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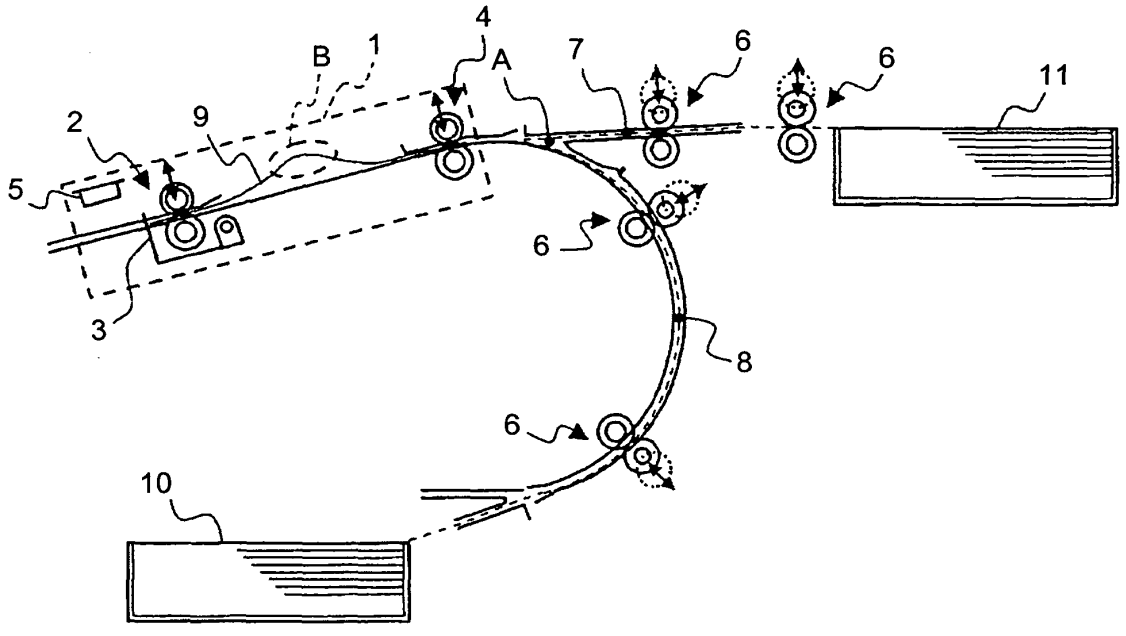
## (54) Sheet aligning device and image forming apparatus using the same

(57) In a sheet aligning device (1), a pair of first rollers (2) provided upstream of a stopper unit (3) moves a sheet in an axial direction thereof after a pair of second rollers (4) provided upstream of the first rollers is separated, and is returned to its home position just after the sheet passes therethrough.

FIG.1

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## Description

**[0001]** The present application claims priority to and incorporates by reference the entire contents of Japanese priority document 2007-103364 filed in Japan on April 11, 2007.

**[0002]** The present invention relates to an image forming apparatus.

**[0003]** An image forming apparatus such as a laser printer feeds sheets such as printing papers accommodated in a feeding unit one by one, transfers a toner image formed on a photosensitive drum, a photosensitive belt, or the like onto the sheet at a transfer position, and fixes the toner image to the sheet, thereby obtaining the sheet with the toner image thereon.

**[0004]** In such image forming apparatus, a registration mechanism including a stopper and rollers is arranged just before the transfer position to correct the direction of the sheet, so that the toner image can be transferred at an appropriate position on the sheet.

**[0005]** For example, in the image forming apparatus in Japanese Patent No. 2893540, a stopper for positioning a sheet in a direction orthogonal to a sheet conveying direction is provided on a conveying path, and a leading end of the sheet is brought into contact with the stopper, so that the sheet is stopped. In this state, the sheet is fed by a conveying unit on the upstream side, and the stopper is released after a loop is formed in the sheet, so that the sheet is nipped and conveyed by a pair of rollers downstream of the stopper. Thereafter, a detecting unit that is arranged downstream of the stopper detects a side edge of the sheet, and a roller moving unit moves the rollers in a direction orthogonal to the sheet conveying direction to correct the position of the sheet so that the side edge of the sheet is aligned with a reference position.

**[0006]** Fig. 7 is a schematic diagram of a conventional sheet conveying mechanism that includes a pair of lateral registration rollers 32, a stopper 33, a pair of feeding rollers 34, a sheet edge detection sensor 35, pairs of conveying rollers 36, sheet conveying paths 37 and 38, and sheet trays 40 and 41.

**[0007]** The stopper 33 is arranged just upstream of the lateral registration rollers 32, and can move between a sheet-conveying-path closed position and a sheet-conveying-path opened position. The distance between the lateral registration rollers 32 and the feeding rollers 34 in the sheet conveying path is shorter than a small-size sheet for enabling them to convey the small-size sheet, and the sheet conveying path upstream of the feeding rollers 34 includes the sheet conveying path 38 connected to the sheet tray 40 arranged in the apparatus body and the sheet conveying path 37 connected to the sheet tray 41 arranged outside the apparatus body. The pairs of conveying rollers 36 are arranged along the sheet conveying paths 37 and 38 for conveying the sheet to the feeding rollers 34. Moreover, the sheet conveying paths 37 and 38 are joined at a sheet-conveying-path junction point D upstream of the feeding rollers 34.

**[0008]** The operations of a sheet conveying position correction and a sheet inclination correction are explained. A sheet 39 conveyed by the feeding rollers 34 is stopped after the leading end thereof comes into contact with the stopper 33 that is set to the sheet-conveying-path closed position in advance. At this time, because the leading end of the sheet 39 is aligned with the stopper 33, the sheet inclination correction is finished. Thereafter, the sheet 39 is fed by the feeding rollers 34 for a while until a buffer C is formed in the sheet 39 between the stopper 33 and the feeding rollers 34. Then, the stopper 33 is lowered to release the leading end of the sheet 39. In this state, due to the stiffness of the sheet 39 at the buffer C, the leading end of the sheet 39 is pushed into the nip portion of the lateral registration rollers 32. At this time, the nipping by the feeding rollers 34 is released, and the edge (side edge) of the sheet 39 in a main scanning direction is detected by the sheet edge detection sensor 35. After the correction amount of the sheet 39 in the main scanning direction is calculated, the lateral registration rollers 32 are moved laterally in an axis direction of the lateral registration rollers 32 by the correction amount, thereby aligning the position of the sheet 39 in the main scanning direction without the feeding rollers 34 affecting the operation of the sheet position correction (lateral registration).

**[0009]** When the sheet conveying position correction and the sheet inclination correction are performed for a sheet having a length longer than the distance between the lateral registration rollers 32 and the conveying rollers 36 in the above sheet conveying mechanism, if the conveying rollers 36 nip (press and hold) the trailing end of the sheet even after the leading end of the sheet is pushed into the nip portion of the lateral registration rollers 32, the sheet may be skewed to wrinkle or the sheet whose inclination has been corrected by the stopper 33 may be inclined again due to the resistance at the nip portion between the conveying rollers 36 at the time of laterally moving the sheet with the lateral registration rollers 32 for the sheet conveying position correction. Therefore, when the sheet conveying position correction is performed, the conveying rollers 36 are released.

**[0010]** At the time when the stopper 33 is lowered to release the leading end of the sheet after forming the buffer C in the sheet between the stopper 33 and the feeding rollers 34, if the sheet is curled or has a low stiffness, the sheet may be buckled or skewed before being nipped by the lateral registration rollers 32, thereby misaligning the direction of the sheet or causing a jam of the sheet. On the contrary, if the sheet has a high stiffness, the sheet whose inclination has been corrected by the stopper 33 may be inclined again and pushed into the nip portion of the lateral registration rollers 32 in this state, which indicates that the inclination correction by the stopper 33 has no meaning. To solve this problem, the stopper 33 is arranged downstream of the lateral registration rollers 32 (for example, see Japanese Patent Application Laid-open No. H10-203690).

**[0011]** In addition, with the above configuration, because the stopper and the conveying unit each need a driving unit, the apparatus itself becomes large and the manufacturing cost thereof becomes high.

**[0012]** Even if the above problems are solved, in the case of conveying the sheet that is thick, stiff, and has a length longer than the distance between the lateral registration rollers 32 and the sheet-conveying-path junction point D, if the radius of curvature of the sheet conveying path 38 from each sheet tray to the feeding rollers 34 is too small, the rear end portion of the sheet remaining on the sheet conveying path receives high resistance in conveying on the sheet conveying path. Consequently, when the sheet conveying position correction of the sheet 39 is performed in the main scanning direction by the lateral registration rollers 32, the resistance on the sheet conveying path interferes with the movement of the sheet 39 in the main scanning direction, which results in lowering the accuracy of aligning a sheet in conveying.

**[0013]** It is an object of the present invention to at least partially solve the problems in the conventional technology.

**[0014]** According to an aspect of the present invention, there is provided 1. A sheet aligning device including a sheet conveying path; a detecting unit that detects a side edge of a sheet conveyed in the sheet conveying path; a stopper unit that is provided upstream of the detecting unit, and positions a leading end of the sheet conveyed in the sheet conveying path by opening and closing the conveying path; a first conveying unit that is provided upstream of the stopper unit and includes a pair of first rollers, the first roller being in contact with or separated from each other; a second conveying unit that is provided upstream of the first conveying unit and includes a pair of second rollers, the second rollers being in contact with or separated from each other; and a lateral moving unit that moves the first rollers in an axial direction thereof based on a result indicative of a detection by the detecting unit.

