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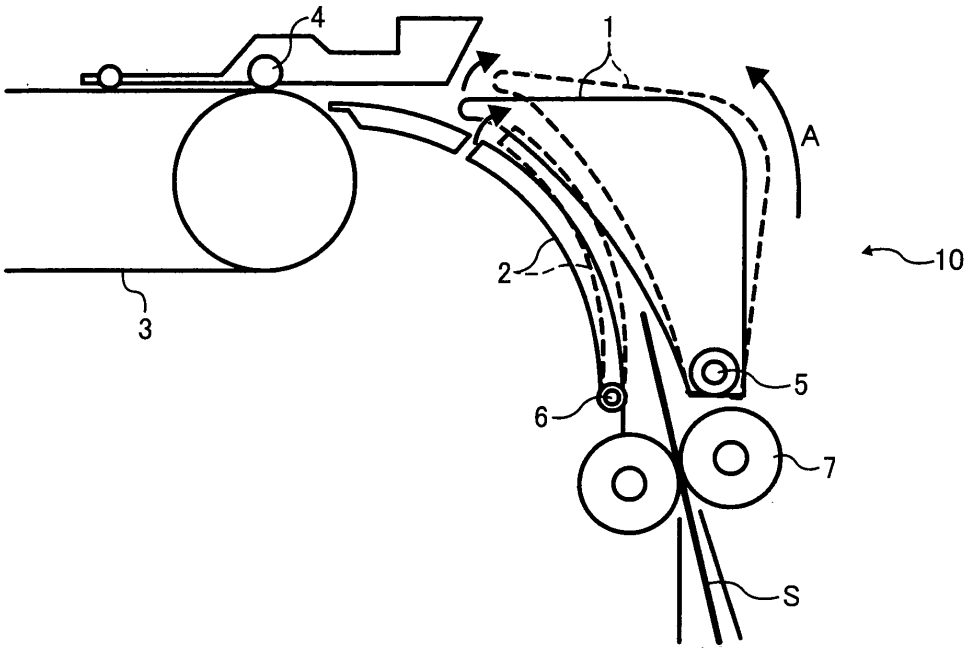
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(54) **Image forming apparatus including sheet transfer unit**

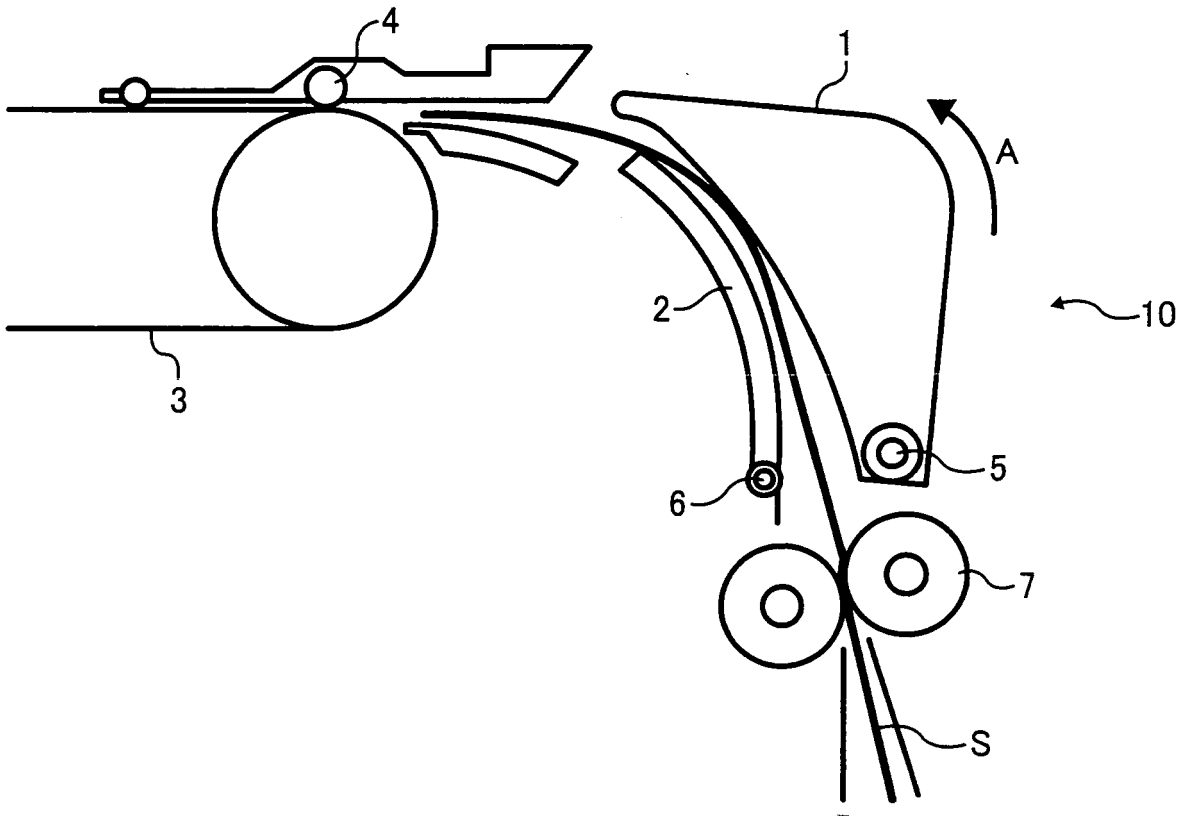
(57) An image forming apparatus (100) includes an image forming mechanism (20) to form an image on a sheet and a sheet transfer unit (10) to transfer a sheet to the image forming mechanism (20). The sheet transfer unit (10) includes a sheet conveying member (3), an input roller (4), an outer guide (1), and a sheet pusher (2, 23, 31, 51). The sheet conveying member (3) is mounted at a position opposite to the input roller (4). The input roller (4) transfers the sheet into the image forming mechanism (20). The outer guide (1) is swingably movable around a support point (5) and mounted at a position where the sheet is curved to guide an outer surface of the sheet. The pusher (2, 23, 31, 51) is mounted at a position opposite to the outer guide (1) and pushes an inner surface of the sheet against the outer guide (1).

FIG. 3A




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FIG. 3B



## Description

**[0001]** The present invention generally relates to an image forming apparatus including a sheet transfer unit, capable of preventing wrinkles or folds of a sheet during sheet transfer.

**[0002]** In general, a related-art image forming apparatus such as a copying machine, a printer, facsimile machine, etc., employing an ink-jet method or electronographic method is provided with a sheet transfer unit and an image forming unit. In such an image forming apparatus, the sheet transfer unit sends a sheet to and from the image forming unit, and the image forming unit forms an image with toner or ink on the sheet.

**[0003]** Such a sheet transfer unit has been improved to include a sheet guide-function for smooth sheet transfer. The sheet guide sandwichingly guides a sheet from both surface of the sheet.

**[0004]** FIGs. 1A illustrate one example of a sheet transfer unit for use in the related-art image forming apparatus employing an ink-jet recording method.

**[0005]** As illustrated in FIG. 1A, the sheet transfer unit includes an outer guide plate 91, a support point 92, an inner guide plate 93, an electrostatic conveyance belt 94, and an input roller 95. The outer guide plate 91 is provided upstream of the input roller 95 in a sheet transfer direction, and swingably fixed by the support point 92. The outer guide plate 91 and inner guide plate 93 sandwichingly guide a sheet S that is forwarded to the electrostatic conveyance belt 94. The electrostatic conveyance belt 94 transfers the sheet S. The input roller 95 facing the electrostatic conveyance belt 94 allows the sheet S to electrostatically adhere to the electrostatic conveyance belt 94. When a front edge of the sheet S reaches the input roller 95, the outer guide plate 91 is swung so that space between the inner guide plate 93 and the outer guide plate 91 is enlarged. The enlarged space allows the sheet S to be curved. Therefore, a transfer load of the sheet S to the electrostatic conveyance belt 94 is reduced.

**[0006]** However, as shown in Fig. 1B, when a front edge of the sheet S reaches the input roller 95 and the sheet S is being curved or kept curved, the sheet S may be folded or wrinkled due to anisotropy of fibers depending its material. When the sheet S transferred to the image forming part is folded or wrinkled, the sheet S may not properly adheres to the electrostatic conveyance belt 94. When the sheet S transferred to the image forming part is wrinkled, a defective image may be produced. Such a sheet transfer unit may be used in an image forming apparatus employing an electronographic method, when a long sheet is used.

