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(71) Applicants:
- **Toshiba TEC Kabushiki Kaisha**
  **Tokyo 141-0032 (JP)**
- **Kabushiki Kaisha Toshiba**
  **Minato-ku**
  **Tokyo (JP)**

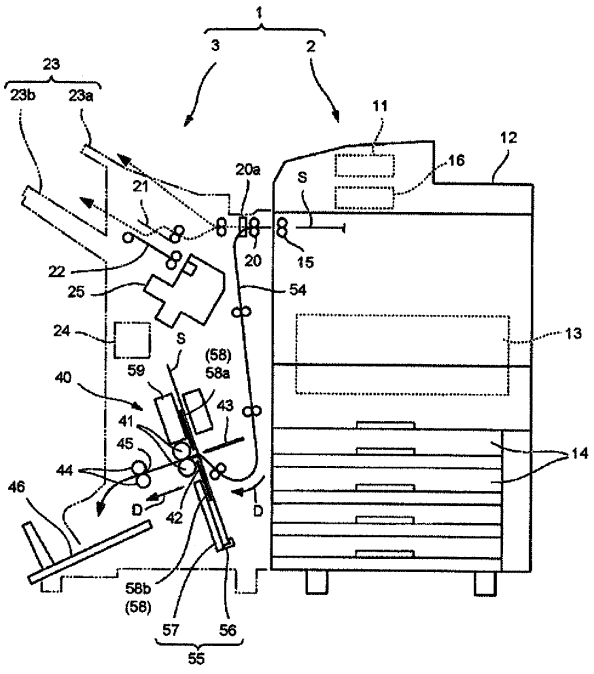
(72) Inventor: **Taguchi, Hiroyuki**
**Tokyo, 141-8562 (JP)**

(74) Representative: **Hoffmann Eitle**
**Patent- und Rechtsanwälte PartmbB**
**Arabellastraße 30**
**81925 München (DE)**

## (54) SHEET POST-PROCESSING APPARATUS AND METHOD OF FOLDING A SHEET

(57) A sheet post-processing apparatus is described. The sheet post-processing apparatus includes a pair of folding rollers (41), a blade (43) and a controller. The blade (43) can fold a sheet (S) in half by pushing the sheet (S) into a nip part (42) between the pair of folding rollers (41) . The controller sets a front end edge of the blade (43) below a target position (PI) where the sheet (S) is folded in half.

FIG.1

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**(Cont. next page)**

FIG.3

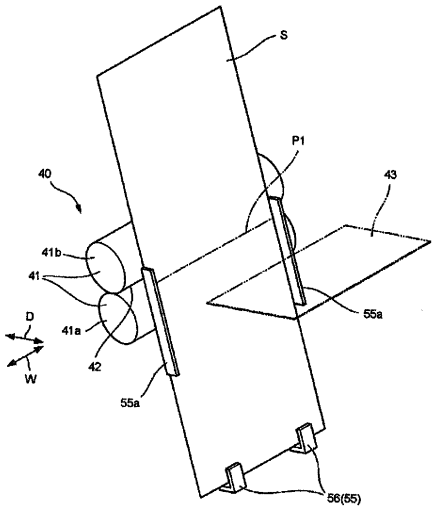



FIG.5

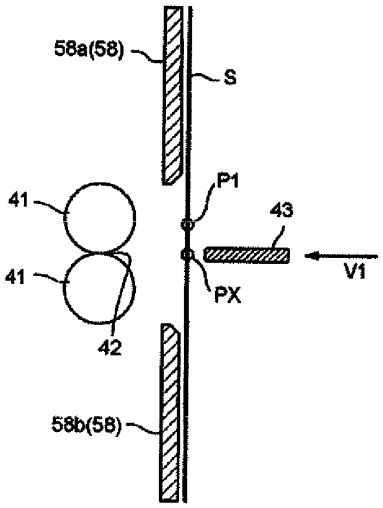
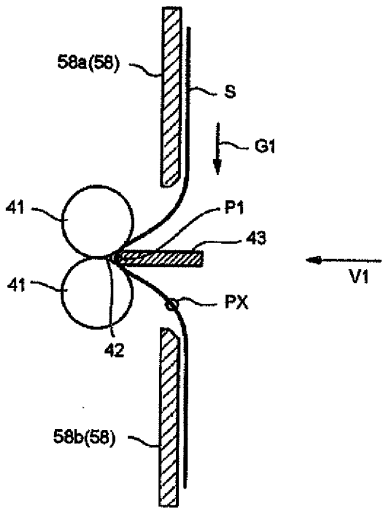