**[0015]** According to another aspect of the present invention, there is provided a sheet aligning device including a sheet conveying path through which a sheet is conveyed to an image transfer unit; a lateral registration unit that moves in a width direction from a home position thereof to correct a misalignment of the sheet in the width direction; and a conveying unit that conveys to the image transfer unit the sheet after the misalignment in the width direction is corrected by the lateral registration unit, wherein the lateral registration unit moves back to the home position immediately after the sheet whose misalignment in the width direction is corrected by the lateral registration unit reaches the conveying unit.

**[0016]** The invention will now be described by way of non-limiting example with reference to the accompanying drawings, in which:

Fig. 1 is a schematic diagram of an example of a sheet conveying mechanism according to a first embodiment of the present invention;

Figs. 2A to 2C are plan views showing a configuration of a sheet aligning unit in the sheet conveying device shown in Fig. 1;

Fig. 3 is a side view of the configuration of the sheet aligning unit;

Figs. 4A to 4E are schematic diagrams for explaining operations of the sheet aligning unit;

Fig. 5 is a timing chart for explaining operations of the sheet aligning unit;

Fig. 6 is a schematic diagram of an example of an image forming apparatus in which the sheet aligning unit is employed;

Fig. 7 is a schematic diagram of a conventional sheet conveying mechanism;

Fig. 8 is a schematic diagram of a sheet aligning unit and its vicinity according to a second embodiment of the present invention;

Fig. 9 is a top view of the sheet aligning unit as seen from a width direction;

Figs. 10A to 10D are schematic diagrams for explaining operations of the sheet aligning unit; and

Figs. 11A to 11D are schematic diagrams for explaining operations of the sheet aligning unit following the operations in Figs. 10A to 10D.

**[0017]** Exemplary embodiments of the present invention are explained below with reference to the accompanying drawings.

**[0018]** Fig. 1 is a schematic diagram of one example of a sheet conveying mechanism according to a first embodiment of the present invention. The sheet conveying mechanism includes a sheet aligning unit 1 including a pair of lateral registration rollers 2 as a first pair of rollers, a stopper 3 including a claw at its one end, a pair of feeding rollers 4 as a second pair of rollers, and a detection sensor 5, pairs of conveying rollers 6 as third pairs of rollers, a straight sheet-conveying path 7, a curved sheet-conveying path 8, and sheet trays 10 and 11.

**[0019]** Sheets 9 in the sheet tray 10 arranged outside the apparatus body and the sheet tray 11 arranged in the apparatus body are conveyed to the feeding rollers 4 through the sheet-conveying paths 7 and 8, respectively, by the conveying rollers 6 provided on the sheet-conveying paths 7 and 8. The distance between adjacent pairs of the conveying rollers 6 is about 150 millimeters to 180 millimeters for enabling them to convey a small-size sheet. In each pair of the conveying rollers 6, one of the rollers is a driving roller, and the other one is a driven roller. The driving roller and the driven roller can be separated from each other. The sheet-conveying paths 7 and 8 are joined at a sheet-conveying-path junction point A upstream of the feeding rollers 4.

**[0020]** The detection sensor 5 is, for example, a contact image sensor (CIS) or a charged coupled device (CCD) linear sensor, and detects a side edge of the sheet 9. The conveying path between the lateral registration rollers 2 and the feeding rollers 4 has a substantially

straight shape with a length of 100 millimeters to 180 millimeters for conveying a small-size sheet. The stopper 3 is arranged just downstream of the lateral registration rollers 2, which is different from the conventional technologies. The stopper 3 can switch its position between a sheet-conveying-path opened position and a sheet-conveying-path closed position.

**[0021]** The operations of a sheet conveying position correction and a sheet inclination correction in the sheet aligning unit 1 are explained. The lateral registration rollers 2 are separated before the leading end of the sheet 9 reaches the lateral registration rollers 2, and the claw of the stopper 3 is raised to the sheet-conveying-path closed position. Just before the leading end of the sheet 9 comes into contact with the claw, the feeding rollers 4 decrease its conveying speed of the sheet 9 and presses the sheet 9 to the stopper 3 while nipping it. With this operation, a buffer B is formed in the sheet 9 between the stopper 3 and the feeding rollers 4, and the leading end of the sheet 9 is aligned with the claw, thereby correcting the inclination of the sheet 9. Thereafter, the sheet 9 is nipped by the lateral registration rollers 2. In the following explanation, the CCD image linear sensor is used as the detection sensor 5.

**[0022]** The stopper 3 is lowered to release the leading end of the sheet 9, and the sheet 9 is conveyed by the lateral registration rollers 2 in a state where the feeding rollers 4 are separated. When the sheet 9 reaches the detection sensor 5, the detection sensor 5 detects the position of the side edge of the sheet 9 in a main scanning direction, and a control unit (not shown) calculates a correction amount of the sheet 9 in the main scanning direction. Furthermore, the control unit laterally moves the lateral registration rollers 2 in a roller axis direction by the calculated correction amount to align the position of the sheet 9 in the main scanning direction, thereby finishing the position correction of the sheet. During the lateral movement, the lateral registration rollers 2 keep its rotation to convey the sheet 9, so that the sheet 9 can be conveyed with minimum loss of time.

**[0023]** Thereafter, when the sheet 9 is nipped by a conveying unit such as a transfer unit (not shown) including rollers and the like downstream of the lateral registration rollers 2, the lateral registration rollers 2 are separated again to return to its home position.

**[0024]** Upon performing the sheet aligning operation, in the case where a sheet to be conveyed has a length longer than the distance between the stopper 3 and the pair of the conveying rollers 6 closest to the sheet-conveying-path junction point A, the control unit controls the pairs of the conveying rollers 6 so that at least the rollers between which the sheet 9 is present are separated at the time when the sheet 9 reaches the stopper 3.

**[0025]** In the sheet aligning operation by the sheet conveying mechanism configured in such manner, when the lateral registration rollers 2 are laterally moved in the roller axis direction, only the lateral registration rollers 2 nip the sheet 9 regardless of the length of the sheet 9. Therefore, the resistance which the sheet 9 receives on the upstream of the lateral registration rollers 2 is only the friction resistance between the sheet 9 and the sheet conveying path. Because the sheet conveying path of the sheet aligning unit 1 has a straight shape, the resistance which the sheet 9 receives during alignment of the sheet conveying position by the lateral registration rollers 2 can be suppressed small. Therefore, when the lateral registration rollers 2 are moved laterally, the force of nipping the sheet 9 by the lateral registration rollers 2 is much larger than the resistance which the sheet 9 receives on the upstream of the lateral registration rollers 2. Thus, it is prevented that the sheet 9 whose inclination has been corrected by the stopper 3 is skewed to wrinkle or inclined again due to the resistance on the upstream of the lateral registration rollers 2, enabling the sheet aligning unit 1 to achieve high accuracy of aligning a sheet in conveying.

**[0026]** Figs. 2A to 2C are plan views showing a configuration of the sheet aligning unit 1, in which a linear sensor is used as the detection sensor 5 in Fig. 2A, a photocoupler is used as the detection sensor 5 in Fig. 2B, and two photocouplers are used as the detection sensor 5 in Fig. 2C as examples. In Figs. 2B and 2C, only part of the sheet aligning unit 1 is shown.

**[0027]** As shown in Fig. 2A, the detection sensor 5 is arranged downstream of the stopper 3, and the lateral registration rollers 2 are attached to a unit frame 12 so that the lateral registration rollers 2 are movable in its axis direction by a lateral moving unit including the unit frame 12, a spring 13, a cam 14 having its rotation axis on the apparatus body side, and a drive source (not shown) for driving the cam 14 to rotate.

**[0028]** The unit frame 12 is normally pressed to the cam 14 by the spring 13, and is movable in a direction orthogonal to the sheet conveying direction as indicated by a left right arrow 15 in Fig. 2A (i.e., the axis direction of the lateral registration rollers 2) by rotating the cam 14.

**[0029]** When it is found by the detection sensor 5 that the side edge of the sheet 9 is misaligned by a misalignment amount 17 from a predetermined reference position 16, a correction amount corresponding to the misalignment amount 17 is given by rotating the cam 14 so that the sheet side edge is aligned with the reference position 16.

**[0030]** When a linear image sensor including a CCD array is used as the detection sensor 5 as shown in Fig. 2A, the misalignment amount 17 of the sheet side edge from the reference position 16 can be easily measured only by using the conventional technology. The misalignment amount 17 is converted into the rotation amount of the cam 14 to be given as the correction amount to the cam 14. Although the measured value is output as a discrete value regarding the length, there is no problem so long as the length corresponding to a pixel with one bit in the CCD array (the distance in a misalignment direction of the sheet side edge) is within an allowable tolerance in sheet alignment.

**[0031]** When a simple photocoupler detecting one point is used as the detection sensor 5 as shown in Fig. 2B, the misalignment amount cannot be directly calculated; however, the direction of the misalignment can be recognized. Therefore, the output of the photocoupler is fed back directly to the control unit that controls the cam 14, thereby controlling the lateral position of the sheet 9.