**[0007]** This patent specification describes an image forming apparatus that may prevent wrinkles and/or folds of a sheet when the sheet is curved during sheet transfer. In one example, the image forming apparatus includes an image forming mechanism to form an image on a sheet, and a sheet transfer unit configured to transfer a sheet to the image forming mechanism. The sheet transfer unit includes an input roller, a sheet conveying member, an outer guide, and a sheet pusher. The input roller transfers the sheet into the image forming mechanism. The sheet conveying member is mounted at a position opposite to the input roller. The outer guide is mounted in a manner swingably movable around a support point at a position along a sheet transfer passage where a sheet transfer direction is changed and the sheet is curved accordingly so as to guide the sheet along an outer surface of the sheet. The pusher is mounted at a position opposite to the outer guide relative to the sheet along the sheet transfer passage in the sheet transfer unit and configured to assist a growth of a curve of the sheet by pushing an inner surface of the sheet against the outer guide.

**[0008]** According to the above image forming apparatus, an image defect resulting from a wrinkle and/or a fold of a sheet may be prevented.

**[0009]** A more complete appreciation of the disclosure and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description of exemplary embodiments and the accompanying drawings, wherein:

FIGs. 1A and 1B are illustrations of a related-art sheet transfer unit;

FIG. 2 is a schematic diagram illustrating a major part of an ink-jet image forming apparatus according to an exemplary embodiment of the present invention;

FIG. 3A and 3B are illustrations of a sheet transfer unit included in the image forming apparatus of FIG. 2;

FIGs. 4A and 4B are illustrations of another sheet transfer unit according to an exemplary embodiment of the present invention;

FIGs. 5A and 5B are illustrations of another sheet transfer unit according to an exemplary embodiment of the present invention;

FIGs. 6A and 6B are illustrations of another sheet transfer unit according to an exemplary embodiment of the present invention;

FIGs. 7A and 7B are illustrations of another sheet transfer unit according to an exemplary embodiment of the present invention;

FIGs. 8A and 8B are illustrations of another sheet transfer unit according to an exemplary embodiment of the present invention; and

FIGs. 9A and 9B are illustrations of another sheet transfer unit according to an exemplary embodiment of the present invention.

**[0010]** In describing preferred embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent specification is not intended to be limited to the specific

terminology so selected and it is to be understood that each specific element includes all technical equivalents that operate in a similar manner. Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, particularly to FIG. 2, an ink-jet image forming apparatus 100 according to an exemplary embodiment of the present invention is described.

**[0011]** As illustrated in FIG. 2, the ink-jet image forming apparatus 100 includes a sheet transfer unit 10 and a carriage 20. The sheet transfer unit 10 includes an outer guide plate 1, an inner guide plate 2, and an electrostatic conveyance belt 3. The carriage 20 includes a guide rod 21, a guide stay (not shown), and an ink-jet recording head (not shown). The carriage 20 further includes a main scanning motor (not shown), a timing belt, a driving pulley (not shown), and a driven pulley (not shown).

**[0012]** The sheet transfer unit 10 forwards a sheet toward the carriage 20 that is an image forming mechanism. The outer guide plate 1 and the inner guide plate 2 face each other and are provided upstream of the electrostatic conveyance belt 3 in a sheet transfer direction. The outer guide plate 1 and the inner guide plate 2 guide the sheet, which is described in detail later. The electrostatic belt 3 is a sheet conveying member, and transfers the sheet by using electrostatic effect.

**[0013]** The carriage 20 is movably supported by the guide rod 21 and guide stay. The carriage 20 is movable in a main scanning direction by the main motor by way of the timing belt. The ink-jet recording head discharges ink droplets to form an image on a surface of the sheet. The timing belt spans between the driving pulley and driven pulley. The ink-jet recording head mounted on the carriage 20 that moves in the main scanning direction discharges ink droplets on the sheet transferred in a sheet transfer direction as a sub-scanning direction.

**[0014]** Although the ink-jet image forming apparatus 100 is described above as an exemplary embodiment of the present invention, the present invention may be applied to an image forming apparatus employing an electrophotographic method such as a copying machine, a printer, facsimile machine, and a multifunction peripheral (MFP).

**[0015]** The sheet transfer unit 10 is described in detail, referring to FIGs. 3A and 3B. As illustrated in FIG. 3A, the sheet transfer unit 10 includes an input roller 4. The outer guide plate 1 includes a support point 5. The inner guide plate 2 includes a support point 6. The sheet transfer unit 10 further includes a pair of rollers 7 provided downstream of the outer guide plate 1 and inner guide plate 2.

**[0016]** The outer guide plate 1 guides a sheet S from an outside of an arc of the sheet S. The inner guide plate 2 includes a curved guide surface facing the outer guide plate 1, and may serve as a sheet pusher, in addition to guiding the sheet S from an inside of the arc. The sheet S is transferred in a direction of an arrow A (sheet transfer direction). The outer guide plate 1 is swingably fixed by the support point 5 provided at an edge of the outer guide plate 1 that is opposite to a side of the input roller 4 (an upstream edge in the sheet transfer direction). The inner guide plate 2 is swingably fixed by the support point 6 provided at one edge of the inner guide plate 2 that is opposite to the side of the input roller 4. The input roller 4 facing the electrostatic conveyance belt 3 allows the sheet S to electrostatically adhere to the electrostatic conveyance belt 3.

**[0017]** When the sheet S is fed into the image forming apparatus 100, the pair of rollers 7 transfers the sheet S to the outer guide plate 1 and inner guide plate 2. Until the sheet S reaches the input roller 4, the outer guide plate 1 and inner guide plate 2 are held at a waiting position shown in full line in Fig. 3A and enough space for transferring the sheet S is kept between them. When a front edge of the sheet S reaches the input roller 4, the outer guide plate 1 swingably moves around the support point 5 to further curve the sheet S. Simultaneously, the inner guide plate 2 swingably moves around the support point 6 to push the sheet S to the outer guide plate 1 and compulsorily retain the sheet to a side of the outer guide plate 1. As a result, the sheet S is stretched. Therefore, the inner guide plate 2 serves as the sheet pusher, and may prevent folds and wrinkles of the sheet S caused by anisotropy of fibers or the like. The above sheet transfer unit 10 may be used as a sheet transfer unit in which the sheet transfer direction is curved and the sheet is accordingly curved.

**[0018]** FIGs. 4A and 4B illustrate a sheet transfer unit 10a according to another exemplary embodiment of the present invention. The sheet transfer unit 10a includes an outer guide plate 1, an inner guide plate 21, a blower 23, an electrostatic conveyance belt 3, an input roller 4, and a pair of rollers 7. The outer guide plate 1 includes a support point 5. The inner guide plate 21 includes at least one vent 22 to an extent that a sheet transferring function is not affected.

**[0019]** The outer guide plate 1, the electrostatic transfer belt 3, the input roller 4, the support point 5, and the pair of rollers 7 function similarly to corresponding parts of the sheet transfer unit 10 of FIGs. 3A and 3B. The inner guide plate 21 guides a sheet S from an inside of an arc of the sheet S. The blower 23 applies wind pressure to the sheet S through the vent 23. The outer guide plate 1 is held at a waiting position shown in full line in Fig. 4A until the sheet S reaches the input roller 24. When a front edge of the sheet S reaches the input roller 4, the outer guide plate 1 swingably moves around the support point 5 to further curve the sheet S. Simultaneously, the blower 23 is driven to apply wind pressure to the sheet S through the vent 22.

**[0020]** Therefore, the sheet S is pushed to the outer guide plate 1 and is compulsorily retained to a side of the outer guide plate. As a result, the sheet S is stretched. Therefore, the blower 23 serves as a sheet pusher and may prevent folds and wrinkles of the sheet S caused by anisotropy of fibers or the like. Further, by using the blow-

er 23 as the pusher, the configuration of the image forming apparatus 100 may be simplified.

**[0021]** FIGs. 5A and 5B illustrate a sheet transfer unit 10b according to another exemplary embodiment of the present invention. The sheet transfer unit 10b includes an outer guide plate 1, an inner guide plate 32, an electrostatic conveyance belt 3, an input roller 4, and a pair of input rollers 7. The outer guide plate 1 includes a support point 5 and at least one guide roller 31. The inner guide plate 32 includes at least an opening 33.

**[0022]** The outer guide plate 1, the inner guide plate 32, the electrostatic conveyance belt 3, the input roller 4, the support point 5, and the pair of rollers 7 function similarly to corresponding parts of the sheet transfer unit 10a illustrated in FIGs. 4A and 4B.

**[0023]** The guide roller 31 is integrated to the outer guide plate 1, and includes a cylindrical roller for supporting a sheet S that is sandwiched between the cylindrical roller and the outer guide plate 1. The guide roller 31 rotates with a load that is light enough not to burden a sheet transfer part such as the electrostatic conveyance belt 4. The opening 33 is for the guide roller 31 to pass through the inner guide plate 32.