FIG.6



## Description

### CROSS-REFERENCE TO RELATED APPLICATIONS

### FIELD

**[0001]** Embodiments described herein relate generally to a sheet post-processing apparatus.

### BACKGROUND

**[0002]** There is known a sheet post-processing apparatus for executing a post-processing on a sheet conveyed from an image forming apparatus (for example, an MFP). The sheet post-processing apparatus has a processing section for executing stapling or sorting on the conveyed sheet. The sheet post-processing apparatus further includes a folding mechanism for folding a plurality of the sheets as a bundle in half. The folding mechanism includes a pair of folding rollers and a blade. The pair of folding rollers is opposite to each other in a vertical direction. A pair of the folding rollers forms a nip part. The blade can fold the sheet in half by pushing the sheet into the nip part.

**[0003]** However, if the blade pushes the sheet into the nip part, there is a possibility that slipping occurs between the blade and the sheet due to the sheets own weight. For example, a coefficient of friction decreases as a coverage rate of a portion where the blade and the sheet contact with each other increases, and there is a high possibility that slipping occurs between the blade and the sheet. If the slipping occurs between the blade and the sheet, there is a possibility that the sheet cannot be correctly pushed into the nip part and a shift occurs in a folding position of the sheet.

### SUMMARY

**[0004]** It is an object of the present disclosure to provide an improved sheet post-processing apparatus.

**[0005]** According to an apparatus embodiment, a sheet post-processing apparatus may comprise:

a pair of folding rollers;
a blade configured to fold a sheet in half by pushing the sheet into a nip part between the pair of folding rollers; and
a controller configured to set a front end edge of the blade below a target position where the sheet is folded in half.

**[0006]** The sheet post-processing apparatus may furthermore be such that the controller is configured to set a shift amount of the front end edge from the target position to an anticipated amount, the anticipated amount corresponding to a distance the sheet shifts downward until the blade pushes the sheet into the nip part.

**[0007]** The sheet post-processing apparatus may furthermore be such that the controller is configured to calculate the shift amount of the front end edge from the target position based on a coverage rate of a surface of the sheet facing the front end edge.

**[0008]** The sheet post-processing apparatus may furthermore be such that the sheet is one of a plurality of sheets to be folded, and the controller is configured to calculate the shift amount of the front end edge from the target position based on a number of the sheets.

**[0009]** The sheet post-processing apparatus may furthermore be such that the controller is configured to calculate the shift amount of the front end edge from the target position based on a size of the sheet.

**[0010]** According to a method embodiment a method of folding a sheet may comprise:

setting a front end edge of a blade below a target position; and
folding a sheet in half by the blade pushing the sheet into a nip part between a pair of folding rollers.

**[0011]** The method may further comprise setting a shift amount of the front end edge from the target position to an anticipated amount, the anticipated amount corresponding to a distance at which the sheet shifts downward until the blade pushes the sheet into the nip part.

**[0012]** The method may further comprise calculating the shift amount of the front end edge from the target position based on a coverage rate of a surface of the sheet facing the front end edge.

**[0013]** The method may furthermore be such that the sheet is one of a plurality of sheets to be folded, and further comprising calculating the shift amount of the front end edge from the target position based on a number of the sheets.

**[0014]** The method may further comprise calculating the shift amount of the front end edge from the target position based on a size of the sheet.

### DESCRIPTION OF THE DRAWINGS

**[0015]**

Fig. 1 is a diagram of an image forming system;
Fig. 2 is a block diagram of the image forming system;
Fig. 3 is a perspective view of a folding mechanism;
Fig. 4 is a flowchart illustrating a shift amount calculation method;
Fig. 5 is a view illustrating the effect of controlling the folding mechanism;
Fig. 6 is a view illustrating the effect by controlling the folding mechanism following Fig. 5;
Fig. 7 is a flowchart of a shift amount calculation method according to a first modification of the embodiment;
Fig. 8 is a flowchart of a shift amount calculation method according to a second modification of the

embodiment.

