722, that is, the first roller 721, and is returned to the entrance of the folding nip N. To achieve this, the first shift member 731 is placed in a first shift location, and the paper P having passed through the folding nip N is returned to the entrance of the folding nip N along the first guide path 761 (FIG. 11(c) and FIG. 11(d)). When the paper P is fed along the folding path 710 in a forward direction, and a $\frac{3}{4}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 11(e)), the $\frac{3}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 11(f)). The push member 750 returns to the retreat location.
- [67] The paper P having passed through the folding nip N for the second time is fed around the first roller 721 again, and is returned to the entrance of the folding nip N. To achieve this, the first shift member 731 is maintained at the first shift location. The paper P having passed through the folding nip N for the second time is returned to the entrance of the folding nip N along the first guide path 761 (FIG. 11(g)). When the paper P is fed along the folding path 710 in the forward direction, and a $\frac{1}{2}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 11(h)), the $\frac{1}{2}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 11(i)). The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P folded in the form of a W is discharged by the discharge roller 760 (FIG. 11(j)). The push member 750 returns to the retreat location.
- [68] [Another W-fold method]
- [69] FIG. 12 shows another example of a W-fold process. In FIG. 12, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, and the first and second shift members 731 and 732 are briefly illustrated.

- [70] As illustrated in FIG. 12(a), the positioning member 740 is located such that a $\frac{1}{4}L$ point of the paper P is located at an entrance of the folding nip N. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. The $\frac{1}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 12(b)). As the paper P passes through the folding nip N, the $\frac{1}{4}L$ point is folded. The push member 750 returns to a retreat location.
- [71] The paper P having passed through the folding nip N is fed around a roller on a side of the first end PF of the paper P from among the first and second rollers 721 and 722, that is, the second roller 722, and is returned to the entrance of the folding nip N. To achieve this, the second shift member 732 is placed in a second shift location, and the paper P having passed through the folding nip N is returned to the entrance of the folding nip N along the second guide path 762 (FIG. 12(c) and FIG. 12(d)). When the paper P is fed along the folding path 710 in a reverse direction, and a $\frac{1}{2}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 12(e)), the $\frac{1}{2}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 12(f)). The push member 750 returns to the retreat location.
- [72] The paper P having passed through the folding nip N for the second time is fed around the first roller 721 and is returned to the entrance of the folding nip N. To achieve this, the first shift member 731 is maintained at a first shift location. The paper P having passed through the folding nip N for the second time is returned to the entrance of the folding nip N along the first guide path 761 (FIG. 12(g)). When the paper P is fed along the folding path 710 in a forward direction, and a $\frac{3}{4}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 12(h)), the $\frac{3}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 12(i)). The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P folded in the form of a W is discharged by the discharge roller 760 (FIG. 12(j)). The push member 750 returns to the retreat location.
- [73] In order to enable performance of the 4-fold, Z-fold, and W-fold processes (the first method), lengths of the first and second guide paths 761 and 762 should be equal to or greater than $\frac{1}{2}$ of the length L of applicable maximum paper P. The lengths of the first and second guide paths 761 and 762 refer to lengths over which the paper P having passed through the folding nip N reaches the folding nip N again along the first and second guide paths 761 and 762. In the present example, since the first and second rollers 721 and 722 define side guides (inner guides) of the first and second guide

paths 761 and 762, outer circumferential lengths of the first and second rollers 721 and 722 should be equal to or greater than $1/2$ of the length L of the applicable maximum paper P .

- [74] In order to enable 3-fold, lengths of the first and second guide paths 761 and 762 should be equal to or greater than $1/3$ of the length L of applicable maximum paper P . In the present example, since the first and second rollers 721 and 722 define side guides (inner guides) of the first and second guide paths 761 and 762, outer circumferential lengths of the first and second rollers 721 and 722 should be equal to or greater than $1/3$ of the length L of the applicable maximum paper P .
- [75] In order to enable C-fold, lengths of the first and second guide paths 761 and 762 should be equal to or greater than $2/3$ of the length L of applicable maximum paper P . In the present example, since the first and second rollers 721 and 722 define side guides (inner guides) of the first and second guide paths 761 and 762, outer circumferential lengths of the first and second rollers 721 and 722 should be equal to or greater than $2/3$ of the length L of the applicable maximum paper P .
- [76] In order to enable double gate fold, roll-fold, and W-fold (the second method), lengths of the first and second guide paths 761 and 762 should be equal to or greater than $3/4$ of the length L of applicable maximum paper P . In the present example, since the first and second rollers 721 and 722 define side guides (inner guides) of the first and second guide paths 761 and 762, outer circumferential lengths of the first and second rollers 721 and 722 should be equal to or greater than $3/4$ of the length L of the applicable maximum paper P .
- [77] By taking the above relationships into account, lengths of the first and second guide paths 761 and 762 may be at least equal to or greater than $1/3$ of the length L of applicable maximum paper P , and when the first and second rollers 721 and 722 define side guides (inner guides) of the first and second guide paths 761 and 762, outer circumferential lengths of the first and second rollers 721 and 722 may be equal to or greater than $1/3$ of the length L of the applicable maximum paper P .
- [78] FIG. 13 is a schematic configuration diagram of a sheet folding apparatus 700a according to an example. The sheet folding apparatus 700a according to the present example is different from the sheet folding apparatus 700 illustrated in FIG. 2 in that the first and second guide paths 761 and 762 are respectively defined by a first outer guide 761a and a first inner guide 761b, and a second outer guide 762a and a second inner guide 762b. Although not denoted by reference numerals, pairs of feed rollers rotatably engaging with each other, and feeding the paper P along the first and second guide paths 761 and 762 may be provided in the first and second guide paths 761 and 762.
- [79] According to the above configuration, limitation on outer circumferential lengths of

the first and second rollers 721 and 722 applied to the sheet folding apparatus 700 illustrated in FIG. 2 is not applied to the sheet folding apparatus 700a according to the present example. Accordingly, sizes of the first and second rollers 721 and 722 may be large. However, lengths of the first and second guide paths 761 and 762 should satisfy the above condition according to a folding method.

- [80] FIG. 14 is a schematic configuration diagram of a sheet folding apparatus 700b according to an example. The sheet folding apparatus 700b according to the present example is different from the sheet folding apparatus 700 illustrated in FIG. 2 in that a guide path includes an inner guide path and an outer guide path and a gate member for selectively guiding paper having passed through the folding nip N and been guided to the guide path by a shift member to the inner guide path or the outer guide path is provided.
- [81] Referring to FIG. 14, the first guide path 761 includes a first inner guide path 761-1 and a first outer guide path 761-2. The first inner guide path 761-1 is a path adjacent to the first roller 721, and the first outer guide path 761-2 is at an outer side of the first inner guide path 761-1. The outer circumference of the first roller 721 may define a side guide (inner guide) of the first inner guide path 761-1.
- [82] A feed distance of the paper P when the paper P having passed through the folding nip N returns to an entrance of the folding nip N is longer along the first outer guide path 761-2 than along the first inner guide path 761-1. A first gate member 733 selectively guides the paper P guided to the first guide path 761 by the first shift member 731 to the first inner guide path 761-1 or the first outer guide path 761-2. For example, the first gate member 733 may rotate to a location (denoted by solid lines) for guiding the paper P to the first inner guide path 761-1 and a location (denoted by dashed lines) for guiding the paper P to the first outer guide path 761-2. Although not illustrated, the first gate member 733 may be driven by an actuator such as solenoid.
- [83] Likewise, the second guide path 762 includes a second inner guide path 762-1 and a second outer guide path 762-2. The second inner guide path 762-1 is a path adjacent to the second roller 722, and the second outer guide path 762-2 is at an outer side of the second inner guide path 762-1. The outer circumference of the second roller 722 may define a side guide (inner guide) of the second inner guide path 762-1.
- [84] A feed distance of the paper P when the paper P having passed through the folding nip N returns to the entrance of the folding nip N is longer along the second outer guide path 762-2 than along the second inner guide path 762-1. A second gate member 734 selectively guides the paper P guided to the second guide path 762 by the second shift member 732 to the second inner guide path 762-1 or the second outer guide path 762-2. For example, the second gate member 734 may rotate to a location (denoted by solid lines) for guiding the paper P to the second inner guide path 762-1 and a location

(denoted by dashed lines) for guiding the paper P to the second outer guide path 762-2. Although not illustrated, the second gate member 734 may be driven by an actuator such as solenoid.