**[0024]** The outer guide plate 1 is held at a waiting position shown in full line in Fig. 5A until the sheet S reaches the input roller 4. When a front edge of the sheet S reaches the input roller 4, the outer guide plate 1 swingably moves around the support point 5 to further curve the sheet S. The guide roller 31 supporting a sheet S from an inside of the curved sheet S moves in conjunction with the outer guide plate 1. The guide roller 31 lifts up and compulsorily retains the sheet S to a side of the outer guide plate 1. As a result, the sheet S is stretched. Therefore, the guide roller 31 serves as a sheet pusher, and may prevent folds and wrinkles of the sheet S caused by anisotropy of fibers or the like. Further, respective control systems are not necessary when the pusher, e.g. the guide roller 31, is moved in conjunction with the outer guide plate 1, and/or is integrated to the outer guide plate 1. As a result, cost for the image forming apparatus 100 may be reduced.

**[0025]** Although the guide roller 31 of FIGs. 5A and 5B is integrated to the outer guide plate 1, the guide roller 31 may be independently provided. FIGs. 6A and 6B illustrate a sheet transfer unit 10c including at least one guide roller 41 that is separated from an outer guide plate 1. Other than that, the sheet transfer unit 10c has a similar configuration to the sheet transfer unit 10b illustrated in FIGs. 5A and 5B. Although independently provided, the guide roller 41 similarly functions to the guide roller 31 of the sheet transfer unit 10b.

**[0026]** When the pusher, e.g. the guide roller 41, is separated from the outer guide plate 1, the pusher may be moved according to degree of the curve of the sheet.

**[0027]** FIGs. 7A and 7B illustrate a sheet transfer unit 10d according to another exemplary embodiment of the present invention. The sheet transfer unit 10d includes an outer guide plate 1, an inner guide plate 32, an electrostatic conveyance belt 3, an input roller 4, and a pair of rollers 7. The outer guide plate 1 includes a support point 5 and a guide plate 51. The inner guide plate 32 includes an opening 33.

**[0028]** The outer guide plate 1, the inner guide plate 32, the electrostatic conveyance belt 3, the input roller 4, the support point 5, and the pair of rollers 7 function similarly to corresponding parts of the sheet transfer unit 10a illustrated FIGs. 4A and 4B.

**[0029]** The guide plate 51 is integrated to the outer guide plate 1, and includes a curved guide surface. The curved guide surface faces the outer guide plate 1, and is disposed so that a sheet S is sandwiched between the guide surface and the outer guide plate 1. The opening 33 is for the guide plate 51 to pass through the inner guide plate 32.

**[0030]** The outer guide plate 1 is held at a waiting position shown in full line in Fig. 7A until the sheet S reaches the input roller 4. When a front edge of the sheet S reaches the input roller 4, the outer guide plate 1 swingably moves around the support point 5 to further curve the sheet S. The guide plate 51 supporting a sheet S from an inside of the curve of the sheet S moves in conjunction with the outer guide plate 1. The guide plate 51 lifts up and compulsorily retains the sheet S to a side of the outer guide plate 1. As a result, the sheet S is stretched. Therefore, the guide plate 51 serves as a sheet pusher and may prevents folds and wrinkles of the sheet S caused by anisotropy of fibers or the like.

**[0031]** Although the guide plate 51 of the sheet transfer unit 10d is one continuous plate, a plurality of guide plates 51 may be provided. FIGs. 8A and 8B illustrate a sheet transfer unit 10e including a plurality of guide plates 51a. Other than that, the sheet transfer unit 10e has a similar configuration to the sheet transfer unit 10d illustrated in FIGs. 7A and 7B.

**[0032]** In the sheet transfer units explained above, the supporting point 5 of the outer guide plate 1 is provided at the upstream edge of the outer guide plate 1 in the sheet transfer direction. Alternatively, the support point 5 may be provided at a downstream edge of the outer guide plate 1 in the sheet transfer direction.

**[0033]** FIGs. 9A and 9B illustrate a sheet transfer unit 10f. The sheet transfer unit 10f includes an outer guide 61, a support point 62, an electrostatic transfer belt 3, an input roller 4, and a pair of rollers 7. The outer guide plate 61 is swingably fixed by the support point 62 and includes a guide plate 51. The support point 62 is provided at an edge of the outer guide plate 61 that is a downstream side in the sheet transfer direction indicated by an arrow A. Other than that, the sheet transfer unit 10f has a similar configuration to the sheet transfer unit 10d illustrated in FIGs. 7A and 7B.

**[0034]** Similarly to the sheet transfer unit 10d, the outer guide plate 1 is held at a waiting position shown in full line in Fig. 9A until a sheet S, which is transferred by the pair of rollers 7, reaches the input roller 4. When a front edge of the sheet S reaches the input roller 4, the outer

guide plate 61 swingably moves around the support point 62 to further curve the sheet S. The guide plate 51 supporting a sheet S from an inside of the curve of the sheet S moves in conjunction with the outer guide plate 1. The guide plate 51 lifts up and compulsorily retains the sheet S to a side of the outer guide plate 61. As a result, the sheet S is stretched. Therefore, the guide plate 51 serves as a sheet pusher and may prevents folds and wrinkles of the sheet S caused by anisotropy of fibers or the like.

**[0035]** Numerous additional modifications and variations are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the disclosure of this patent specification may be practiced otherwise than as specifically described herein.

**[0036]** This patent specification is based on Japanese patent application, No. JP2005-338455 filed on November 24, 2005 in the Japan Patent Office, the entire contents of which are incorporated by reference herein.

## Claims

**1.** An image forming apparatus (100) which includes:

an image forming mechanism (20) to form an image on a sheet; and
a sheet transfer unit (10) configured to transfer a sheet to the image forming mechanism (20) and having

an input roller (4) to transfer the sheet into the image forming mechanism (20), and
a sheet conveying member (3) mounted at a position opposite to the input roller (4),
an outer guide (1) mounted in a manner swingably movable around a support point (5) at a position along a sheet transfer passage where a sheet transfer direction is changed and the sheet is curved accordingly so as to guide the sheet along an outer surface of the sheet, wherein a curve of the sheet is grown when a leading edge of the sheet collides with the input roller (4), the image forming apparatus (100) being **characterized by** comprising:

a sheet pusher (2, 23, 31, 51) mounted at a position opposite to the outer guide (1) relative to the sheet along the sheet transfer passage in the sheet transfer unit (10) and configured to assist a growth of the curve of the sheet by pushing an inner surface of the sheet against the outer guide (1).

**2.** An image forming apparatus (100) according to claim 1, wherein the outer guide (61) of the sheet transfer unit (10f) is configured to swingably movable around a support point (62) provided a downstream edge of the outer guide (61) in the sheet transfer direction.

**3.** An image forming apparatus (100) according to claim 1 or 2, wherein the sheet pusher (2, 51) of the sheet transfer unit (10) is at least one plate-like shaped member having a curved surface facing the outer guide (1).

**4.** An image forming apparatus (100) according to claim 1, 2 or 3, wherein the sheet pusher (2, 31, 51) of the sheet transfer unit (10) is configured to be movable from an inside of the curve of the sheet to the outer guide (1).

**5.** An image forming apparatus (100) according to claim 4, wherein the sheet pusher (2) of the sheet transfer unit (10) is configured to be movable in conjunction with the outer guide (1).

**6.** An image forming apparatus (100) according to Claim 1, 2, 3, 4 or 5 wherein the sheet pusher (2) of the sheet transfer unit (10) is configured to be swingably movable around a support point (6).

**7.** An image forming apparatus (100) according to any one of the previous claims, wherein the sheet pusher (31, 51) of the sheet transfer unit (10a, 10d) is integrated with the outer guide (1).

**8.** An image forming apparatus (100) according to any one of the preceding claims, wherein the sheet transfer unit (10a) further comprises:

an inner guide (21) mounted at a position opposite to the outer guide (1) and configured to guide the inner surface of the sheet.

**9.** An image forming apparatus (100) according to any one of the preceding claims, wherein the sheet pusher (23) of the sheet transfer unit (10a) comprises a blower for applying wind pressure to the sheet from the inside of the curve of the sheet.

**10.** An image forming apparatus (100) according to any one of claims 1 to 8, wherein the sheet pusher (31) of the sheet transfer unit (10b) comprises at least one cylindrical roller configured to move perpendicularly to the sheet transfer direction along the inner surface of the sheet.

**11.** An image forming apparatus (100) according to any one of claims 1 to 6, wherein the sheet pusher (41) of the sheet transfer unit (10c) is separate from the outer guide (1).