DETAILED DESCRIPTION

**[0016]** In accordance with an embodiment, a sheet post-processing apparatus comprises a pair of folding rollers, a blade and a controller. The blade can fold a sheet in half by pushing the sheet into a nip part between the pair of folding rollers. The controller sets a front end edge of the blade below a target position where the sheet is folded in half.

**[0017]** Hereinafter, a sheet post-processing apparatus of an embodiment is described with reference to the accompanying drawings. In each drawing, the same components are denoted with the same reference numerals.

**[0018]** Fig. 1 is a diagram illustrating an example of an image forming system 1 according to the embodiment. As shown in Fig. 1, the image forming system 1 includes an image forming apparatus 2 and a sheet post-processing apparatus 3 (hereinafter, also referred to as a "post-processing apparatus 3") .

**[0019]** The image forming apparatus 2 forms an image on a sheet-like image receiving medium (hereinafter referred to as a "sheet S") such as a paper. For example, the image forming apparatus 2 is an MFP (Multi-Function Peripheral) which is a multifunction peripheral, a printer, a copying machine, and the like. The post-processing apparatus 3 executes a post-processing on the sheet S conveyed from the image forming apparatus 2. The sheet S is not limited to paper, and also includes a plastic sheet such as an OHP (Overhead projector) sheet. The sheet S is not limited to being sent from the image forming apparatus 2 to the post-processing apparatus 3, and can also be sent manually to the post-processing apparatus 3.

**[0020]** Fig. 2 is a block diagram illustrating the structure of the image forming system 1 according to the embodiment.

**[0021]** As shown in Fig. 2, the image forming apparatus 2 includes a control panel 11, a scanner section 12, a printer section 13, a sheet feed section 14, a sheet discharge section 15 and an image forming controller 16.

**[0022]** The control panel 11 includes various keys or a touch panel for receiving an operation of a user. For example, the control panel 11 receives an input relating to a type of the post-processing of the sheet S. The image forming apparatus 2 sends information on the type of the post-processing input by the control panel 11 to the post-processing apparatus 3.

**[0023]** The scanner section 12 includes a reading section that reads image information of a copy object. The scanner section 12 sends the scanned image information to the printer section 13.

**[0024]** The printer section 13 forms an output image (hereinafter, referred to as a "toner image") with a developer such as a toner based on the image information transmitted from the scanner section 12 or an external device. The printer section 13 transfers the toner image onto a surface of the sheet S. The printer section 13 fixes the toner image on the sheet S by applying heat and pressure to the toner image transferred onto the sheet S.

**[0025]** The sheet feed section 14 supplies the sheets S one by one to the printer section 13 in accordance with a timing at which the printer section 13 forms the toner image.

**[0026]** The sheet discharge section 15 conveys the sheet S discharged from the printer section 13 to the post-processing apparatus 3.

**[0027]** The image forming controller 16 controls the overall operation of the image forming apparatus 2. The image forming controller 16 controls the control panel 11, the scanner section 12, the printer section 13, the sheet feed section 14 and the sheet discharge section 15. The image forming controller 16 is formed of a control circuit including a CPU (Central Processing Unit), a ROM (Read Only Memory), and a RAM (Random Access Memory).

**[0028]** Next, the post-processing apparatus 3 is described.

**[0029]** As shown in Fig. 1, the post-processing apparatus 3 is arranged adjacent to the image forming apparatus 2. The sheet S is conveyed from the image forming apparatus 2 to the post-processing apparatus 3. The post-processing apparatus 3 executes a post-processing designated through the control panel 11 on the conveyed sheet S. For example, the post-processing apparatus 3 executes a stapling processing and a sort processing. For example, the post-processing apparatus 3 executes a sheet folding processing to fold the sheet S in half and then discharge it.

**[0030]** The post-processing apparatus 3 includes a conveyance section 20, a standby section 21, a processing section 22, a discharge section 23, a post-processing controller 24 (controller) and a folding mechanism 40.