- [85] Although not denoted by reference numerals, driven rollers rotatably engaging with the first and second rollers 721 and 722, and feeding the paper P along the first and second inner guide paths 761-1 and 762-1 may be provided in the first and second inner guide paths 761-1 and 762-1. In addition, although not denoted by reference numerals, pairs of feed rollers rotatably engaging with each other, and feeding the paper P along the first and second outer guide paths 761-2 and 762-2 may be provided in the first and second outer guide paths 761-2 and 762-2.
- [86] According to the above configuration, a path satisfying a length condition of the guide path according to a folding method may be selected, and thus, folding may be performed in various ways. Also, the paper P having a small length may be guided to the first and second inner guide paths 761-1 and 762-1, and the paper P having a large length may be guided to the first and second outer guide paths 761-2 and 762-2. Accordingly, the paper P having various lengths may be folded in various ways.
- [87] A radius of curvature of the first and second outer guide paths 761-2 and 762-2 may be greater than that of the first and second inner guide paths 761-1 and 762-1. According to the above configuration, the paper P may be guided to a proper guide path according to a thickness or rigidity of the paper P. For example, the paper P having a large thickness or rigidity may be guided to the first and second outer guide paths 761-2 and 762-2 having a large radius of curvature, and the paper P having a small thickness or rigidity may be guided to the first and second inner guide paths 761-1 and 762-1 having a small radius of curvature.
- [88] FIG. 15 is a configuration diagram of a sheet folding apparatus 700c according to an example. The sheet folding apparatus 700c according to the present example is different from the sheet folding apparatus 700 illustrated in FIG. 2 in that the sheet folding apparatus 700c includes a guide member installed at an exit of a guide path that is capable of moving to a guide location for guiding the paper P to the folding path 710 and an escape location for escaping from the guide location.
- [89] Referring to FIG. 15, a first guide member 781 is at an exit of the first guide path 761. The first guide member 781 may move from a first escape location a1 to a first guide location b1. For example, the first guide member 781 may be installed at a rotation axis of the first roller 721 so as to be capable of rotating to the first escape location a1 and the first guide location b1. Although not illustrated, the first guide member 781 is rotated to the first escape location a1 and the first guide location b1 by an actuator. The actuator may be, for example, a rotation motor. The rotation motor may be connected to the first guide member 781, for example, by a gear. At the first

guide location b1, the first guide member 781 guides the paper P so that the paper P fed along the first guide path 761 may stably enter the folding path 710.

[90] A second guide member 782 is at an exit of the second guide path 762. The second guide member 782 may move from a second escape location a2 to a second guide location b2. For example, the second guide member 782 may be installed at a rotation axis of the second roller 722 so as to be capable of rotating to the second escape location a2 and the second guide location b2. Although not illustrated, the second guide member 782 is rotated to the second escape location a2 and the second guide location b2 by an actuator. The actuator may be, for example, a rotation motor. The rotation motor may be connected to the second guide member 782, for example, by a gear. At the second guide location b2, the second guide member 782 guides the paper P so that the paper P fed along the second guide path 762 may stably enter the folding path 710.

[91] According to the above configuration, the paper P having come out from the guide path may stably enter the folding path 710, and thus, a second or subsequent folding operation may be stably performed.

[92] The first guide member 781 may further have a first blocking location c1. The first blocking location c1 is a location for blocking the paper P that comes out from the second guide path 762 and is fed along the folding path 710 in a reverse direction from reversely entering the first guide path 761 via an exit of the first guide path 761. Likewise, the second guide member 782 may further have a second blocking location c2. The second blocking location c2 is a location for blocking the paper P that comes out from the first guide path 761 and is fed along the folding path 710 in a forward direction from reversely entering the second guide path 762 via an exit of the second guide path 762.

[93] According to the above configuration, the paper P having come out from the first and second guide paths 761 and 762 may be blocked from reversely entering the second and first guide paths 762 and 761. Thus, an operational error of a sheet folding apparatus may be prevented, and operation reliability of the sheet folding apparatus may be improved.

[94] FIG. 16 shows an example of a double gate fold process using the sheet folding apparatus 700c illustrated in FIG. 15. In FIG. 16, only the first and second rollers 721 and 722, the positioning member 740, the push member 750, the first and second shift members 731 and 732, and the first and second guide members 781 and 782 are briefly illustrated.

[95] As illustrated in FIG. 16(a), the positioning member 740 is located such that a $\frac{1}{4}L$ point of the paper P is located at an entrance of the folding nip N. The first guide member 781 is placed in the first guide location b1, and the second guide member 782

is placed in the second blocking location c2 for blocking the paper P that is fed along the folding path 710 in a forward direction from entering the second guide path 762 via an exit thereof. The paper P is fed along the folding path 710. In an example, the paper P may be discharged from a printer, such as printer 100, and fed along the folding path 710. The first end PF of one piece or a plurality of pieces of paper P is supported by the positioning member 740. The first guide member 781 is moved to the first escape location a1, and the second guide member 782 is moved to the second escape location a2. The $\frac{1}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to an insertion location (FIG. 16(b)). As the paper P passes through the folding nip N, the $\frac{1}{4}L$ point is folded. The push member 750 returns to a retreat location.

[96] The paper P having passed through the folding nip N is fed around a roller on an opposite side of the first end PF of the paper P from among the first and second rollers 721 and 722, that is, the first roller 721, and is returned to the entrance of the folding nip N. To achieve this, the first shift member 731 is placed in a first shift location, and the paper P having passed through the folding nip N is returned to the entrance of the folding nip N along the first guide path 761. In this regard, the first guide member 781 is placed in the first guide location b1 for guiding the paper P to the folding path 710, and the second guide member 782 is placed in the second blocking location c2 for blocking the paper P that is fed along the folding path 710 in the forward direction from entering the second guide path 762 (FIG. 16(c) and FIG. 16(d)). When the paper P is fed along the folding path 710 in the forward direction, and a $\frac{3}{4}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 16(e)), the first and second guide members 781 and 782 are respectively moved to the first and second escape locations a1 and a2, and the $\frac{3}{4}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 16(f)). The push member 750 returns to the retreat location.

[97] The paper P having passed through the folding nip N for the second time is fed around the second roller 722 and is returned to the entrance of the folding nip N. To achieve this, the second shift member 732 is placed in a second shift location, and the paper P having passed through the folding nip N for the second time is returned to the entrance of the folding nip N along the second guide path 762 (FIG. 16(g)). The second guide member 782 is placed in the second guide location b2, and the first guide member 781 is placed in the first blocking location c1 for blocking the paper P that is fed along the folding path 710 in a reverse direction from entering the first guide path 761 via an exit thereof. When the paper P is fed along the folding path 710 in the reverse direction, and a $\frac{1}{2}L$ point of the paper P reaches the vicinity of the folding nip N (FIG. 16(h)), the first and second guide members 781 and 782 are respectively

moved to the first and second escape locations a1 and a2, and the $\frac{1}{2}L$ point of the paper P is pushed into the folding nip N by moving the push member 750 to the insertion location (FIG. 16(i)). The first and second shift members 731 and 732 are placed in discharge locations. Accordingly, the paper P folded in the form of a double gate is discharged by the discharge roller 760 (FIG. 16(j)). The push member 750 returns to the retreat location.

[98] The first and second blocking locations c1 and c2 of the first and second guide members 781 and 782 may be respectively locations for guiding the paper P having come out from the first and second guide paths 761 and 762 to go into the folding nip N again. Independently of the first and second blocking locations c1 and c2, the first and second guide members 781 and 782 may further have first and second re-entry locations for guiding the paper P having come out from the first and second guide paths 761 and 762 to go into the folding nip N again.

[99] When the paper P re-enters the folding nip N as described above, the folded paper P may be pressed between the first and second rollers 721 and 722 one more time, and thus, a vivid folding line may be obtained.

[100] FIG. 17 shows a process of allowing paper P folded in the form of a double gate to re-enter a folding nip N. After the process of FIG. 16(i), as illustrated in FIG. 17(a), for example, the first shift member 731 is shifted to the first shift location so that the paper P folded in the form of a double gate enters the first guide path 761. The first guide member 781 is moved to the first blocking location c1 (or a first re-entry location d1) (FIG. 17(b)). As a result, as illustrated in FIG. 17(c), the paper P having come out from the first guide path 761 re-enters the folding nip N. In this regard, the first and second shift members 731 and 732 are placed in the discharge locations, and the paper P is discharged by the discharge roller 760 (FIG. 17(d)). If necessary, the operations of FIG. 17(a) to (c) may be performed two or more times.

[101] The above re-entry process may be applied to 4-fold, Z-fold, W-fold, 3-fold outside, C-fold, double gate fold, and roll-fold.

[102] It should be understood that examples described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each example should typically be considered as available for other similar features or aspects in other examples.

[103] While one or more examples have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the inventive concept as defined by the following claims.