**12.** A sheet transfer unit (10) configured to transfer a

sheet along a sheet transfer passage and includes:

a sheet conveying member (3) mounted at a position opposite to the input roller (4);
an input roller (4) to transfer the sheet into the image forming mechanism (20); and
an outer guide (1) mounted in a manner swingably movable around a support point (5) at a position along the sheet transfer passage where a sheet transfer direction is changed and the sheet is curved accordingly so as to guide the sheet along an outer surface of the sheet, wherein a curve of the sheet is grown when a leading edge of the sheet collides with the input roller (4), the sheet transfer unit (10) being **characterized by** comprising:

a sheet pusher (2, 23, 31, 51) mounted at a position opposite to the outer guide (1) relative to the sheet along the sheet transfer passage in the sheet transfer unit (10) and configured to assist a growth of the curve of the sheet by softly pushing an inner surface of the sheet against the outer guide (1).

FIG. 1A
PRIOR ART

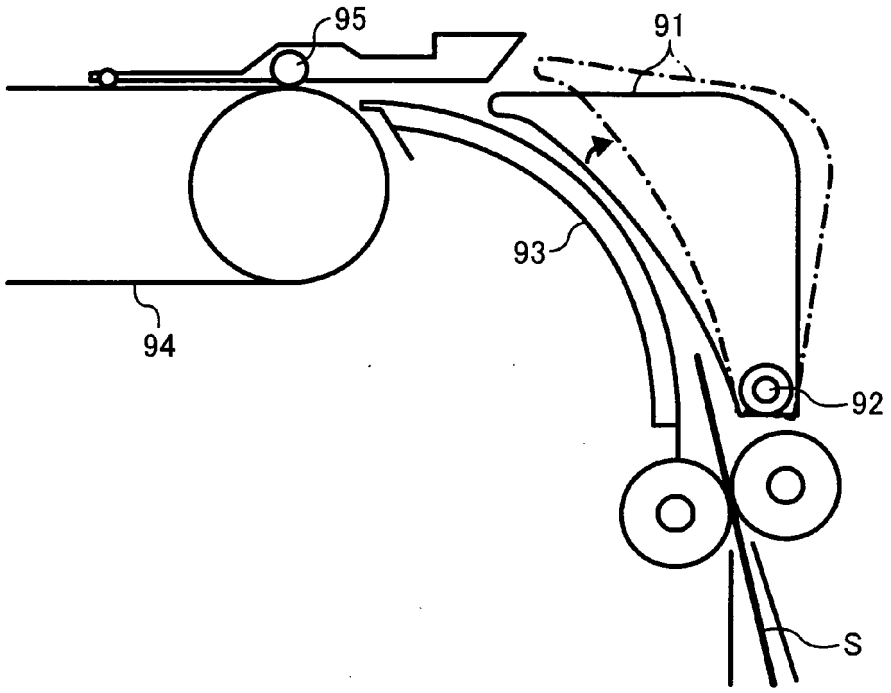
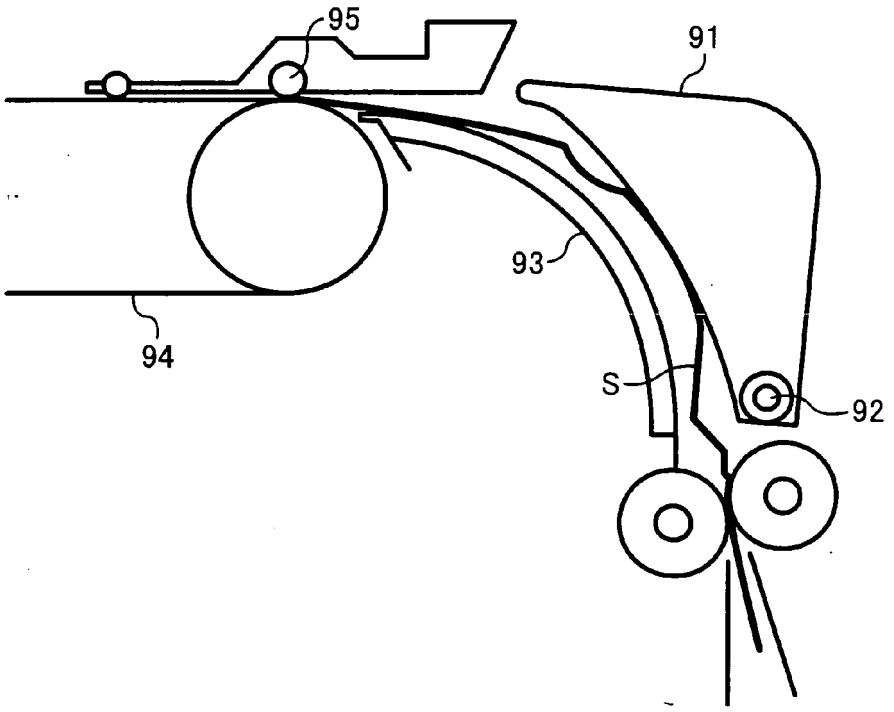