**[0031]** The conveyance section 20 is connected to the downstream side of the sheet discharge section 15 in a conveyance direction. The conveyance section 20 receives the sheet S conveyed from the image forming apparatus 2. A manual feed tray (not shown) is connected to the sheet discharge section 15.

**[0032]** The standby section 21 temporarily retains (buffers) the sheet S conveyed from the image forming apparatus 2. The standby section 21 is provided above the processing section 22. The standby section 21 drops the retained sheet S toward the processing section 22 if the processing section 22 is empty.

**[0033]** The processing section 22 executes the post-processing on the conveyed sheet S. For example, the processing section 22 executes the sorting processing to align a plurality of sheets S. For example, the processing section 22 executes a sheet binding processing on a sheet bundle obtained by aligning a plurality of sheets S with a staple or adhesive tape. In Fig. 1, reference numeral 25 denotes a sheet binding apparatus which executes a binding processing on the sheet bundle in the processing section 22 with the staple. The processing section 22 discharges the sheet S on which the post-

processing is executed to the discharge section 23.

**[0034]** The discharge section 23 includes a fixing tray 23a and a movable tray 23b. The fixing tray 23a is provided at the upper part of the post-processing apparatus 3. The movable tray 23b is provided at the side of the post-processing apparatus 3. The sheet S is discharged from the standby section 21 and the processing section 22 to the fixing tray 23a and the movable tray 23b.

**[0035]** As shown in Fig. 2, the post-processing controller 24 controls the overall operation of the post-processing apparatus 3. The post-processing controller 24 controls the operations of the conveyance section 20, the standby section 21, the processing section 22, the discharge section 23 and the folding mechanism 40. Similar to the image forming controller 16, the post-processing controller 24 is formed by a control circuit including a CPU, a ROM and a RAM.

**[0036]** Next, the folding mechanism 40 of the post-processing apparatus 3 is described.

**[0037]** As shown in Fig. 1, the post-processing apparatus 3 includes the folding mechanism 40 that folds one or a plurality of the sheets S in half.

**[0038]** The post-processing apparatus 3 conveys the sheet S along a path along a page surface in Fig. 1. The sheet S arranges front and back surfaces in parallel with a direction orthogonal to the page surface in Fig. 1. Hereinafter, the direction along the conveyance path of the sheet S in the folding mechanism 40 is referred to as a sheet conveyance direction D (or simply conveyance direction). Hereinafter, the direction orthogonal to the page surface in Fig. 1 is referred to as a sheet width direction W (refer to Fig. 3). The sheet S has a rectangular shape with two sides along the sheet conveyance direction D and two sides along the sheet width direction W.

**[0039]** The sheet S is conveyed from the image forming apparatus 2 to the folding mechanism 40 via a sheet path 54. The sheet S conveyed to the folding mechanism 40 is stopped by a stacker 55.

**[0040]** For example, the stacker 55 stops the sent sheet S in a standing attitude. The stacker 55 tilts the sheet S so that an upper side of the sheet S stopped is positioned at a downstream side (a folding roller 41 side) in the conveyance direction. If a plurality of sheets S is folded in half, a plurality of the sheets S is sequentially stacked and stopped by the stacker 55 to become a bundle.

**[0041]** The sheet S (or the sheet bundle) stopped by the stacker 55 is supported by a guide member 58 from the downstream side in the conveyance direction and is arranged flat. At this time, a central position P1 (center in the sheet conveyance direction) of the sheet S in the standing direction faces a nip part 42 of the folding roller 41 in a thickness direction of the sheet S (refer to Fig. 3) . In the embodiment, the standing direction of the sheet S is a slightly inclined direction with respect to the vertical direction.

**[0042]** A folding blade 43 (hereinafter, simply referred to as a "blade 43") is arranged at a portion facing the nip part 42 across the sheet S in the thickness direction of the sheet S. In the embodiment, the blade 43 extends in a direction orthogonal to the standing direction of the sheet S. The blade 43 is slightly inclined with respect to the horizontal direction. For example, the blade 43 is made of stainless steel.