[104]

Claims

- [Claim 1] A sheet folding apparatus comprising:
a folding path;
a positioning member to support a first end of a printing medium which is fed along the folding path and arrange the printing medium in an initial folding location;
a folding roller comprising a pair of rollers rotatably engaging with each other to form a folding nip;
a push member to move to an insertion location for pushing the printing medium on the folding path into the folding nip, and move to a retreat location for escaping from the folding path;
a guide path for returning the printing medium having passed through the folding nip to the folding path, the guide path provided around at least one of the pair of rollers; and
a shift member, located at an exit of the folding nip, to selectively guide the printing medium.
- [Claim 2] The sheet folding apparatus of claim 1, wherein a length of the guide path is equal to or greater than $1/3$ of a maximum printing medium length.
- [Claim 3] The sheet folding apparatus of claim 1,
wherein the at least one of the pair of rollers defines an inner guide of the guide path, and
wherein an outer circumferential length of a roller from among the pair of rollers defining the inner guide of the guide path is equal to or greater than $1/3$ of a maximum printing medium length.
- [Claim 4] The sheet folding apparatus of claim 1, wherein the guide path comprises an inner path adjacent to the roller, and an outer path located at an outer side of the inner path.
- [Claim 5] The sheet folding apparatus of claim 4, further comprising a gate member to selectively guide the printing medium to the inner path or the outer path.
- [Claim 6] The sheet folding apparatus of claim 1, further comprising a guide member to selectively move to a guide location for guiding the printing medium coming out from the guide path to the folding path or an escape location for escaping from the guide location.
- [Claim 7] The sheet folding apparatus of claim 6, wherein the guide member rotates on an axis of a roller from among the pair of rollers around

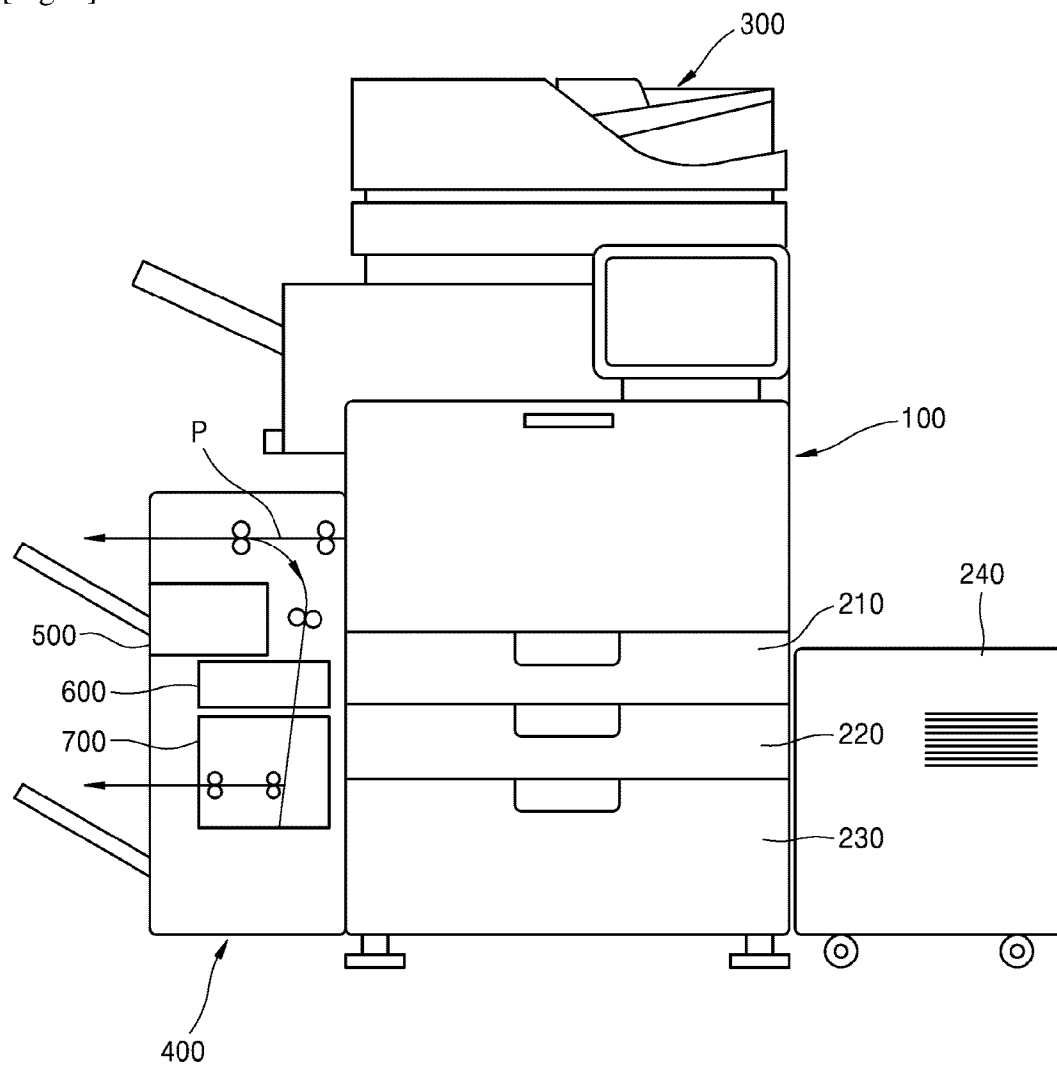
- which the guide path is disposed.
- [Claim 8] The sheet folding apparatus of claim 6, wherein the guide member moves to a re-entry location for allowing the printing medium coming out from the guide path to re-enter the folding nip.
- [Claim 9] The sheet folding apparatus of claim 6, wherein the guide member moves to a blocking location for blocking the printing medium on the folding path from reversely entering the guide path.
- [Claim 10] The sheet folding apparatus of claim 1, wherein the pair of rollers comprises a first roller and a second roller, wherein the guide path comprises a first guide path around the first roller and a second guide path around the second roller, wherein the shift member comprises a first shift member to selectively guide the printing medium having passed through the folding nip to the first guide path and a second shift member to selectively guide the printing medium having passed through the folding nip to the second guide path, and wherein a length of each of the first and second guide paths is equal to or greater than 1/3 of a maximum printing medium length.
- [Claim 11] The sheet folding apparatus of claim 10, wherein the first and second rollers define inner guides of the first and second guide paths, and wherein an outer circumferential length of each of the first and second rollers is equal to or greater than 1/3 of a maximum printing medium length.
- [Claim 12] The sheet folding apparatus of claim 10, further comprising a gate member, wherein at least one of the first guide path or the second guide path comprises an inner path adjacent to a corresponding roller, and an outer path located at an outer side of the inner path, and wherein the gate member selectively guides the printing medium to the inner path or the outer path.
- [Claim 13] The sheet folding apparatus of claim 10, further comprising first and second guide members to selectively move to a guide location for guiding the printing medium coming out from the first and second guide paths to the folding path or an escape location for escaping from the guide location.
- [Claim 14] The sheet folding apparatus of claim 13, wherein the first and second guide members move to a re-entry location for allowing the printing

medium coming out from the first and second guide paths to re-enter the folding nip.

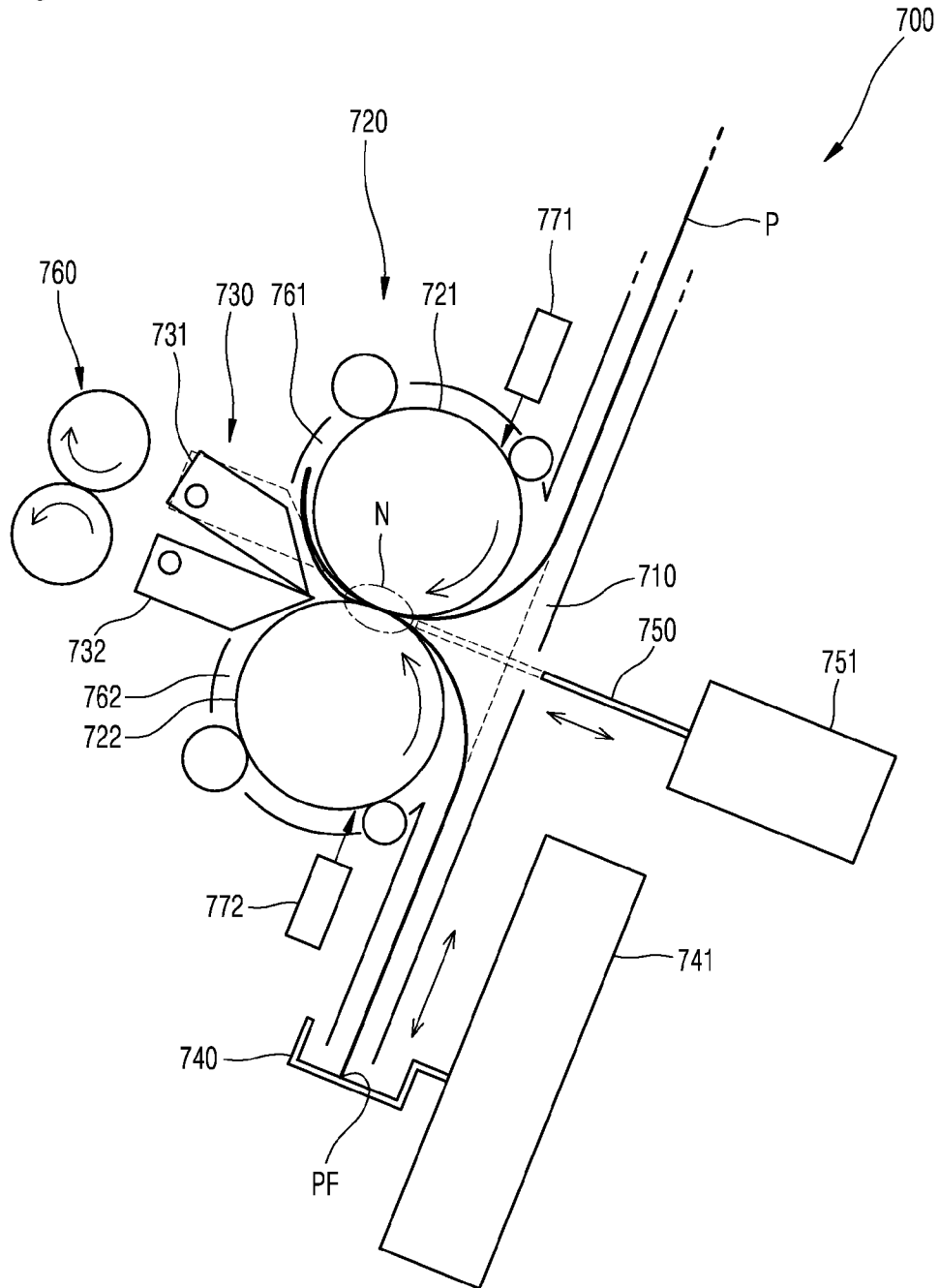
[Claim 15]