**[0032]** The controlling method of the cam 14 is explained. When the light flux is blocked by the sheet 9 so that there is no signal output from the photocoupler (a first case), the sheet 9 is laterally moved in a direction in which the photocoupler outputs a signal (a direction toward a center of the sheet 9) and is stopped at the position where the photocoupler starts to output a signal. On the contrary, when the light flux is not blocked by the sheet 9 (a second case), the sheet 9 is laterally moved in a direction opposite to the above until the photocoupler stops outputting a signal. However, in such manner, the stop position of the sheet 9 may not be the same as that in the first case, and there may be a big difference between both stop positions. Therefore, after the output of a signal from the photocoupler is stopped, the sheet 9 is moved again in the direction in which the photocoupler outputs a signal, and the sheet 9 is stopped when the photocoupler starts to output a signal. With this method, the difference in the stop positions depends only upon the difference in stopping the motor for rotating the cam 14 and the difference in transmitting the driving force of the motor to the cam 14. Adversely, a method can also be adapted, in which the stop position is determined in both first and second cases at the time when the output of a signal is stopped. Any method can be employed according to the design.

**[0033]** The position of the cam 14 at which the lateral moving amount of the lateral registration rollers 2 is the minimum when the sheet 9 is sent in a state where the side edge is aligned with the reference position 16 is set as a home position. The control unit controls the cam 14 so that the cam 14 is normally placed at the home position. After the cam 14 rotates to laterally move the lateral registration rollers 2 and finishes its role, the control unit returns the cam 14 to its original position, that is, the home position.

**[0034]** Alternatively, two photocouplers 5A and 5B can be used as the detection sensor 5. The photocouplers 5A and 5B are arranged so that the detection positions thereof are on the opposite sides of the reference position 16. The interval between the detection positions is set to about an allowable tolerance of the lateral registration.

**[0035]** For example, in the case where the photocoupler 5A is arranged on the center side of the sheet with respect to the reference position 16, when the photocoupler 5A does not output a signal because the light flux is blocked by the sheet 9 and the photocoupler 5B outputs a signal, it indicates that the side edge of the sheet 9 is placed at a desired position. Therefore, when both or none of the photocouplers 5A and 5B output a signal, the sheet 9 is laterally misaligned. To correct the misalignment, the sheet 9 is laterally moved until the photocoupler 5A stops outputting a signal in the former case, and until the photocoupler 5B starts to output a signal in the latter case.

**[0036]** Fig. 3 is a side view of the sheet aligning unit that includes springs 18, 19, and 20, a cam shaft 21, cams 22, 23, and 24, a support shaft 25 of the stopper 3, a retract arm 26 that makes the lateral registration rollers 2 in contact with or separated from each other, a support shaft 27 of the retract arm 26, a retract arm 28 that makes the feeding rollers 4 in contact with or separated from each other, a support shaft 29 of the retract arm 28, and a sheet conveying path 30.

**[0037]** The stopper 3 can rotate around the support shaft 25, and project into the sheet conveying path 30 by the spring 19. Moreover, the stopper 3 can make the sheet conveying path 30 in the opened state by the action of the cam 23.

**[0038]** The sheet aligning unit 1 includes a first conveying unit and a second conveying unit in its relevant part. The first conveying unit includes the lateral registration rollers 2, and a driving mechanism and a contact/separation mechanism of the lateral registration rollers 2. The second conveying unit includes the feeding rollers 4, and a driving mechanism and a contact/separation mechanism of the feeding rollers 4.

**[0039]** The lateral registration rollers 2 are arranged upstream of the stopper 3, and are in pressure-contact with each other by the spring 18. The lateral registration rollers 2 can be separated from each other by the cam 22 pushing up the retract arm 26 that is rotatably attached to the support shaft 27. In the similar manner, the feeding rollers 4 are in pressure-contact with each other by the spring 20, and can be separated from each other by the cam 24 pushing up the retract arm 28 that is rotatably attached to the support shaft 29. With the rotation of the cam shaft 21 by a given angle, the cams 22, 23, and 24 fixed on the cam shaft 21 can perform combination of the operations of the contact/separation of the lateral registration rollers 2, the opening/closing of the sheet conveying path 30 by the stopper 3, and the contact/separation of the feeding rollers 4.

**[0040]** Figs. 4A to 4E are schematic diagrams for explaining operations of the sheet aligning unit 1, in which the lateral registration rollers 2 are in the released (separated) state in Fig. 4A, all of the cams 22, 23, and 24 are not operated in Fig. 4B, the stopper 3 and the feeding rollers 4 are in the released state in Fig. 4C, the stopper 3, the feeding rollers 4, and the lateral registration rollers 2 are in the released state in Fig. 4D, and the lateral registration rollers 2 are in the released state in Fig. 4E.

**[0041]** Fig. 5 is a timing chart representing operations of the sheet aligning unit 1 shown in Figs. 4A to 4E, in which heavy broken lines indicate the states of the cams 22, 23, and 24 with respect to the retract arm 26, an arm 3a, and the retract arm 28, respectively, and heavy solid lines indicate the operation states of the lateral registration rollers 2, the sheet conveying path 30, and the feed-

ing rollers 4 corresponding to the states of the cams 22, 23, and 24, respectively. In Fig. 5, the term "contact" indicates a contact state (in some cases, referred to as an operating state), and the term "separated" indicates a separated state (in some cases, referred to as a released state). Moreover, the term "opened" indicates that the sheet conveying path 30 is in the opened state, and the term "closed" indicates that the sheet conveying path 30 is in the closed state. Furthermore, although each of the regions (a) to (e) is depicted to have the same width in the lateral direction in Fig. 5 for convenience sake, the width does not correspond to the rotation angle of the cam shaft corresponding to each state.

**[0042]** The operations of the sheet aligning unit 1 shown in Figs. 4A to 4E are explained referring to Fig. 5.

**[0043]** In Fig, 4A, the stopper 3 projects into the sheet conveying path 30, and the cam 22 is in contact with the retract arm 26 and pushes up the retract arm 26 against the force by the spring 18 thereby separating the lateral registration rollers 2. The feeding rollers 4 are in pressure-contact with each other while nipping the sheet 9 therebetween. The sheet 9 conveyed at a predetermined speed by the rotation of the feeding rollers 4 decreases its speed when the leading end thereof reaches just in front of the stopper 3, and comes into contact with the stopper 3. Furthermore, the sheet 9 is pushed in the sheet conveying direction by the feeding rollers 4, and the feeding rollers 4 are stopped in a state where a loop 9a is formed in the sheet 9. At this time, the leading end of the sheet 9 is into contact with the stopper 3 due to the force exerted by the loop 9a, so that the skew of the sheet 9 is corrected.

**[0044]** In the region (a) in Fig. 5, the cam 22 and the retract arm 26 are in the "contact" state, so that the lateral registration rollers 2 are in the "separated" state. Moreover, the cam 23 and the arm 3a are in the "separated" state, so that the sheet conveying path 30 is in the "closed" state. Furthermore, the cam 24 and the retract arm 28 are in the "separated" state, so that the feeding rollers 4 are in the "contact" state.

**[0045]** In Fig, 4B, with the rotation of the cam shaft 21, the cam 22 is separated from the retract arm 26, and the lateral registration rollers 2 come into pressure-contact with each other by the force of the spring 18. At this time, the sheet 9 is nipped between the lateral registration rollers 2 in a state where the skew is corrected by the stopper 3, and the cam 23 and the cam 24 are still not in contact with the arm 3a and the retract arm 28.

**[0046]** In the region (b) in Fig. 5, all of the cams 22, 23, and 24 are in the "separated" state, and the rollers and the arms corresponding to the cams 22, 23, and 24 are all in stable states due to the force of the springs 18, 19, and 20. Specifically, the lateral registration rollers 2 and the feeding rollers 4 are both in the "contact" state, and the sheet conveying path 30 is in the "closed" state by the claw of the stopper 3.

**[0047]** In Fig, 4C, with the further rotation of the cam shaft 21, the cam 23 comes into contact with the arm 3a that is on the opposite side of the claw with respect to the support shaft 25 of the stopper 3, thereby rotating the stopper 3 counterclockwise against the force of the spring 19. Consequently, the claw of the stopper 3 is retracted, so that the sheet conveying path 30 becomes the opened state. Moreover, the cam 24 comes into contact with the retract arm 28 to rotate the retract arm 28 counterclockwise against the force of the spring 20, so that the feeding rollers 4 are separated. In this state, the sheet 9 is conveyed by the lateral registration rollers 2. The side edge of the sheet 9 is detected by the detection sensor 5, and the lateral registration rollers 2 are moved in the direction as indicated by the left right arrow 15 by the cam 14 while nipping and conveying the sheet 9 by the misalignment amount 17 between the reference position 16 and the sheet side edge position so that the side edge of the sheet 9 coincides with the reference position 16.

**[0048]** In the region (c) in Fig. 5, only the lateral registration rollers 2 are in the "contact" state, and the feeding rollers 4 and the sheet conveying path 30 are both in the released state.

**[0049]** In Fig, 4D, after the sheet 9 reaches a conveying unit (not shown) or an image transfer unit (not shown) arranged downstream of the sheet aligning unit 1, the lateral registration rollers 2 are separated due to the action of the cam 22 by the rotation of the cam shaft 21. Thereafter, the lateral registration rollers 2 move in the direction opposite to the movement thereof in Fig. 4C, by the further rotation or the inverse rotation of the cam 14 to return to the home position. At this time, the lateral registration rollers 2 are still separated from each other, so that the conveyance of the sheet 9 is not affected by the lateral registration rollers 2 even if the middle portion of the sheet 9 is positioned between the lateral registration rollers 2.

**[0050]** In the first embodiment, just after the sheet 9 whose misalignment in the width direction has been corrected (lateral registration) by the lateral registration rollers 2 (lateral registration unit) reaches the conveying unit or the image transfer unit, the lateral registration rollers 2 move in an opposite direction to return to the home position. Therefore, skew correction (inclination correction) and lateral registration can be promptly performed to the sheet to be conveyed next. As a result, an interval between the sheets 9 to be continuously conveyed can be shortened, and productivity of the image forming apparatus can be improved.