FIG. 1B
PRIOR ART



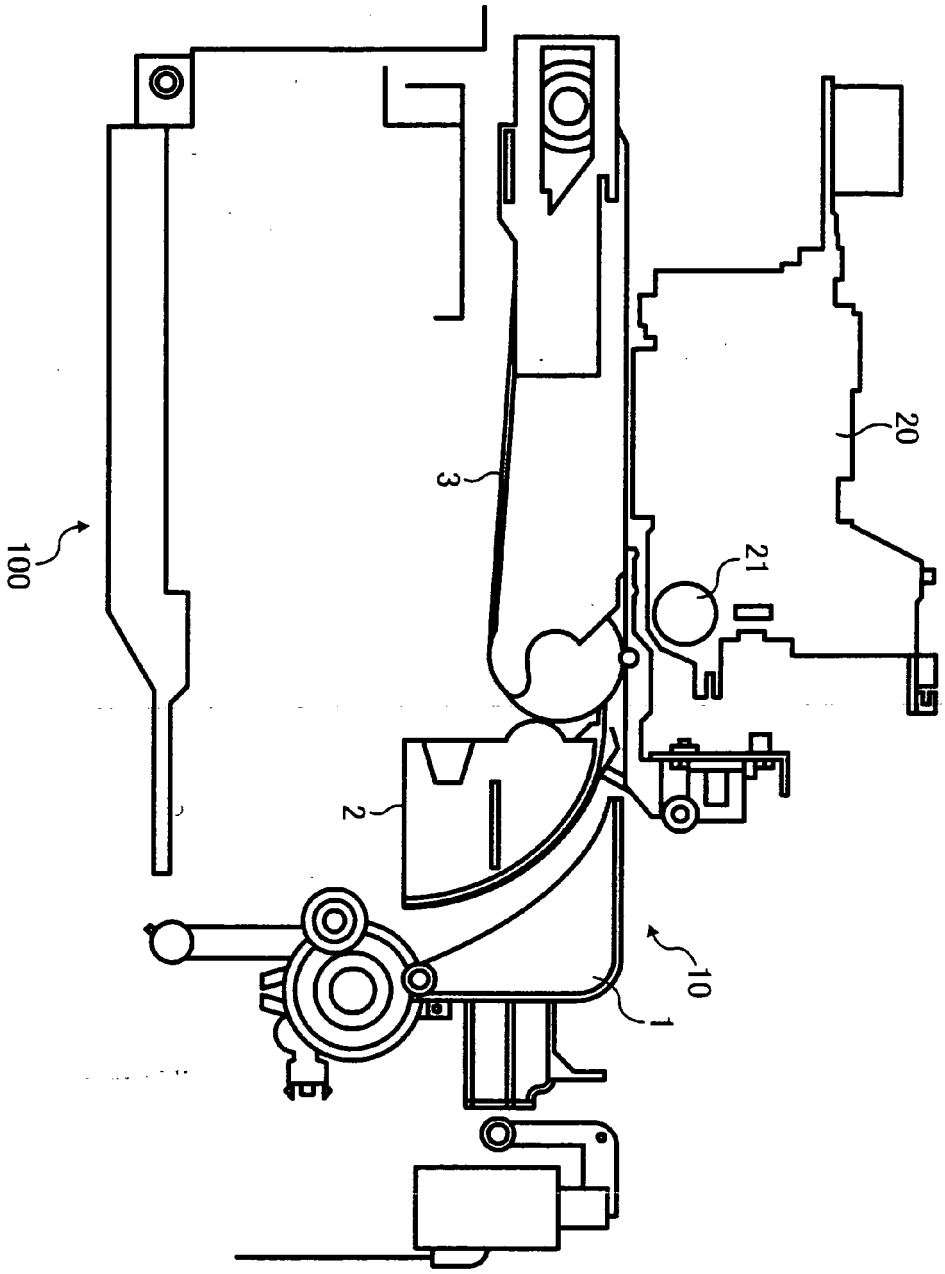



FIG. 2

FIG. 3A

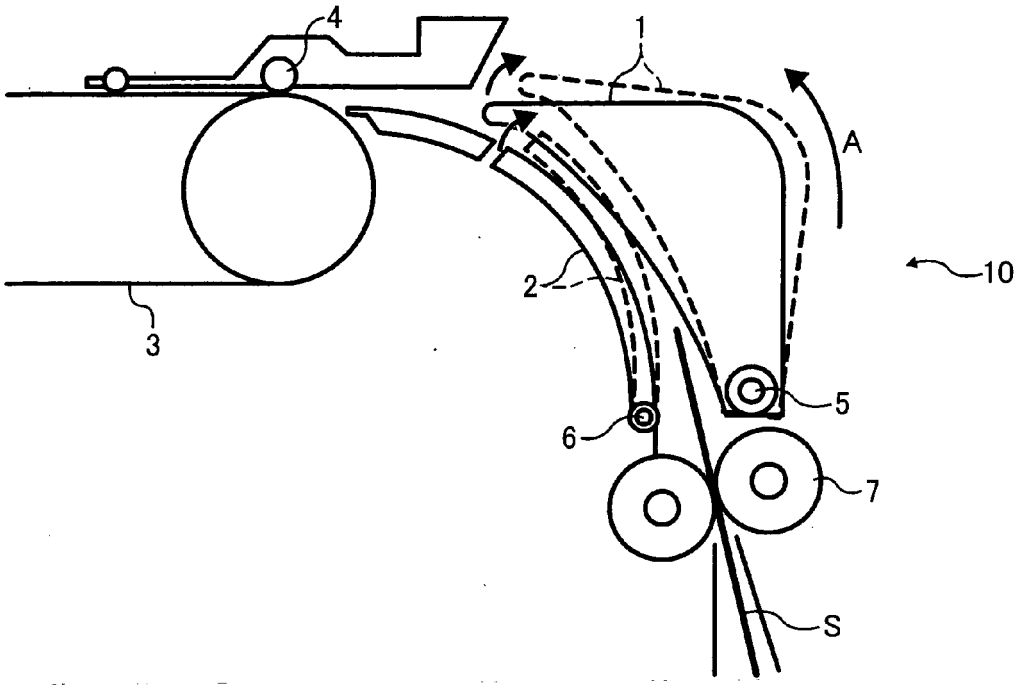



FIG. 3B

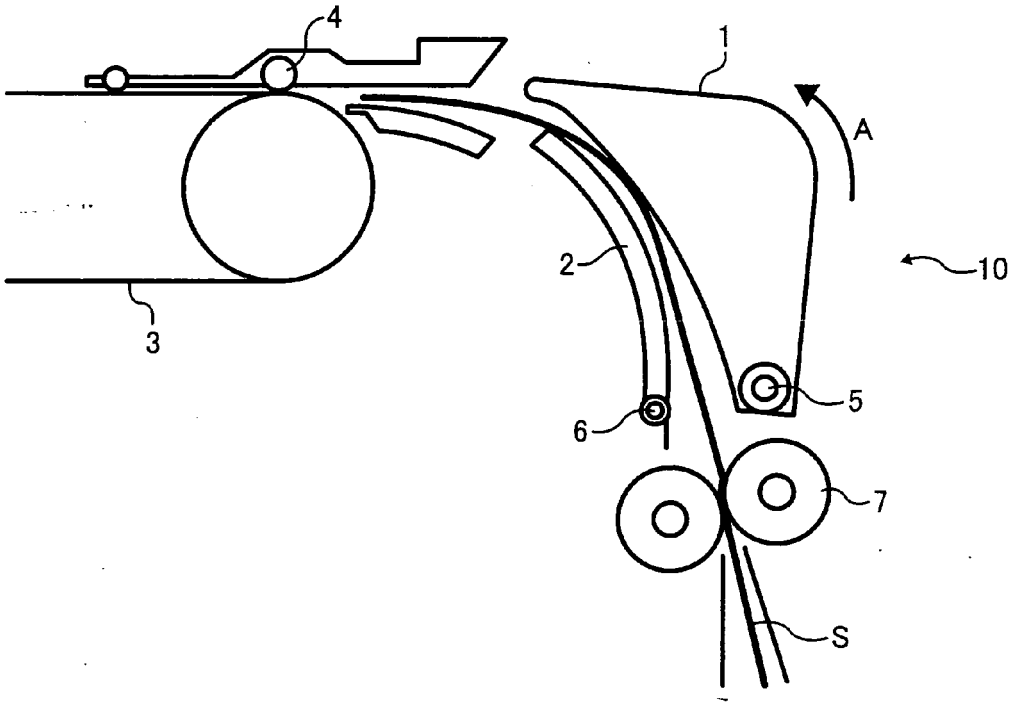


FIG. 4A

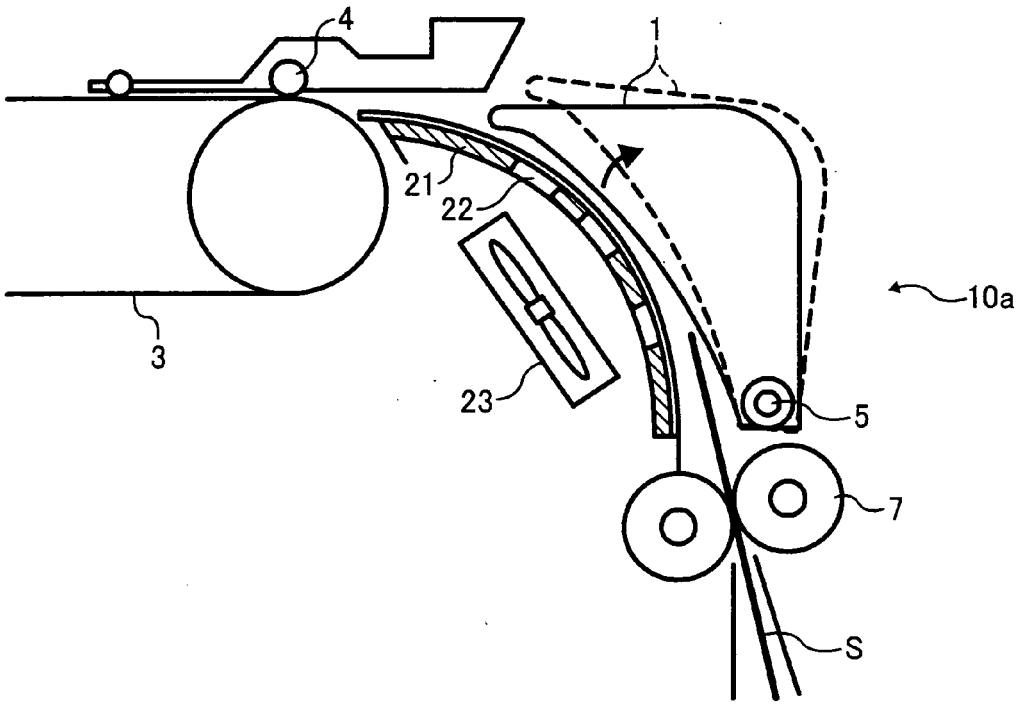



FIG. 4B

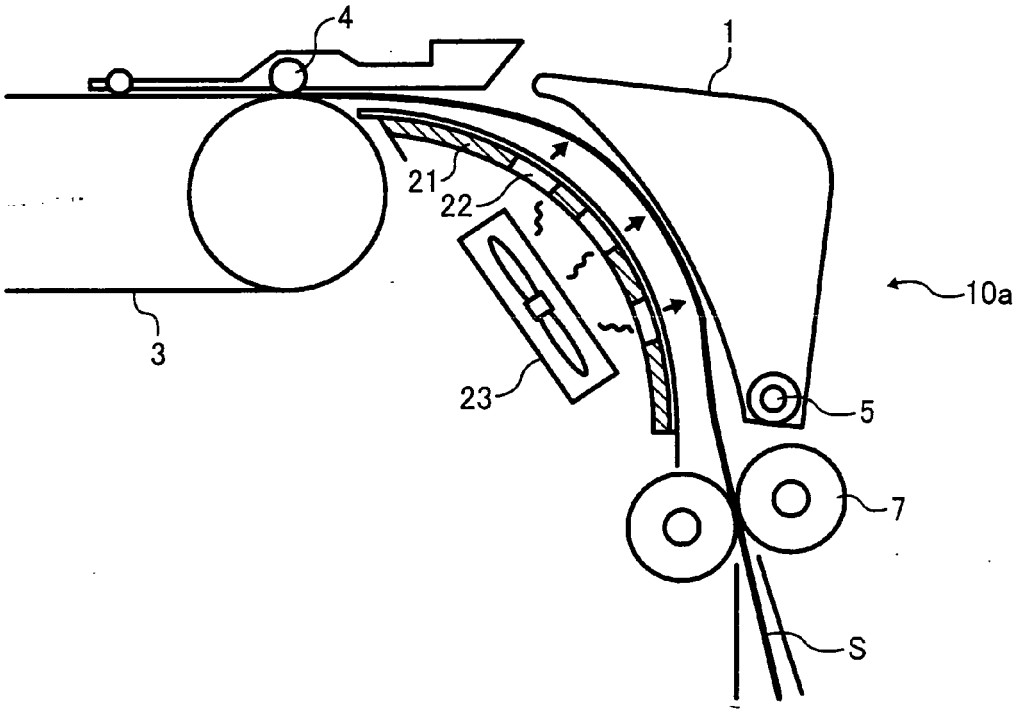


FIG. 5A