The sheet folding apparatus of claim 13, wherein the first and second guide members move to a blocking location for blocking the printing medium on the folding path from reversely entering the first and second guide paths.

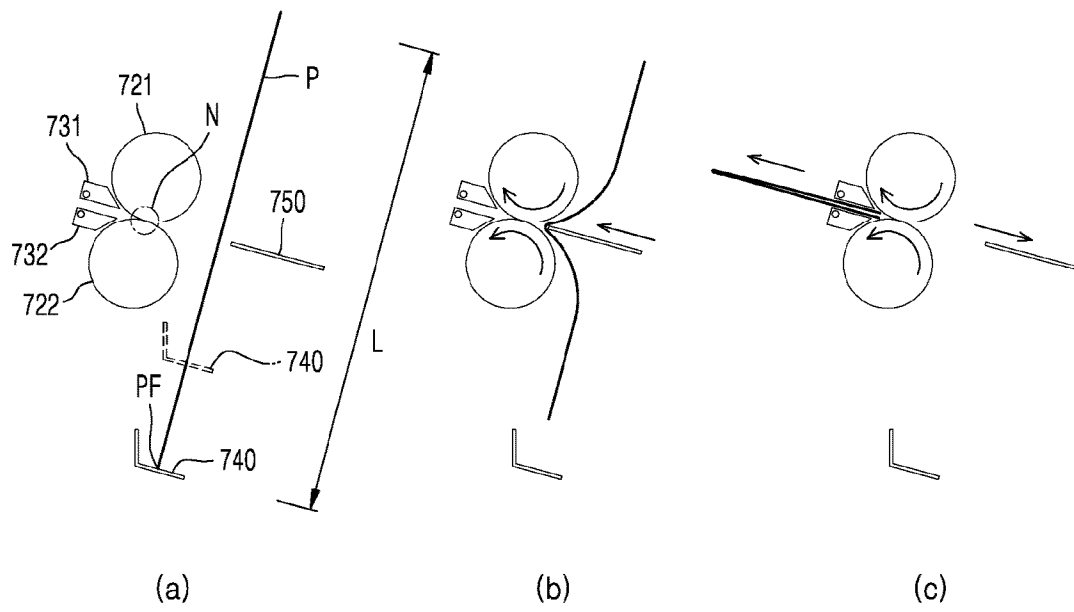
[Fig. 1]



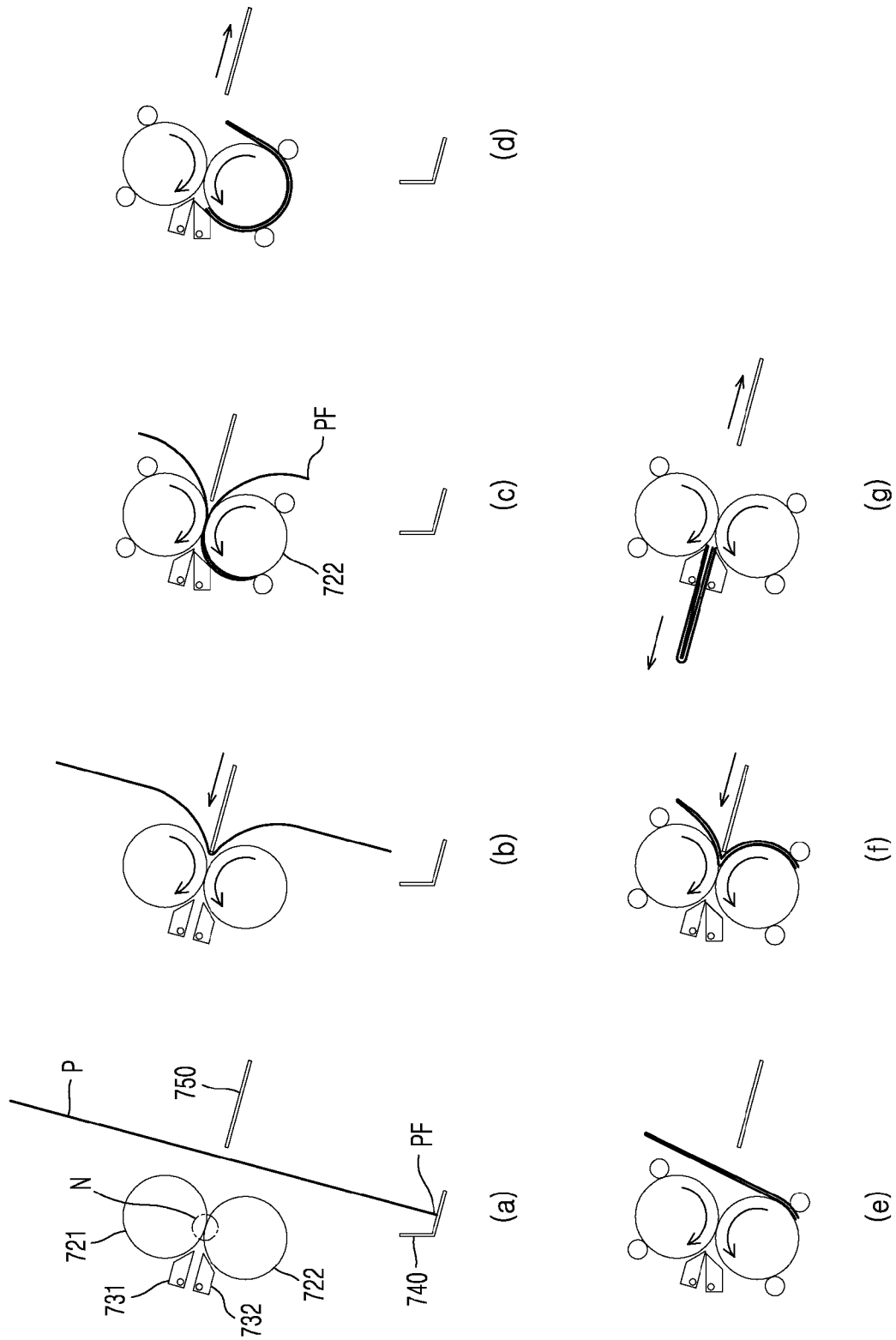
[Fig. 3]