**[0051]** In the region (d) in Fig. 5, the lateral registration rollers 2, the sheet conveying path 30, and the feeding rollers 4 are all in the released state. Specifically, the lateral registration rollers 2 and the feeding rollers 4 are both in the "separated" state, and the sheet conveying path 30 is in the "opened" state. In this state, the trailing end of the sheet 9 passes the feeding rollers 4.

**[0052]** In Fig, 4E, the feeding rollers 4 are in pressure-contact with each other due to the action of the cam 24 by the rotation of the cam shaft 21 before a sheet 9' that is conveyed next to the sheet 9 reaches the feeding roll-

ers 4 to be ready for conveying the sheet 9'. Moreover, the cam 23 is rotated to release the contact with the arm 3a to cause the claw of the stopper 3 to project into the sheet conveying path 30 before the leading end of the sheet 9' reaches the stopper 3 after the trailing end of the sheet 9 passes the claw of the stopper 3 to return to the state shown in Fig. 4A. Therefore, the inclination and the conveying position of the sheet 9' can also be corrected in the same manner.

**[0053]** In the region (e) in Fig. 5, the lateral registration rollers 2 in the "contact" state convey the sheet 9 while the sheet conveying path 30 is in the "opened" state, so that the sheet 9 is handed over to a conveying mechanism downstream of the sheet aligning unit 1. The sheet 9 has already passed the feeding rollers 4, so that the feeding rollers 4 come into the "contact" state to be ready for conveying the sheet 9'.

**[0054]** Fig. 6 is a schematic diagram of an image forming apparatus including photosensitive elements 101 for yellow (Y), cyan (C), magenta (M), and black (B), an optical writing unit 102, developing units 103 for Y, C, M, and B, a transfer belt 104, a secondary transfer unit 105, a conveying unit 106, and a fixing unit 107.

**[0055]** A latent image is formed in each of the photosensitive elements 101 by the optical writing unit 102, and images developed by the developing units 103 are transferred onto the transfer belt 104.

**[0056]** A sheet P supplied from the sheet tray 10 reaches the feeding rollers 4 by the conveying rollers 6 provided in the middle of the curved sheet-conveying path 8, and is conveyed by the feeding rollers 4 until the leading end of the sheet P is in contact with the claw of the stopper 3 that projects into the sheet conveying path. When the sheet P is supplied from the sheet tray 11, the sheet P reaches the feeding rollers 4 by the conveying rollers 6 provided in the middle of the straight sheet-conveying path 7, and is conveyed by the feeding rollers 4 in the same manner.

**[0057]** At this time, the lateral registration rollers 2 are in the released state. After the inclination of the sheet P is corrected by making the leading end the sheet P in contact with the stopper 3, and the sheet P is nipped by the lateral registration rollers 2, the stopper 3 and the feeding rollers 4 are both released. The lateral registration rollers 2 move in the lateral direction according to the output of the detection sensor 5 while conveying the sheet 9, thereby performing the lateral registration of the sheet P. The speed of the lateral movement of the lateral registration rollers 2 is set so that the lateral registration is finished before the leading end of the sheet P reaches the secondary transfer unit 105. When the leading end of the sheet P is nipped by the secondary transfer unit 105, the lateral registration rollers 2 are released.

**[0058]** The sheet P onto which the image is transferred from the transfer belt 104 is conveyed to the fixing unit 107 by the conveying unit 106, and is discharged out of the image forming apparatus after fixing.

**[0059]** The curved sheet-conveying path 8 is explained. With the radius of curvature of the curved sheet-conveying path 8 set to 50 millimeters or larger, the resistance between the sheet 9 and the curved sheet-conveying path 8 while conveying is reduced. Consequently, when the sheet 9 is conveyed to the sheet aligning unit 1 for aligning the conveying position of the sheet 9 by the lateral registration rollers 2 via the curved sheet-conveying path 8, even if the sheet 9 has a length longer than the distance between the stopper 3 and the sheet-conveying-path junction point A, a large thickness, and a high stiffness, i.e., has a large resistance in conveying, the resistance exerted on the trailing end of the sheet 9 can be suppressed. Therefore, variation in accuracy of aligning a sheet in conveying due to the difference in length, thickness, and stiffness of the sheet 9 can be reduced, enabling to obtain high accuracy of aligning a sheet in conveying for various types of sheets.

**[0060]** The present invention is employed as the sheet aligning unit in the sheet feeding device of the image forming apparatus; however, the present invention can be also employed in other devices for preventing skew (inclination) or lateral misalignment in conveying the sheet in general printing machines or the like.

**[0061]** Fig. 8 is a schematic diagram of the sheet aligning unit 1 (sheet aligning mechanism) and its vicinity according to a second embodiment of the present invention. Fig. 9 is a top view of the sheet aligning unit 1 as seen from a width direction. In the sheet aligning unit 1 according to the second embodiment, a pair of longitudinal registration rollers 50 as a conveying unit (sheet conveying unit) are provided downstream of the stopper 3 (stopper unit).

**[0062]** As shown in Fig. 8, the sheet aligning unit 1 is arranged on a lower right side of the transfer belt 104 (intermediate transfer belt).

**[0063]** The transfer belt 104 is supported by four transfer rollers 109Y, 109M, 109C, and 109K, a driving roller 112A, an opposing roller 112B, and supporting rollers 112C to 112F, and is endlessly moved in a direction indicated by an arrow in Fig. 8 by driving the driving roller 12A to rotate.

**[0064]** The transfer rollers 109Y, 109M, 109C, and 109K nip the transfer belt 104 with photosensitive drums 101Y, 101M, 101C and 101K, respectively, to form primary transfer nips. A transfer voltage (transfer bias) having a polarity opposite to that of a toner is applied to the transfer rollers 109Y, 109M, 109C, and 109K.

**[0065]** The transfer belt 104 as an image carrier moves in the direction indicated by the arrow, and sequentially passes through the primary transfer nips formed by the transfer rollers 109Y, 109M, 109C, and 109K. Thus, toner images of the respective colors formed on the photosensitive drums 101Y, 101M, 101C, and 101K through charging, exposing, and developing processes are primarily transferred onto the transfer belt 104 in a superimposed manner.

**[0066]** Subsequently, the transfer belt 104 onto which the toner images of the respective colors have been

transferred in a superimposed manner reaches a position (image transfer unit) opposing the secondary transfer roller 105 (secondary transfer unit). At this position, the opposing roller 112B nips the transfer belt 104 with the secondary transfer roller 105 to form a secondary transfer nip (image transferring unit). Then, the toner images of the four colors formed on the transfer belt 104 are transferred onto the sheet P (recording medium) conveyed to the secondary transfer nip.

**[0067]** As shown in Figs. 8 and 9, in the sheet aligning unit 1, the feeding rollers 4, the lateral registration rollers 2 as a lateral registration unit, the stopper 3 as a stopper unit, and the longitudinal registration rollers 50 as a conveying unit are arranged along the sheet conveying path which is shown by a dashed line in Fig. 8. The detection sensor 5 that is a CIS in this embodiment is arranged between the stopper 3 and the longitudinal registration rollers 50. A photosensor 51 is arranged between the longitudinal registration rollers 50 and the secondary transfer nip (image transfer unit).

**[0068]** The stopper 3 is a metal plate having a contact surface which is divided into a plurality of portions in the width direction. The leading end of the sheet P comes into contact with the contact surface, so that skew (inclination) of the sheet P is corrected. The stopper 3 can open and close the sheet conveying path. Specifically, with the driving of a cam mechanism that is engaged with the stopper 3, the stopper 3 moves upward to close the sheet conveying path or downward to open the sheet conveying path in Fig. 8 at predetermined timing.

**[0069]** The lateral registration rollers 2 are a pair of rollers which is divided into a plurality of rolling parts in the width direction, and are arranged upstream of the stopper 3 in the conveying direction of the sheet P. The cam mechanism causes the lateral registration rollers 2 to be in contact with or separated from each other and to move in the width direction indicated by a dashed arrow S in Fig. 9. The lateral registration rollers 2 nip the sheet P being in contact with the stopper 3, and then move in the width direction, thereby performing the lateral registration of the sheet P (correcting misalignment in the width direction).

**[0070]** The lateral registration rollers 2 are normally on standby at the home position before starting to nip the sheet P, and do not move laterally when the lateral registration is unnecessary.

**[0071]** The longitudinal registration rollers 50 are a pair of rollers arranged downstream of the stopper 3 in the conveying direction of the sheet P. The longitudinal registration rollers 50 convey to the secondary transfer nip the sheet P after the lateral registration is performed by the lateral registration rollers 2. At this time, the sheet P comes into contact with the nip of the longitudinal registration rollers 50, and longitudinal registration of the sheet P is performed (misalignment in the conveying direction is corrected). In other words, the longitudinal registration rollers 50 convey the sheet P to the secondary transfer nip with appropriate timing.

**[0072]** The detection sensor 5 includes a plurality of photosensors (including light emitting elements such as light emitting diodes (LEDs) and photodetectors such as photodiodes) arranged in the width direction, and detects a misalignment amount in the width direction by detecting positions of both sides of the sheet P in the width direction. Then, based on a result indicative of the detection by the detection sensor 5, the lateral registration is performed by the lateral registration rollers 2.

**[0073]** The photosensor 51 is arranged downstream of the longitudinal registration rollers 50 in the conveying direction of the sheet P, and optically detects the leading end of the sheet P conveyed by the longitudinal registration rollers 50. Then, based on a result indicative of the detection by the photosensor 51, conveying timing to convey the sheet P to the secondary transfer nip by the longitudinal registration rollers 50 is finely adjusted.