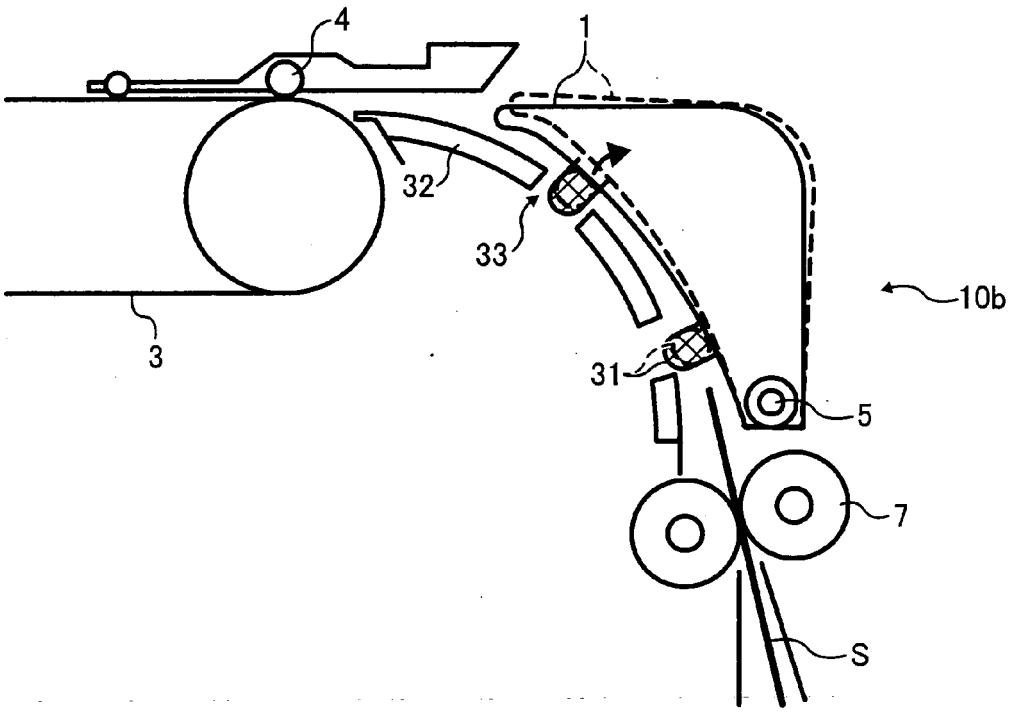



FIG. 5B

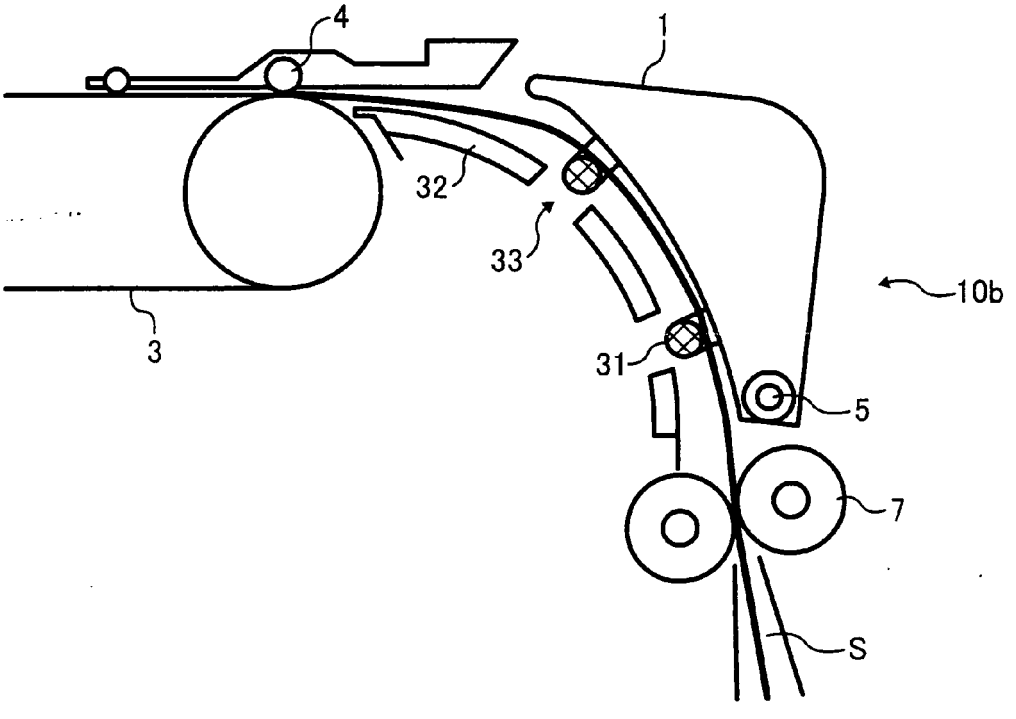


FIG. 6A

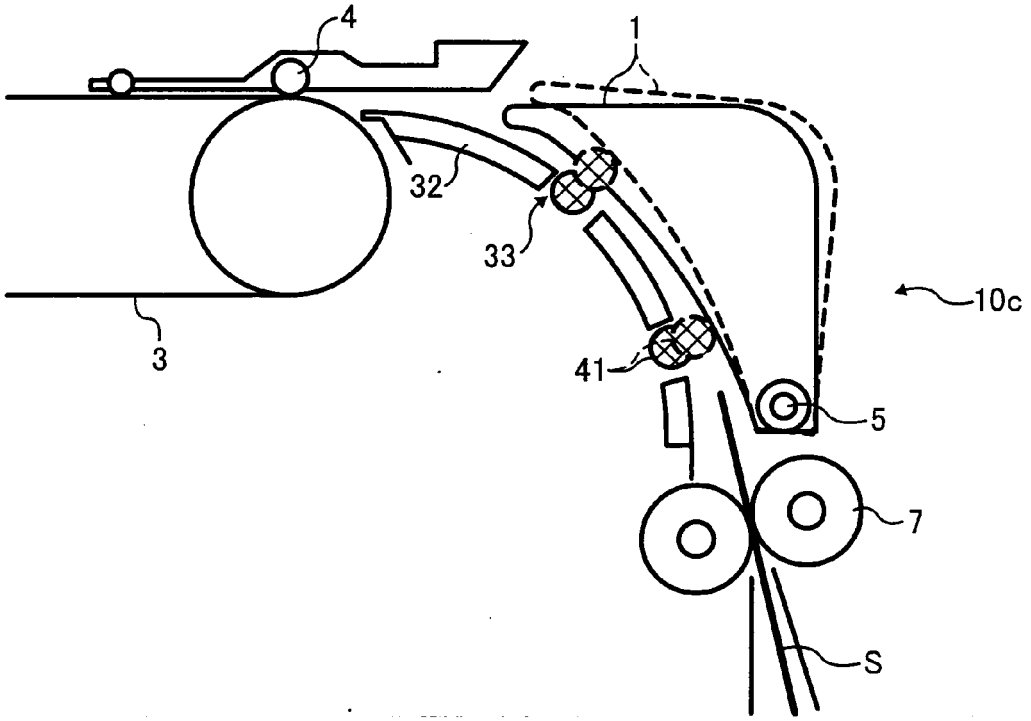



FIG. 6B

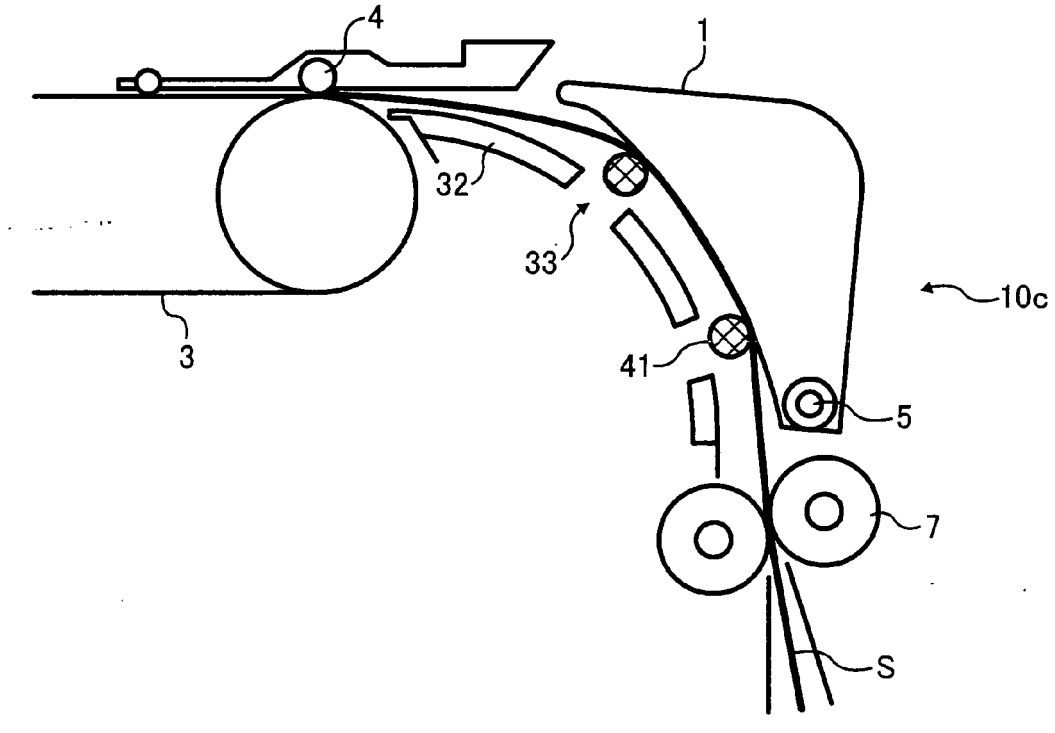


FIG. 7A

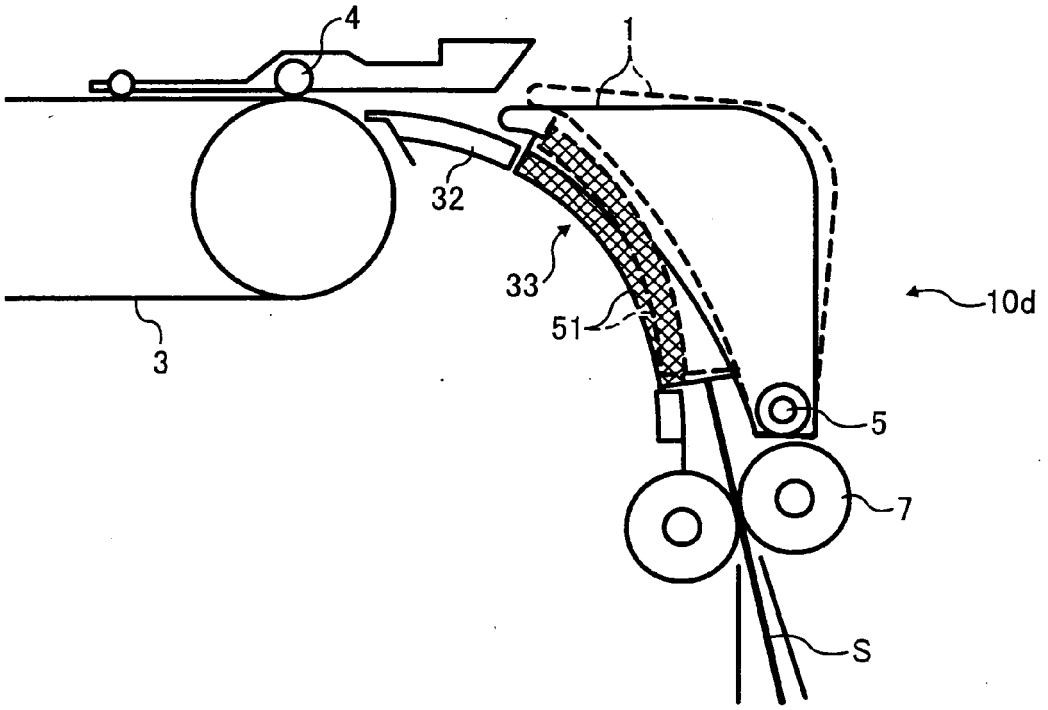



FIG. 7B

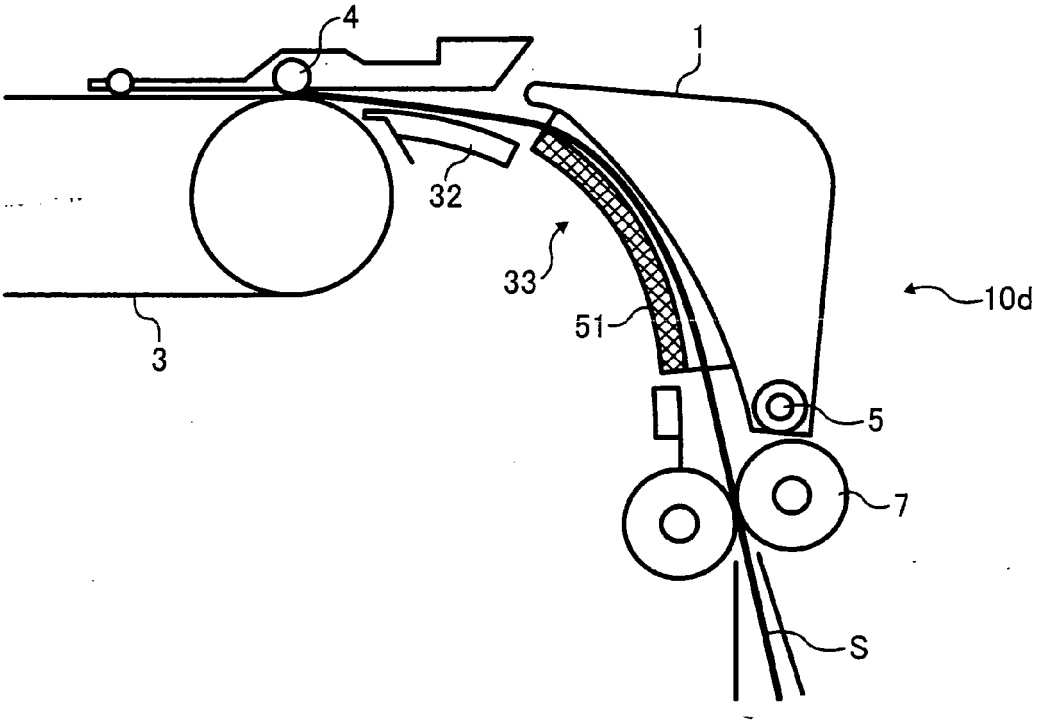


FIG. 8A