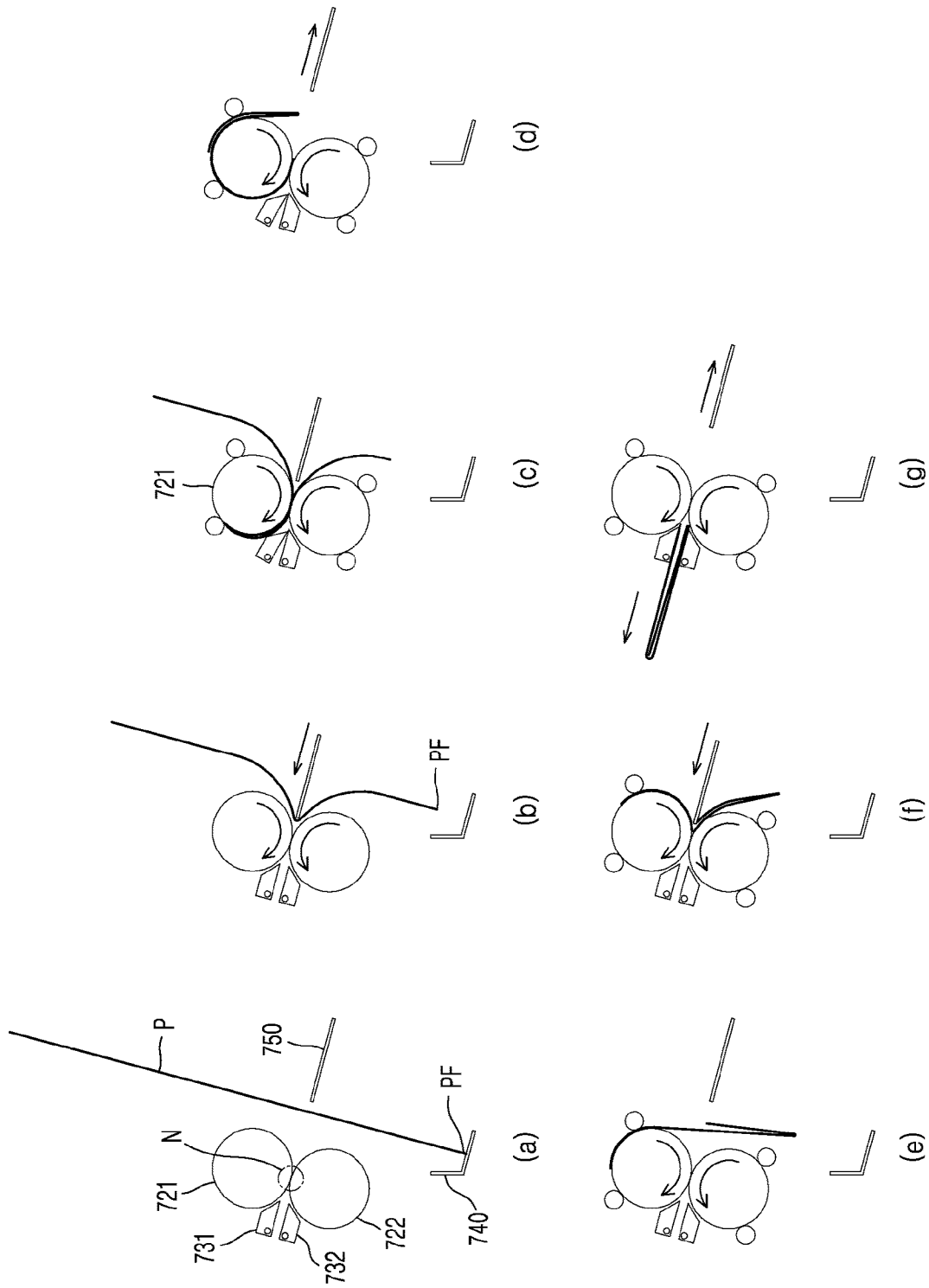
[Fig. 5]



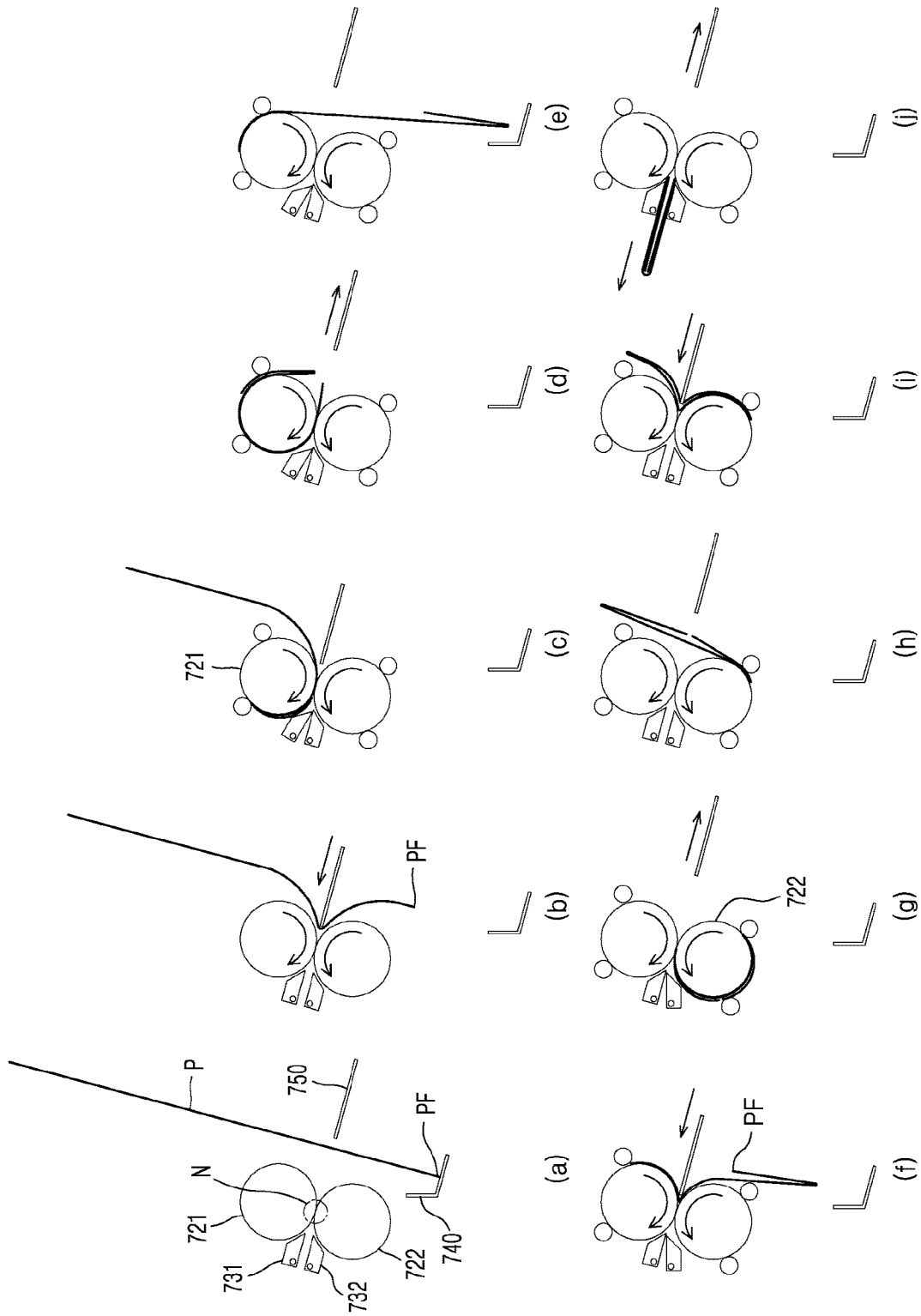
[Fig. 6]