**[0074]** Operations of the sheet aligning unit 1 configured as mentioned above are explained in detail referring to Figs. 10A to 10D and Figs. 11A to 11D.

**[0075]** First, as shown in Fig. 10A, the sheet P fed from the sheet tray 40 or 41 is conveyed to the stopper 3 in a direction indicated by a dashed arrow by rotating the feeding rollers 4 in an R1 direction. At this time, the lateral registration rollers 2 are moved in the direction in which the lateral registration rollers 2 are separated (in an a1 direction), and the stopper 3 is moved in a direction in which the sheet conveying path is closed (in a b1 direction).

**[0076]** Subsequently, as shown in Fig. 10B, the leading end of the sheet P stops by coming into contact with the stopper 3. Then, as shown in Fig. 10C, the feeding rollers 4 stop its rotation, and the lateral registration rollers 2 move in a direction in which the sheet P is nipped (in an a2 direction). At this time, part of the sheet P is deformed.

**[0077]** In this manner, inclination of the sheet P is corrected by making the leading end of the sheet P in contact with the stopper 3. More specifically, even when the sheet P is conveyed in an inclined state with respect to the conveying direction (the sheet P is skewed), one corner of the sheet leading end first comes into contact with the stopper 3, and then the sheet P moves around the corner, so that the other corner also comes into contact with the stopper 3 after a while. Consequently, the skew of the sheet P is corrected.

**[0078]** Then, as shown in Fig. 10D, the feeding rollers 4 move in a direction in which the feeding rollers 4 are separated (in a c1 direction), and the stopper 3 also moves in a direction in which the sheet conveying path is opened (in a b2 direction). Accordingly, the sheet P is nipped only by the lateral registration rollers 2.

**[0079]** Subsequently, as shown in Fig. 11A, rotation of the lateral registration rollers 2 in an R2 direction causes the sheet P to be conveyed to the longitudinal registration rollers 50 (in a direction indicated by a dashed arrow). At this time, the detecting unit 5 detects a misalignment amount of the sheet P in the lateral direction, and the lateral registration rollers 2 move from the home position

in a direction perpendicular to the drawing sheet (for example, in an S1 direction) so that the misalignment amount is offset. Specifically, when the lateral position of the sheet P is misaligned by 3 millimeters to a right side in Fig. 9, the lateral registration rollers 2 that nip the sheet P are shifted by 3 millimeters to a left side.

**[0080]** In this manner, in the state where the sheet conveying path is opened by the stopper 3, the lateral registration rollers 2 convey the sheet P to the longitudinal registration rollers 50 while performing the lateral registration.

**[0081]** Then, as shown in Fig. 11B, the sheet P subjected to the lateral registration stops when the leading end thereof comes into contact with the longitudinal registration rollers 50 (the sheet P stops in the state of being pressed into the nip of the longitudinal registration rollers 50). At this time, the feeding rollers 4 move in a direction to convey the sheet P (in the c2 direction) to prepare for conveyance of the next sheet.

**[0082]** Furthermore, the lateral registration rollers 2 move in an opposite direction (for example, an S2 direction opposite to the S1 direction) toward the home position to prepare for conveyance and lateral registration of the next sheet. Simultaneously, the lateral registration rollers 2 move in the direction in which nipping of the sheet P is released (in the a1 direction). Specifically, immediately after the conveying operation by the lateral registration rollers 2 (operation to convey the sheet P to the longitudinal registration rollers 50) is completed, and also immediately after the conveying operation by the longitudinal registration rollers 50 (operation to convey the sheet P to the image transfer unit) is ready, the lateral registration rollers 2 return to the home position, and release the nipping of the sheet P. With these operations, the skew correction and the lateral registration can be promptly performed to the sheet to be conveyed next. As a result, an interval between the sheets P to be conveyed continuously can be shortened, leading to improvement of productivity of the image forming apparatus.

**[0083]** As shown in Fig. 11C, the feeding rollers 4 resume its rotation. Moreover, when the photosensor 51 detects the leading end of the sheet P that is conveyed by the rotation of the longitudinal registration rollers 50, the longitudinal registration rollers 50 temporarily stop the rotation.

**[0084]** Then, longitudinal registration of the sheet P is performed. That is, as shown in Fig. 11D, in synchronization with timing of the color image transferred onto the transfer belt 104, the sheet P is conveyed to the secondary transfer nip. Thus, the color image is transferred to a desired position on the sheet P. At this time, the stopper 3 moves in the direction in which the sheet conveying path is closed (in the b1 direction) to prepare for skew correction to the next sheet P' to be conveyed by the feeding rollers 4.

**[0085]** Drive of a variable driving motor (not shown) enables the longitudinal registration rollers 50 to vary the rotation speed thereof. Therefore, the conveying speed of the sheet P conveyed from the longitudinal registration rollers 50 to the secondary transfer nip can be adjusted, so that longitudinal registration can be performed with higher accuracy.

**[0086]** As explained above, in the same manner as the sheet aligning unit according to the first embodiment, the sheet aligning unit 1 according to the second embodiment can accurately position the leading end of the sheet to be sent into the image transfer unit, prevent sheet jam and fold of the sheet leading end, and be manufactured at relatively low cost.

**[0087]** Additionally, immediately after the sheet P whose misalignment in the width direction has been corrected by the lateral registration rollers 2 (lateral registration) reaches the longitudinal registration rollers 50, the lateral registration rollers 2 move back to the home position (return to the home position). Therefore, the skew correction (inclination correction) and the lateral registration can be promptly performed to the sheet P to be conveyed next. In other words, an interval between the sheets P to be conveyed continuously can be shortened, and productivity of the image forming apparatus can be improved.

**[0088]** According to one aspect of the present invention, an image forming apparatus having a mechanism that can accurately position the leading end of the sheet to be sent into the image transfer position, prevent sheet jam and fold of the sheet leading end at the registration unit, and be manufactured at low cost.

**[0089]** Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

## Claims

**1.** A sheet aligning device comprising:

a sheet conveying path (30);
a detecting unit (5) that detects a side edge of a sheet conveyed in the sheet conveying path;
a stopper unit (3) that is provided upstream of the detecting unit, and positions a leading end of the sheet conveyed in the sheet conveying path by opening and closing the conveying path;
a first conveying unit (2) that is provided upstream of the stopper unit and includes a pair of first rollers, the first roller being in contact with or separated from each other;
a second conveying unit (4) that is provided upstream of the first conveying unit and includes a pair of second rollers, the second rollers being in contact with or separated from each other; and
a lateral moving unit (12, 13, 14) that moves the

first rollers in an axial direction thereof based on a result indicative of a detection by the detecting unit.

**2.** The sheet aligning device according to claim 1, wherein with the first rollers being separated, the second conveying unit conveys the sheet so that the sheet forms a loop between the stopper unit and the second conveying unit;
subsequently, the first rollers are made in pressure-contact with each other, the stopper is released, and the second rollers are separated to convey the sheet and to move the first rollers in an axial direction thereof; and
after the sheet passes through the first conveying unit, the first rollers is returned to an original position thereof.

**3.** The sheet aligning device according to claim 1 or 2, wherein a conveying speed of the second conveying unit is temporarily decreased upon making the sheet in contact with the stopper unit.

**4.** The sheet aligning device of any one of claims 1 to 3, further comprising a drive unit that associates an open/close operation of the conveying path by the stopper unit and contact/separation operations of the first rollers and the second rollers with one another.

**5.** The sheet aligning device according to claim 4, further comprising a cam unit (22, 23, 24) that is fixed on a cam shaft (21) and performs the open/close operation and the contact/separation operations.

**6.** The sheet aligning device according to claim 5, wherein the cam unit includes three cams (22, 23, 24).

**7.** A sheet aligning device comprising:

a sheet conveying path (30) through which a sheet is conveyed to an image transfer unit;
a lateral registration unit (2) that moves in a width direction from a home position thereof to correct a misalignment of the sheet in the width direction; and
a conveying unit that (50) conveys to the image transfer unit the sheet after the misalignment in the width direction is corrected by the lateral registration unit, wherein
the lateral registration unit moves back to the home position immediately after the sheet whose misalignment in the width direction is corrected by the lateral registration unit reaches the conveying unit.

**8.** The sheet aligning device according to claim 7, further comprising a stopper unit (3) that is capable of opening and closing the sheet conveying path and corrects an inclination of the sheet by making a leading end of the sheet in contact therewith, wherein
the lateral registration unit includes a pair of lateral registration rollers (2) that moves in the width direction after nipping the sheet that is in contact with the stopper unit, and
the conveying unit includes a pair of longitudinal registration rollers (50) that is arranged downstream of the stopper unit in a conveying direction of the sheet and corrects a misalignment in the conveying direction of the sheet whose misalignment in the width direction is corrected by the lateral registration rollers.

**9.** The sheet aligning device according to claim 8, wherein the lateral registration rollers move back to the home position immediately and release the nipping of the sheet immediately after the sheet whose misalignment in the width direction is corrected by the lateral registration unit reaches the longitudinal registration rollers.

**10.** An image forming apparatus comprising:

the sheet aligning device according to any one of claims 1 to 9.