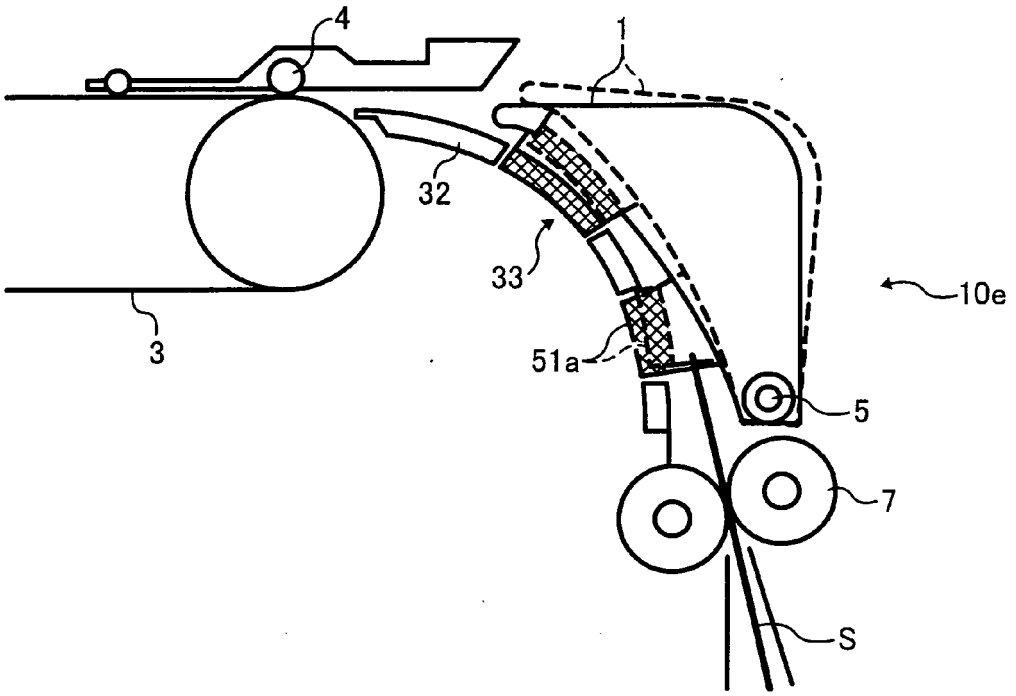



FIG. 8B

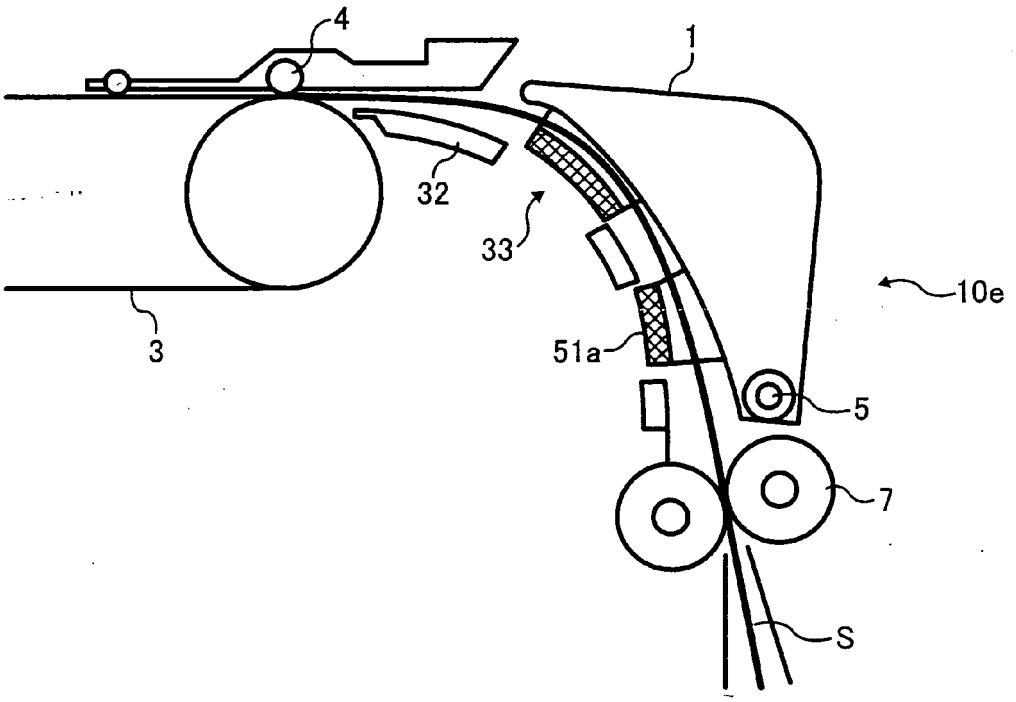


FIG. 9A

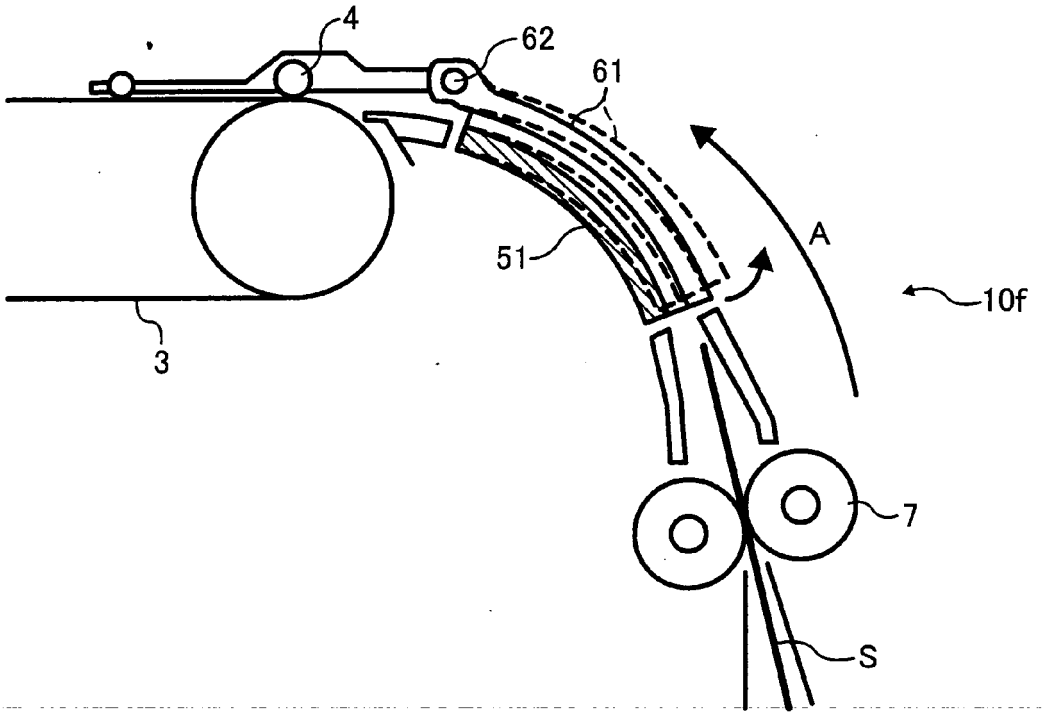
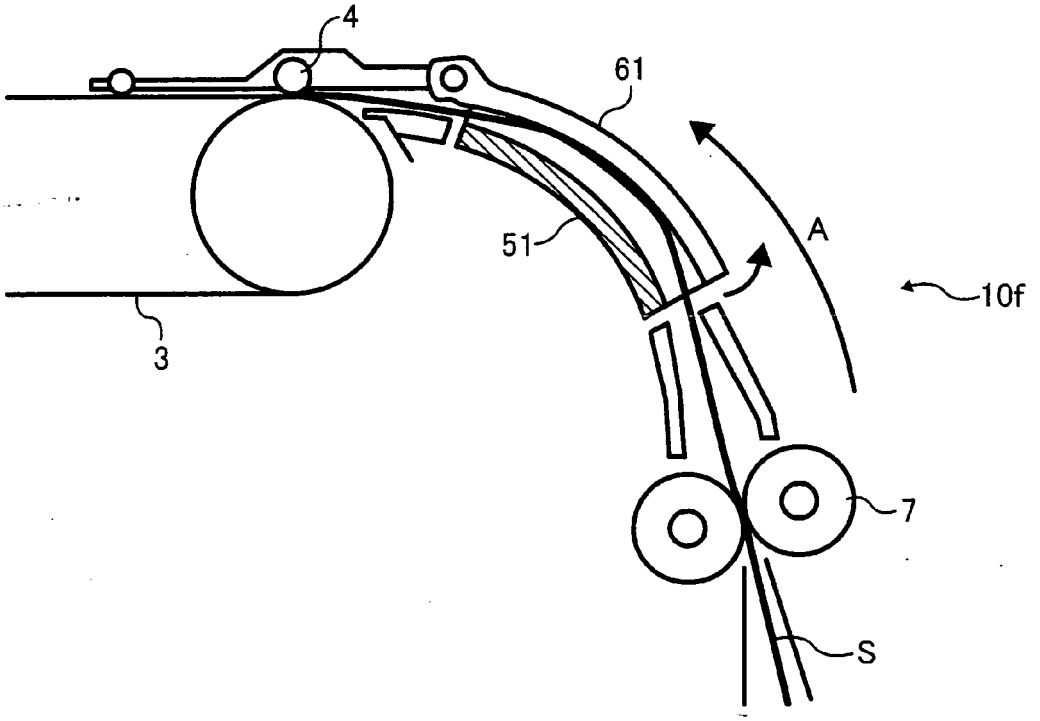



FIG. 9B



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# EUROPEAN SEARCH REPORT

Application Number
EP 06 25 5840

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The present search report has been drawn up for all claims

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|---|---|---|
| The Hague | 22 February 2007 | Van Oorschot, Hans |

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