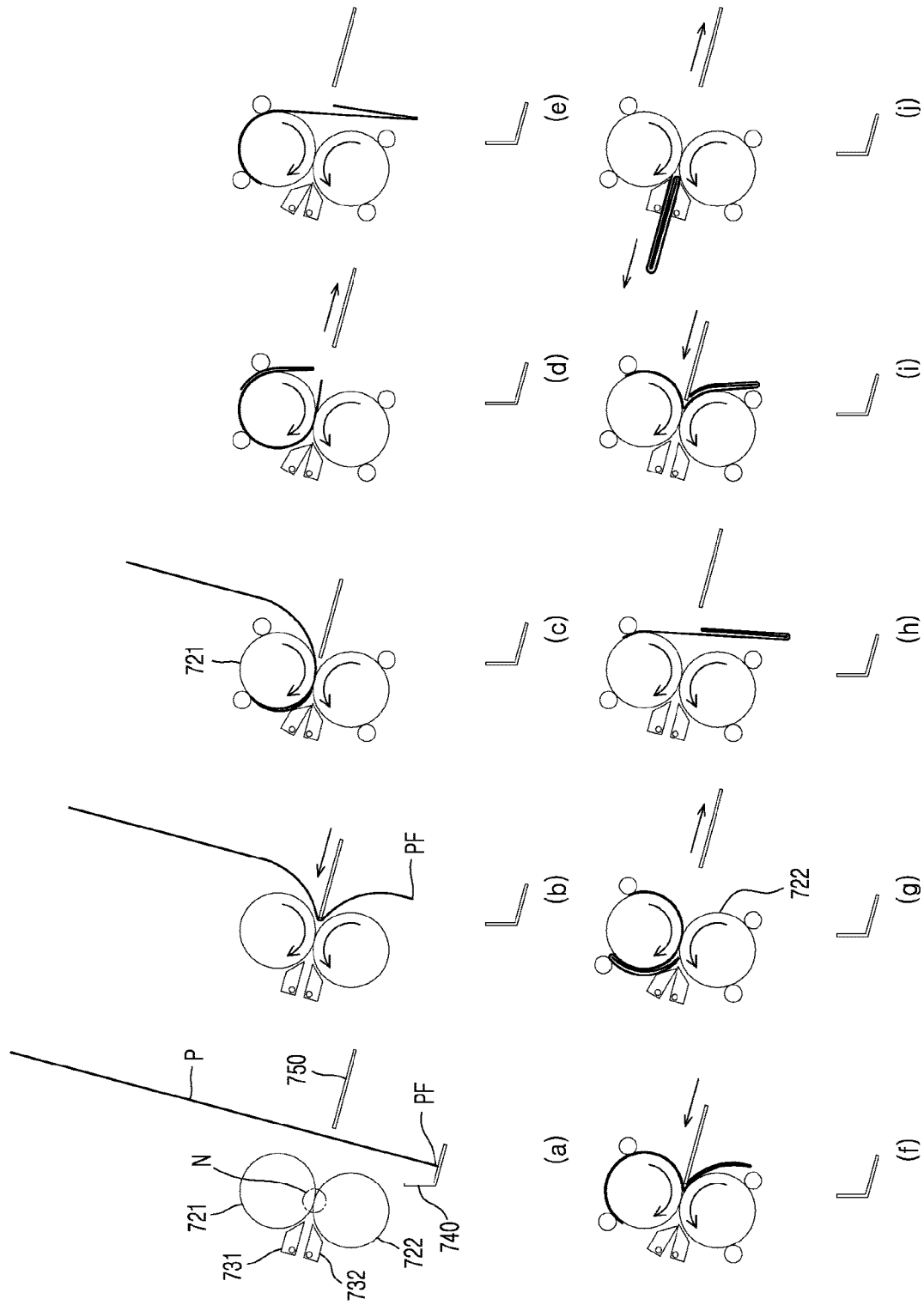
[Fig. 8]



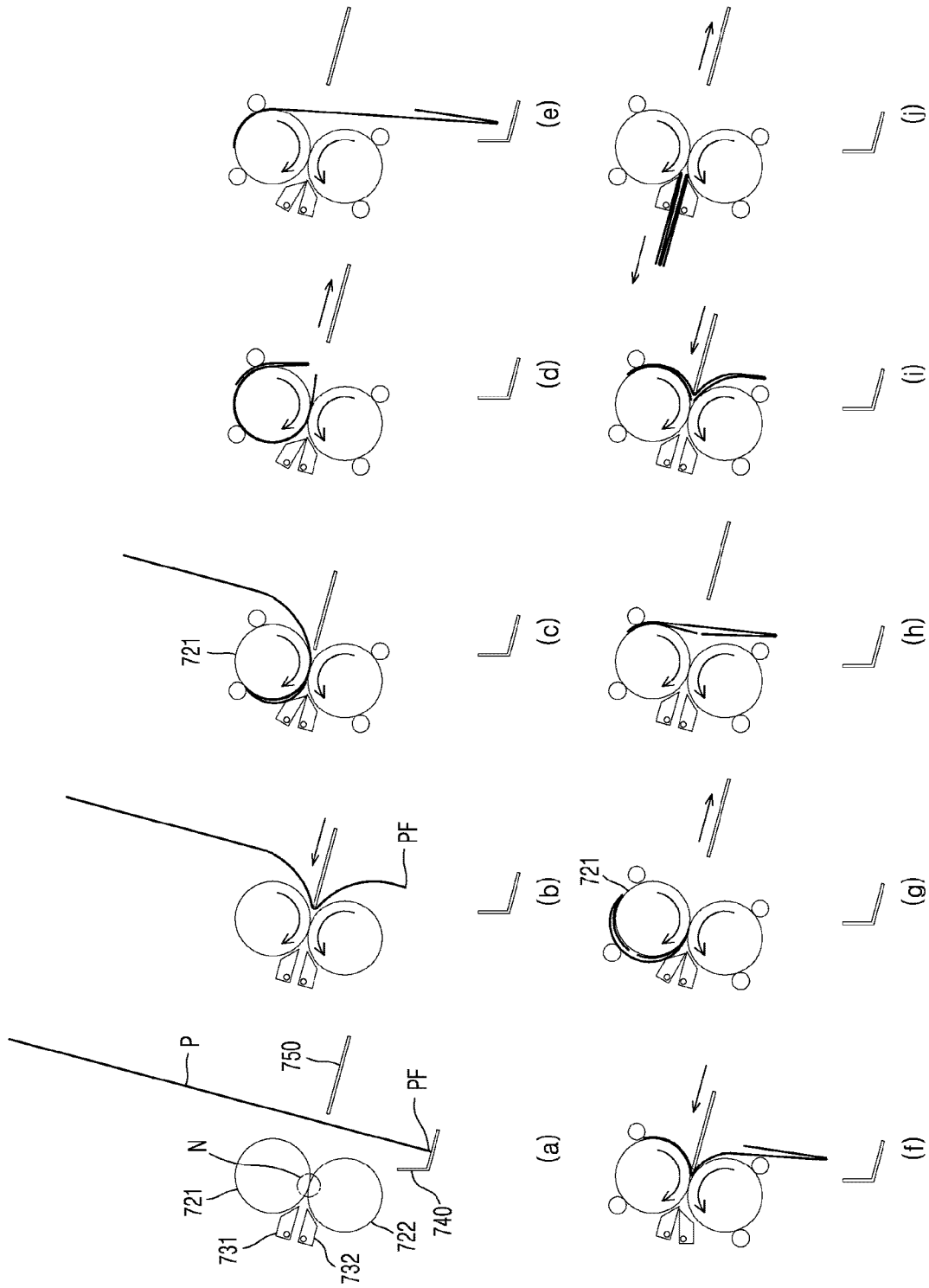
[Fig. 9]



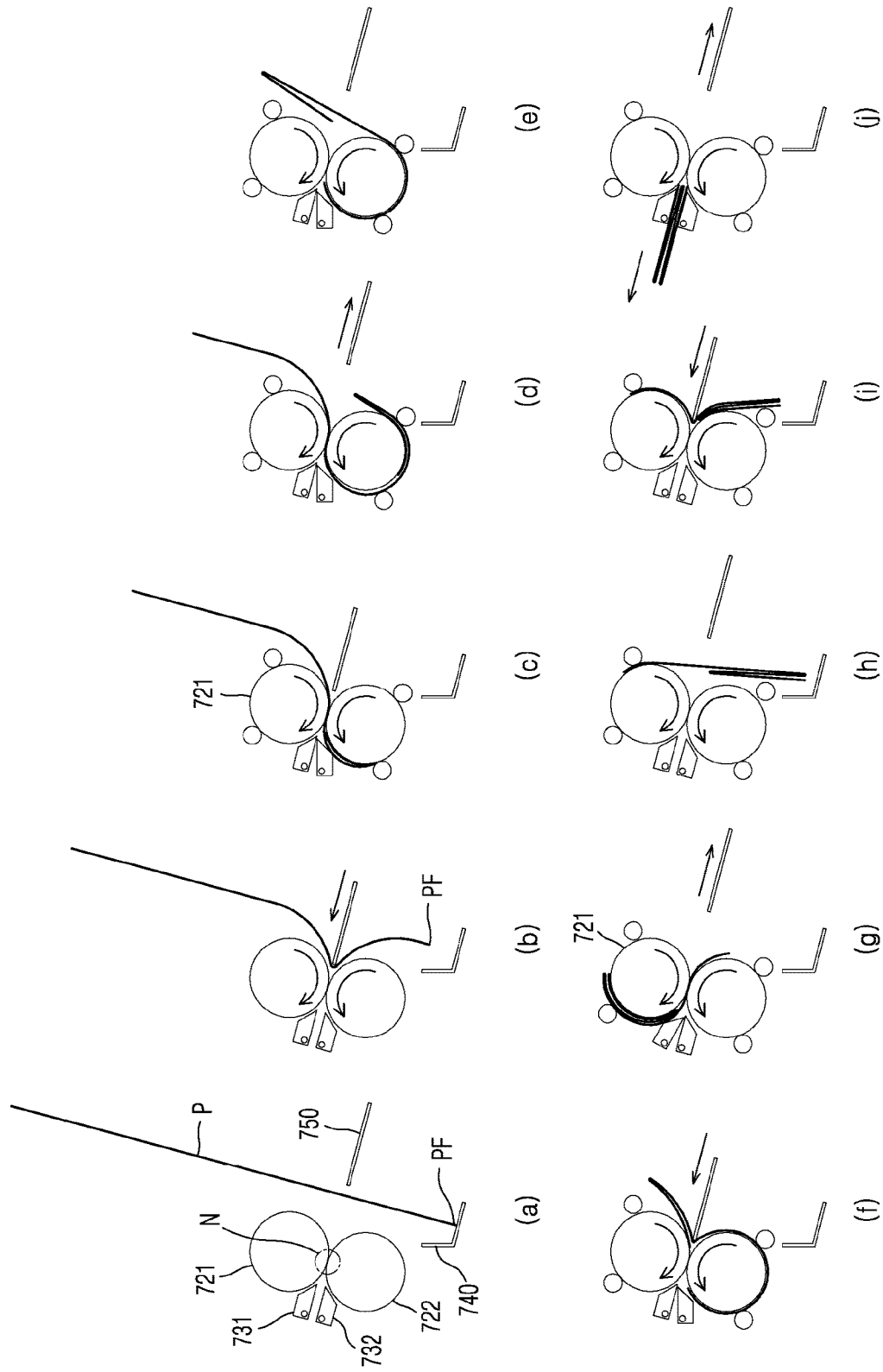
[Fig. 10]