FIG.1

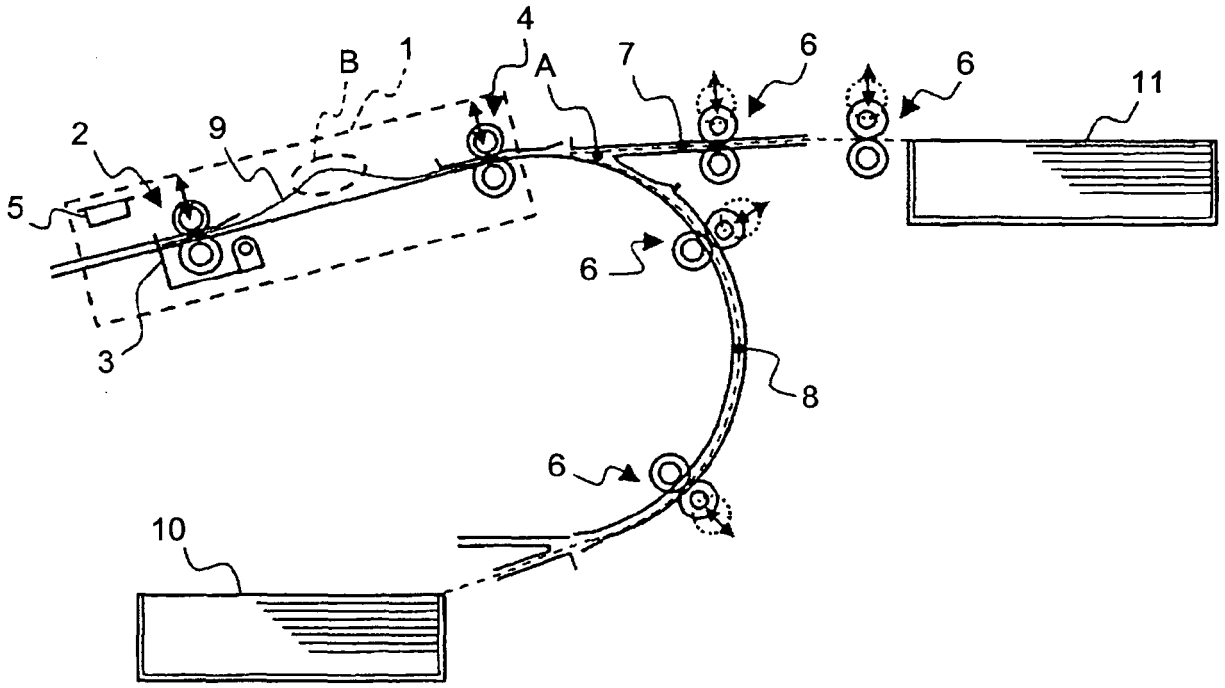


FIG.2A

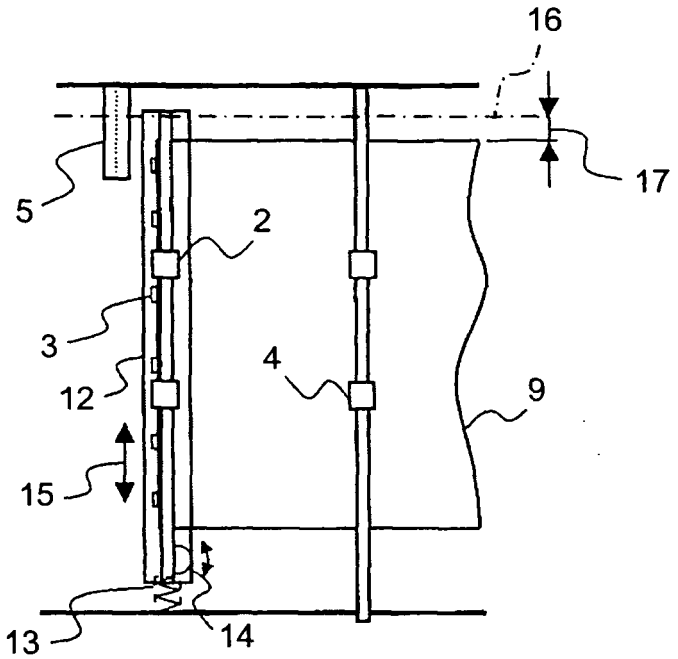



FIG.2B

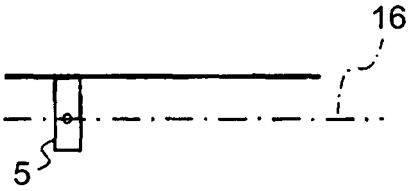



FIG.2C

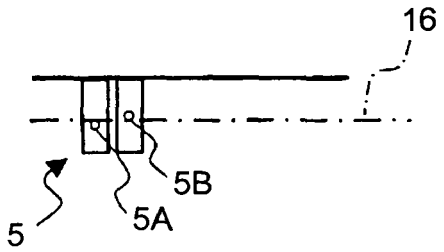


FIG.3

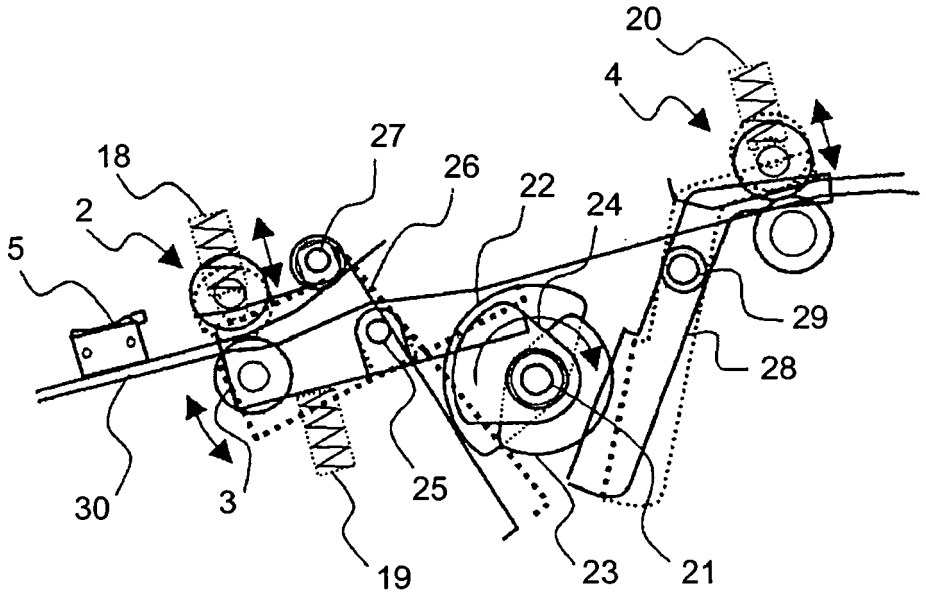


FIG.4A

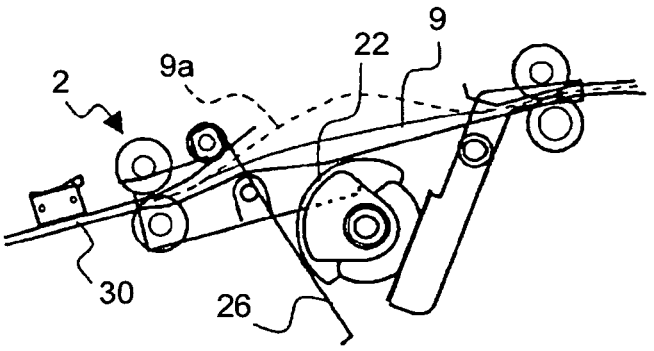



FIG.4B

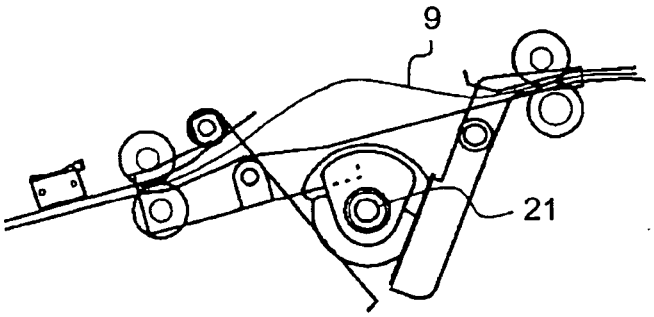



FIG.4C

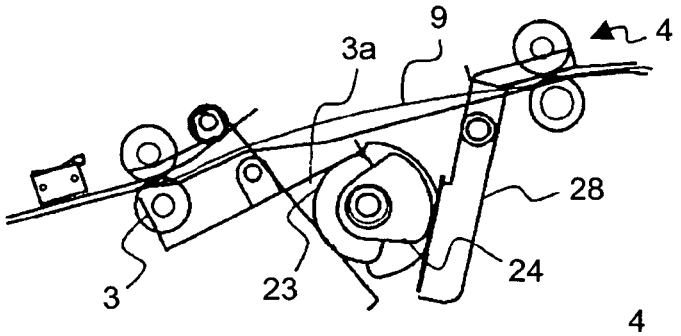



FIG.4D

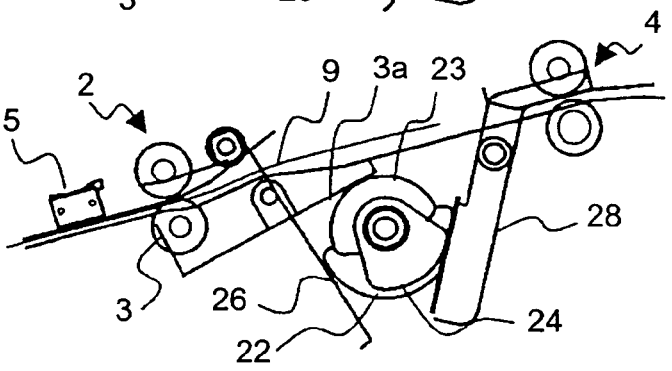



FIG.4E

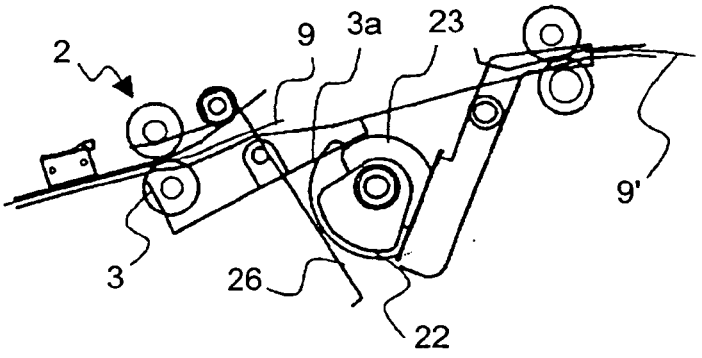


FIG.5

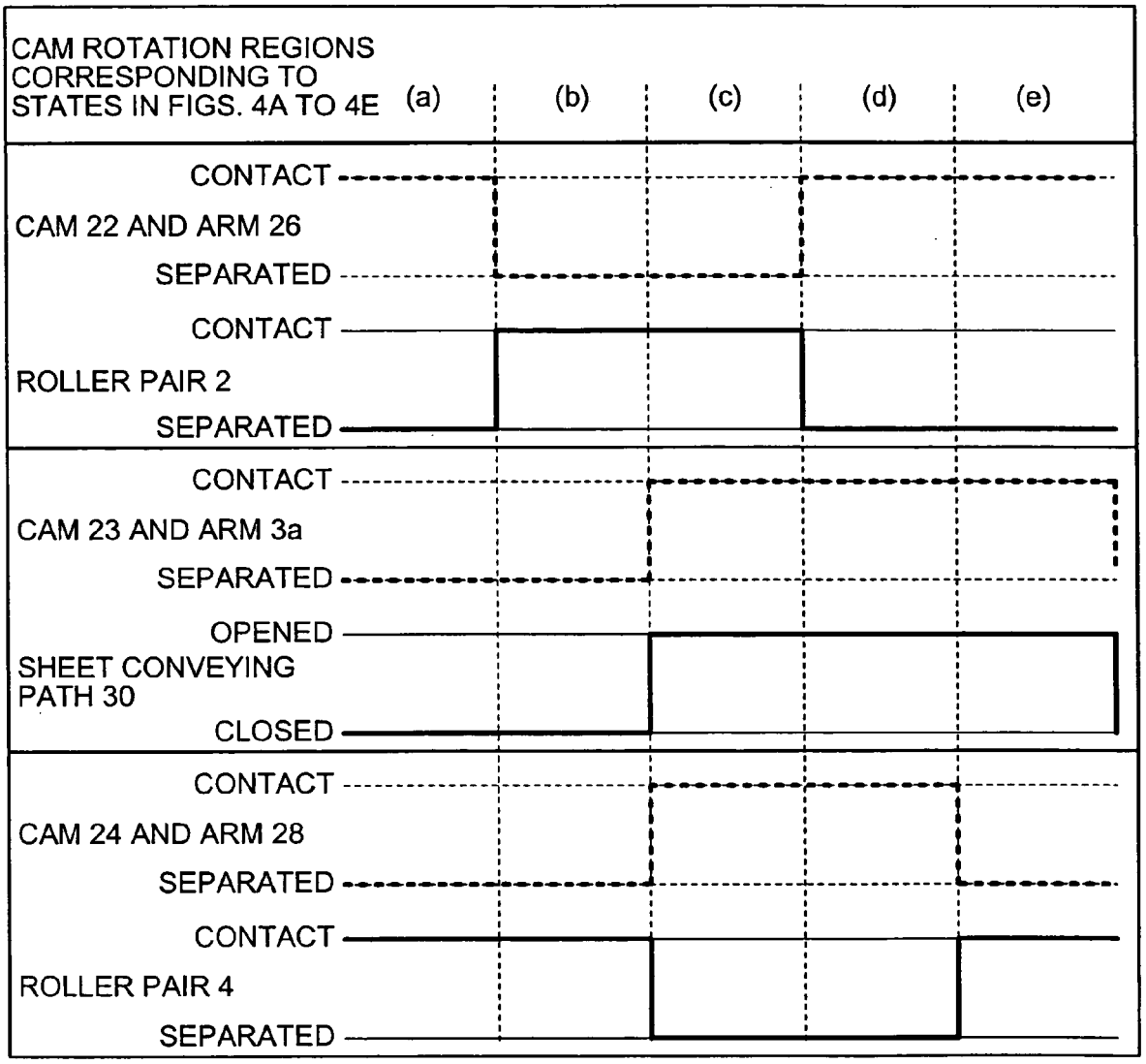

CAM ROTATION REGIONS CORRESPONDING TO STATES IN FIGS. 4A TO 4E
(a)
(b)
(c)
(d)
(e)
CONTACT
CAM 22 AND ARM 26
SEPARATED
CONTACT
ROLLER PAIR 2
SEPARATED
CONTACT
CAM 23 AND ARM 3a
SEPARATED
OPENED
SHEET CONVEYING PATH 30
CLOSED
CONTACT
CAM 24 AND ARM 28
SEPARATED
CONTACT
ROLLER PAIR 4
SEPARATED