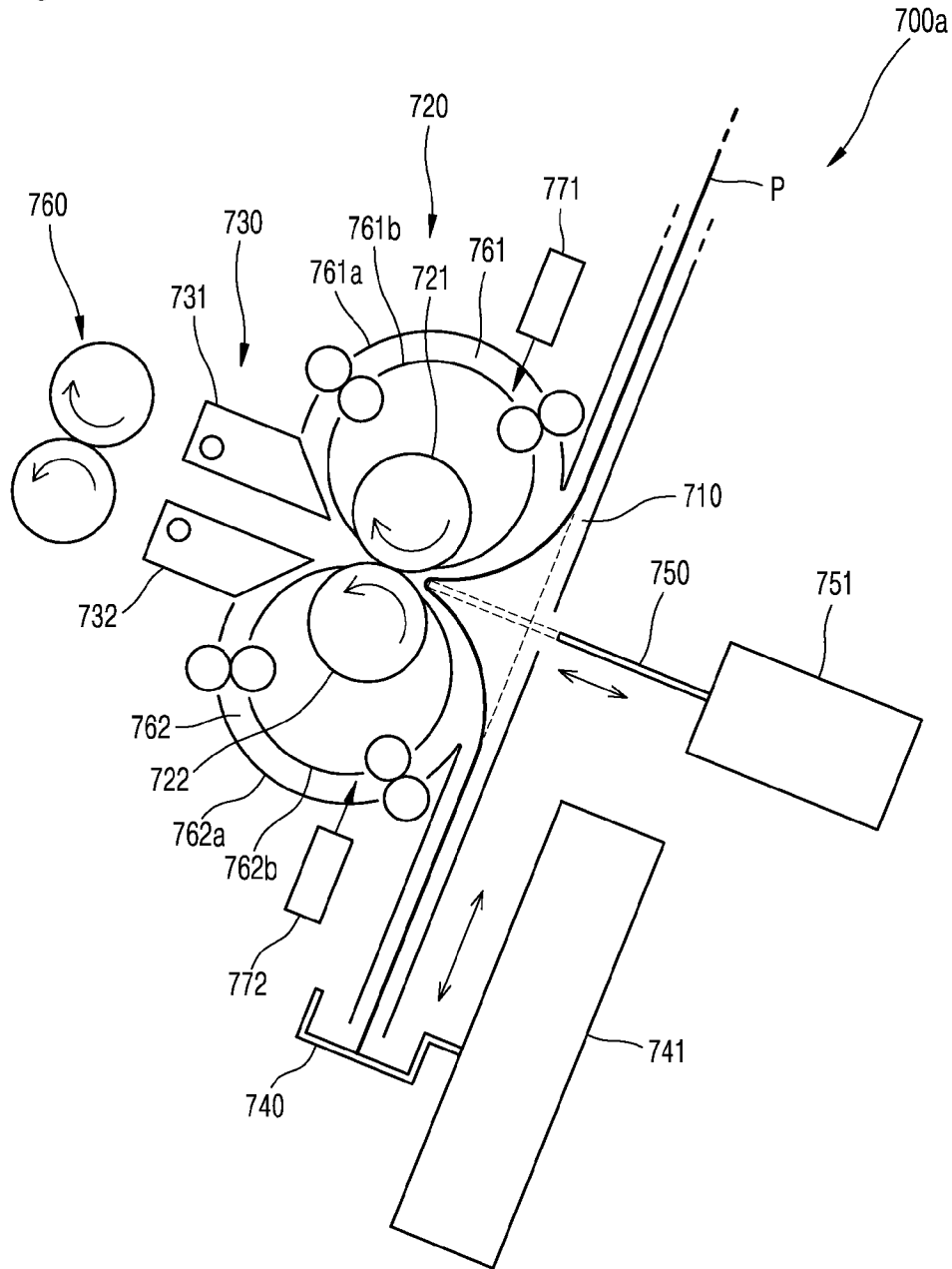
[Fig. 11]



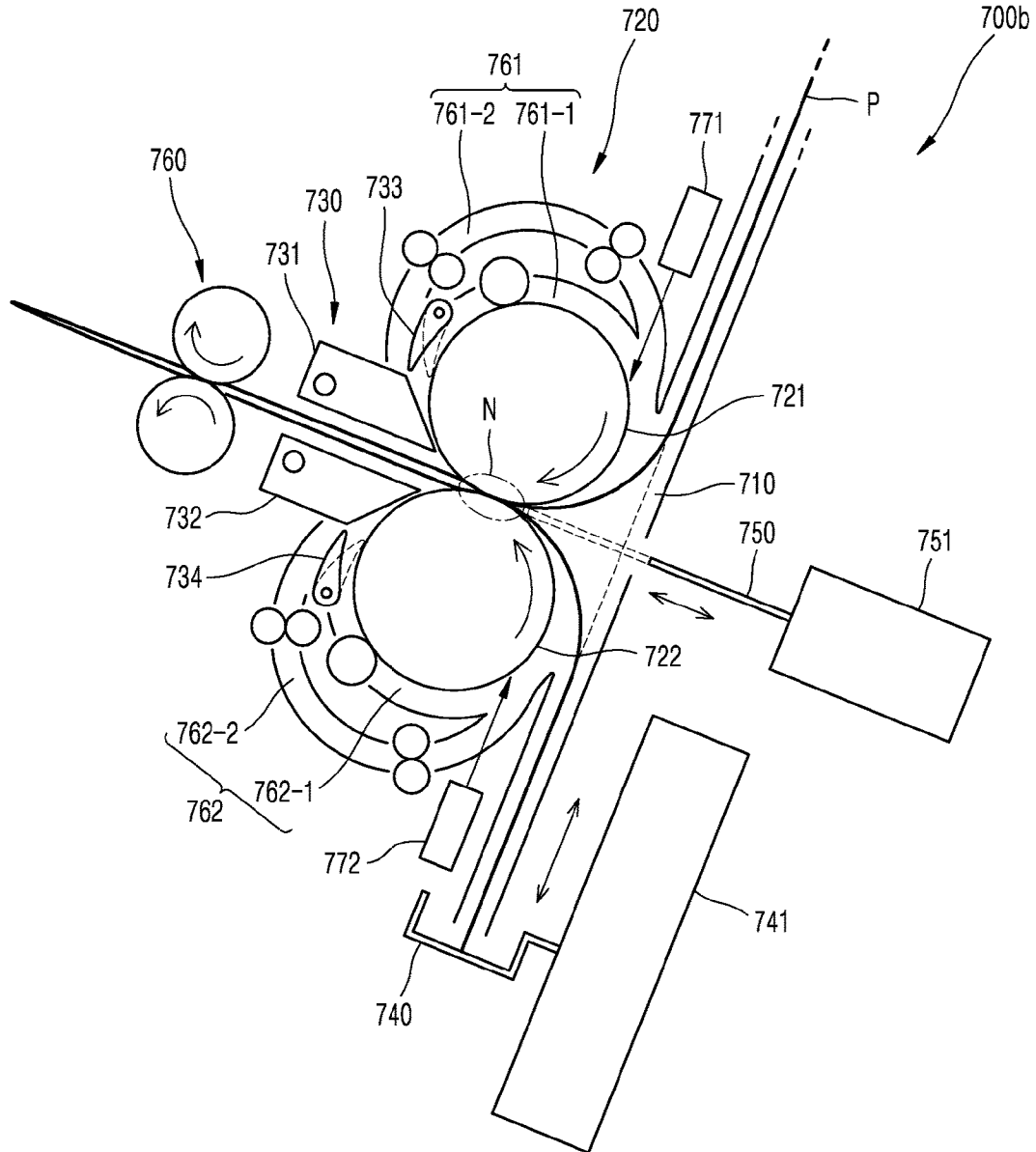
[Fig. 12]