FIG.6

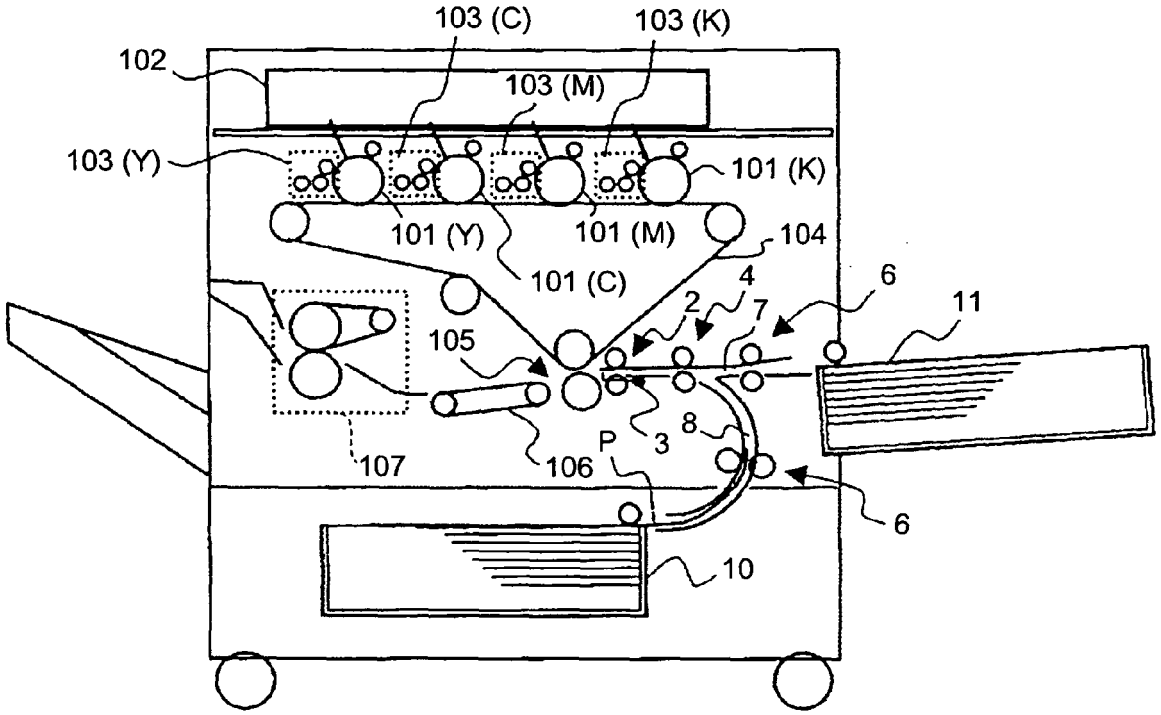

103 (C)
103 (K)
102
103 (M)
103 (Y)
101 (K)
101 (Y)
101 (M)
104
101 (C)
6
4
2
7
11
105
8
3
P
107
106
6
10

FIG.7

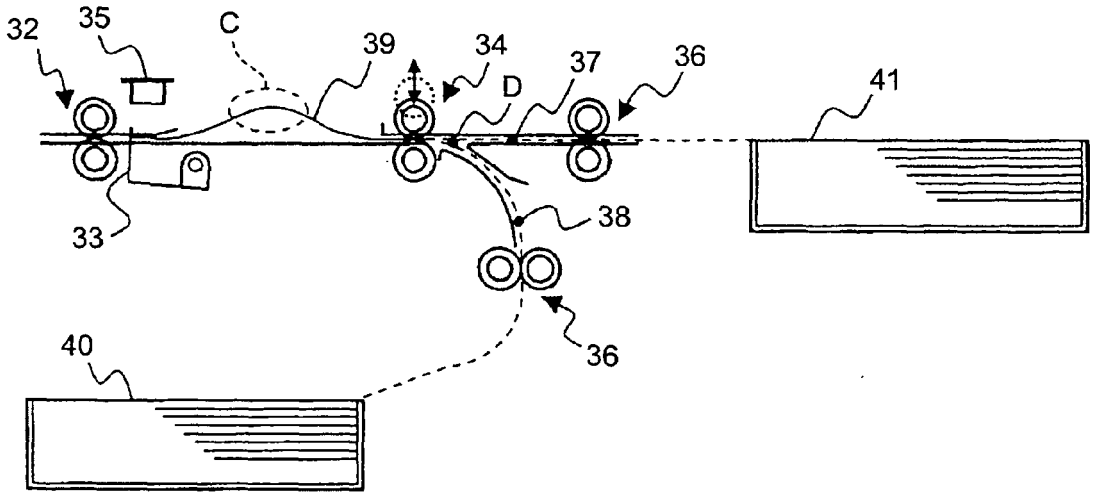

32
35
C
39
34
37
36
41
D
L
33
38
36
40

FIG.8

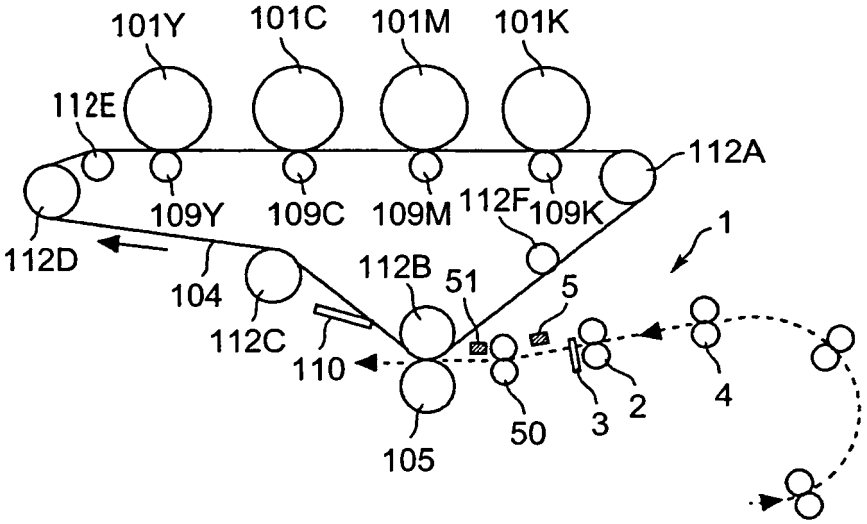

101Y
101C
101M
101K
112E
112A
109Y
109C
109M
112F
109K
1
112D
104
112B
51
5
112C
110
2
4
50
3
105

FIG.9

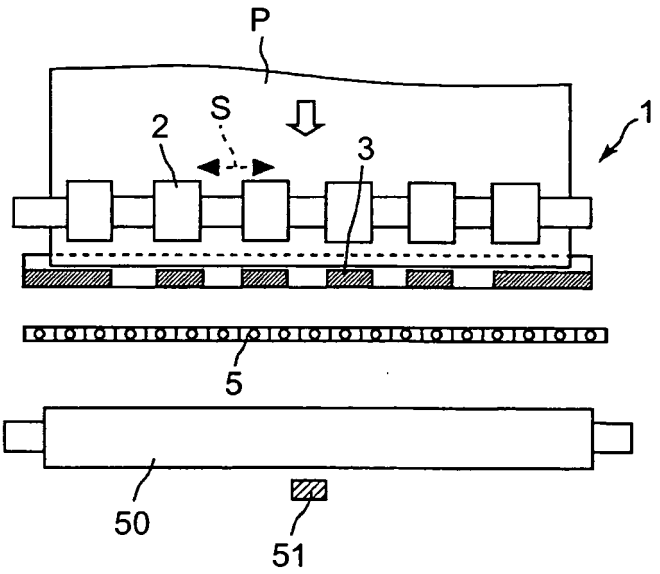

P
S
2
3
1
5
50
51

FIG.10A

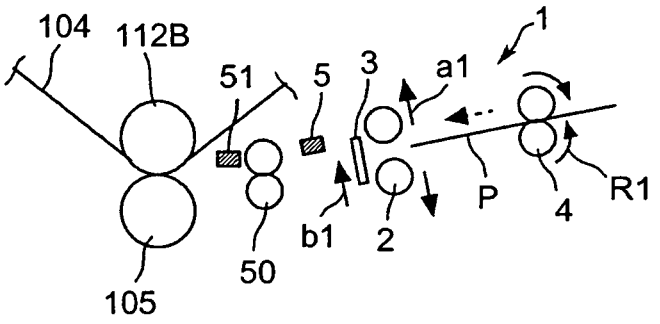



FIG.10B

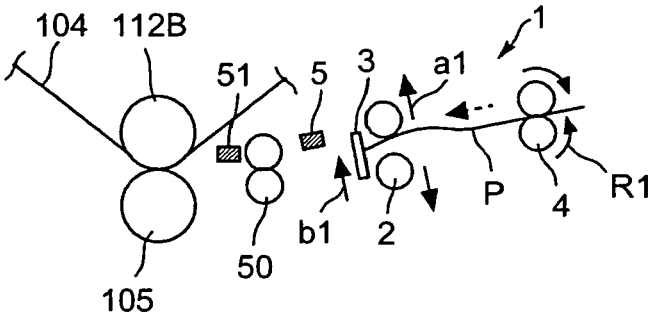



FIG.10C

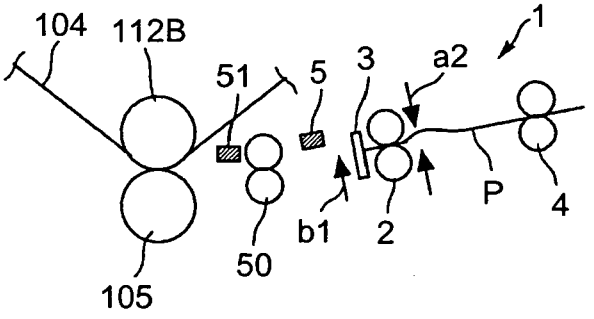



FIG.10D

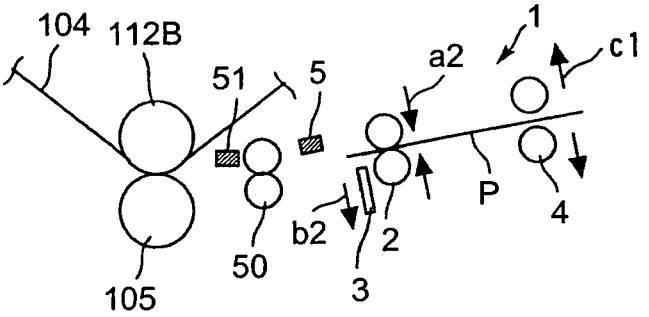


FIG.11A

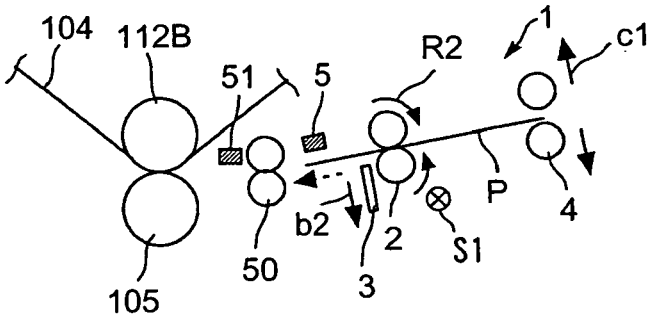



FIG.11B

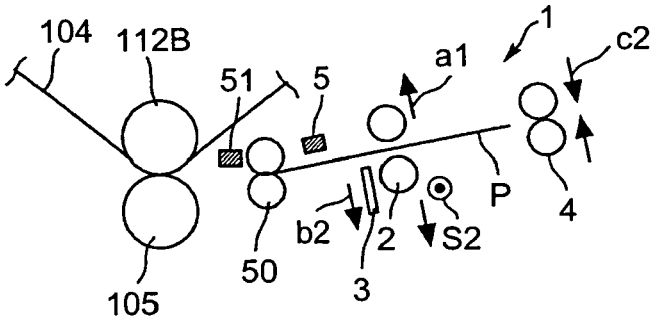



FIG.11C

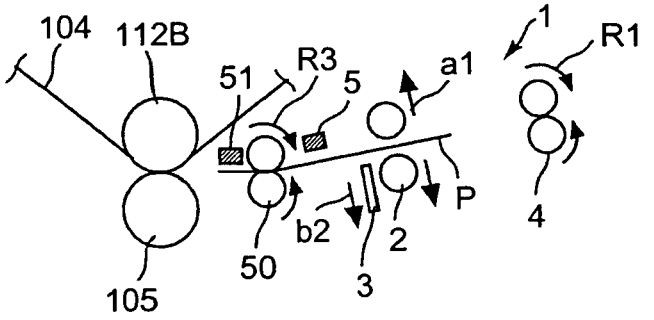
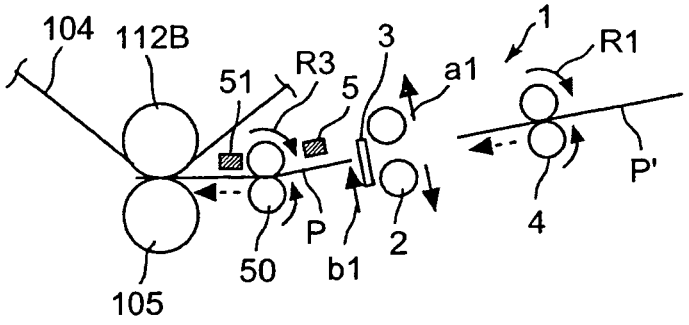



FIG.11D



## REFERENCES CITED IN THE DESCRIPTION

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- JP 2893540 B **[0005]**
- JP H10203690 B **[0010]**