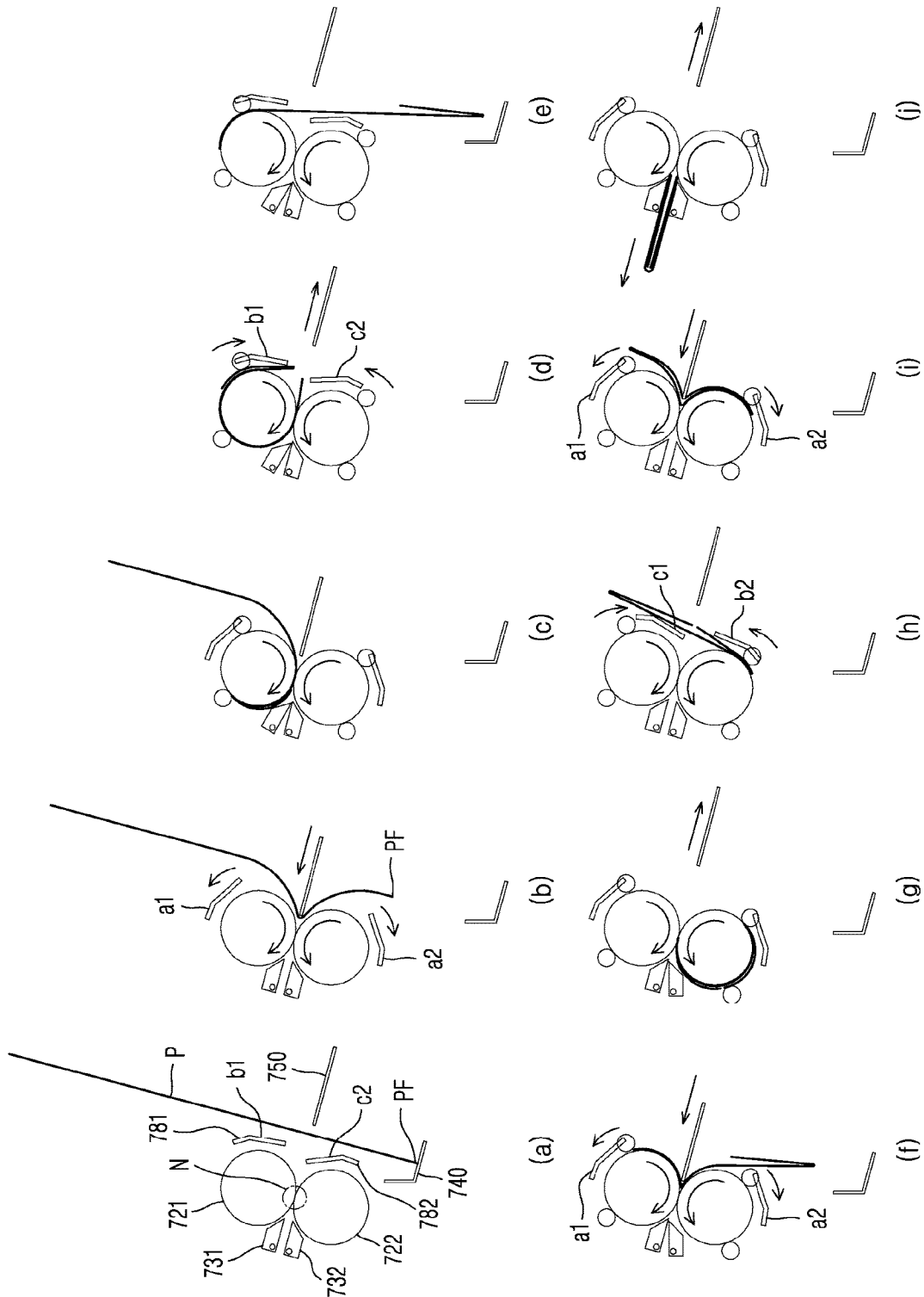
[Fig. 13]



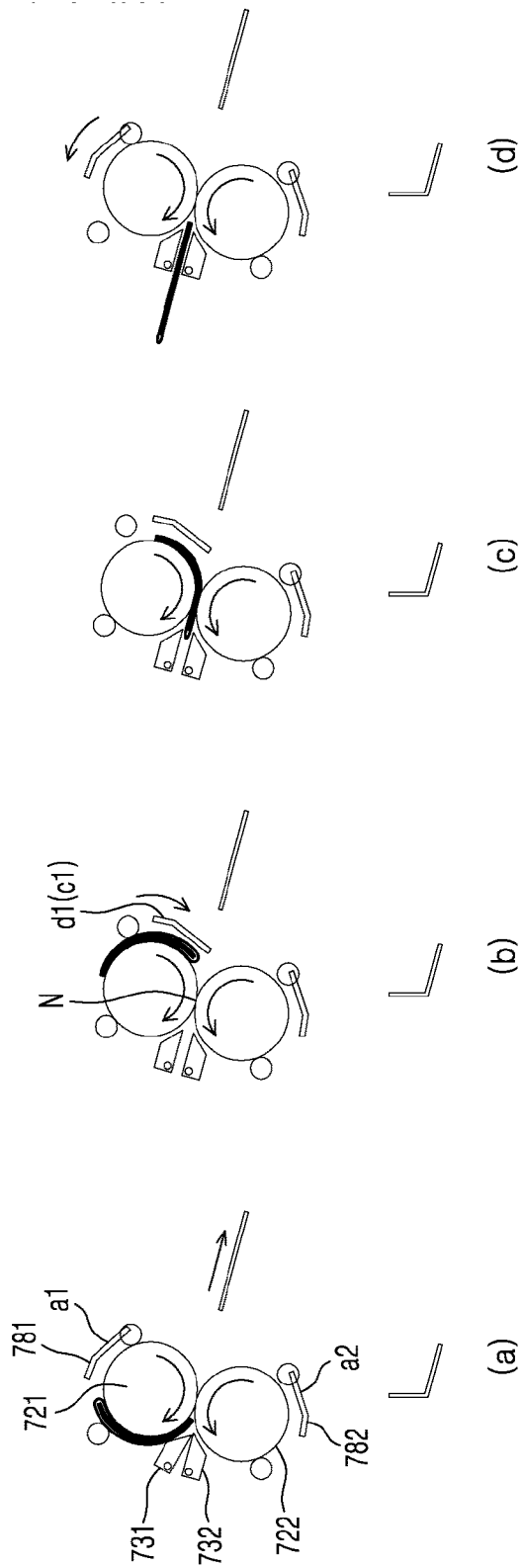
[Fig. 14]



[Fig. 16]



[Fig. 17]



A. CLASSIFICATION OF SUBJECT MATTER**B65H 45/04(2006.01)i, B65H 45/16(2006.01)i, B65H 37/04(2006.01)i**

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)

B65H 45/04; B65H 45/14; B31F 1/08; B65H 45/30; B41F 13/56; B31B 1/14; B65H 45/16; B65H 37/04

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: printer, copy, sheet, folding, paper, roller, push, rod, guide, nip, gate, member, apparatus

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005-0037906 A1 (SPARANO et al.) 17 February 2005	1-4, 10-11
A	See paragraphs [0009], [0011]-[0012]; claim 1; and figures 1-3.	5-9, 12-15
Y	JP 2011-168387 A (RICOH ELEMEX CORP.) 01 September 2011	1-4, 10-11
A	See paragraphs [0028], [0032]; and figure 3.	
A	US 2002-0046666 A1 (BIALEK, HERBERT) 25 April 2002	1-15
A	See paragraphs [0047]-[0049]; and figure 3.	
A	US 2005-0079968 A1 (TROVINGER, STEVEN W.) 14 April 2005	1-15
A	See paragraphs [0030]-[0031]; and figures 3A-3D.	
A	US 2008-0234118 A1 (ISHIDA et al.) 25 September 2008	1-15
A	See paragraphs [0019]-[0032], [0036]-[0037]; and figures 1, 4.	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

13 April 2018 (13.04.2018)

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International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

HWANG, Chan Yoon

Telephone No. +82-42-481-3347



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2018/000420

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005-0037906 A1	17/02/2005	CN 1579800 A CN 1579800 C EP 1506879 A2 EP 1506879 A3 EP 1506879 B1 JP 2005-060112 A JP 4659408 B2 US 6939283 B2	16/02/2005 03/12/2008 16/02/2005 22/03/2006 02/07/2008 10/03/2005 30/03/2011 06/09/2005
JP 2011-168387 A	01/09/2011	JP 5564976 B2	06/08/2014
US 2002-0046666 A1	25/04/2002	DE 10143042 A1 US 6669619 B2	02/05/2002 30/12/2003
US 2005-0079968 A1	14/04/2005	US 7101332 B2	05/09/2006
US 2008-0234118 A1	25/09/2008	CN 101100253 A EP 1854752 A1 JP 2007-302383 A	09/01/2008 14/11/2007 22/11/2007