**[0043]** As shown in Fig. 3, the blade 43 extrudes a central position P1 of the sheet S in the standing direction towards the nip part 42 of the folding roller 41 and extrudes the central position P1 of the sheet S to the nip part 42. The folding roller 41 rotates while sandwiching the central position P1 of the sheet S to fold the sheet S in half. As shown in Fig. 1, the sheet S folded in half (hereinafter, referred to as a "folding body") is conveyed by a discharge roller 44 located at the downstream side in the conveyance direction of the nip part 42 and then discharged to a sheet discharge tray 46. The folding roller 41 and the discharge roller 44 are rotationally driven independently of each other or synchronously by a driving motor (not shown).

**[0044]** As shown in Fig. 1, in order to switch a conveyance destination of the sheet S conveyed from the image forming apparatus 2 to the processing section 22 side or the folding mechanism 40 side, a gate 20a is provided in the conveyance section 20 of the post-processing apparatus 3. If the sheet folding processing is not executed, the gate 20a conveys the sheet S conveyed from the image forming apparatus 2 to the processing section 22 side. The gate 20a conveys the sheet S to the folding mechanism 40 side at the time of executing the sheet folding processing.

**[0045]** Fig. 3 is a perspective view illustrating an example of the folding mechanism 40 according to the embodiment.

**[0046]** As shown in Fig. 3, the folding mechanism 40 includes the folding roller 41 and the blade 43.

**[0047]** The folding roller 41 is composed of a pair of rollers forming the nip part 42. For example, the pair of rollers is rubber rollers. One of the pair of rollers of the folding roller 41 is a driving roller 41a. The other of the pair of rollers of the folding roller 41 is a driven roller 41b. The driving roller 41a and the driven roller 41b are opposed to each other in the vertical direction.

**[0048]** The driving roller 41a is rotationally driven at a fixed position without moving. The driving roller 41a is driven by a driving source (not shown). For example, the driving source of the driving roller 41a uses a direct current motor. The driving source communicates a driving force to the driving roller 41a. For example, the driving source of the driving roller 41a also communicates the driving force to the blade 43.

**[0049]** The driven roller 41b is detachable with respect to the driving roller 41a. The driven roller 41b is energized towards the driving roller 41a by an energization mechanism (not shown) . The driven roller 41b is driven to rotate by the rotation of the driving roller 41a.

**[0050]** At the nip part 42 of the folding roller 41, the central position P1 of the sheet S is sandwiched by the

blade 43. The folding roller 41 folds the sheet S inserted into the nip part 42 and conveys the sheet S folded in half to the conveyance direction downstream side.

**[0051]** The blade 43 is a plate-like member having a thickness in a direction in which the pair of rollers of the folding roller 41 faces each other. The blade 43 can reciprocate so as to insert and pull the front end edge into and out of the nip part 42. For example, the blade 43 reciprocates via a slider crank mechanism. The blade 43 enters the nip part 42 while pushing the central position P1 of the sheet S into the nip part 42. The blade 43 retracts from the nip part 42 while leaving the central position P1 of the sheet S in the nip part 42.

**[0052]** As shown in Fig. 1, the guide member 58 is arranged between the folding roller 41 and the sheet S in the sheet conveyance direction D. The guide member 58 is a plate-like member orthogonal to an advancing and retreating direction of the blade 43. The guide member 58 guides the sheet S conveyed from the sheet path 54 to the standing state and places it on the stacker 55. The guide member 58 is divided into a first guide member 58a and a second guide member 58b with a gap therebetween allowing advancement and retraction of the blade 43. The blade 43 can move forward through the gap between the first guide member 58a and the second guide member 58b to push the central position P1 (refer to Fig. 3) of the sheet S into the nip part 42. If the central position P1 (refer to Fig. 3) of the sheet S is pushed into the nip part 42, a crease is formed on the sheet S. The blade 43 can exit from the nip part 42 after retracting after forming the crease on the sheet S.

**[0053]** The stacker 55 includes a support claw 56 and a moving device 57. The support claw 56 supports the lower end of the sheet S in the standing state. The moving device 57 can move the support claw 56 up and down.

**[0054]** Above the stacker 55, a stapling unit 59 is arranged. In response to the type of the post-processing, the stapling unit 59 executes a stapling processing to the central position P1 of the sheet S in advance. The sheet S placed on the stacker 55 can move up and down by movement of the support claw 56. For example, the support claw 56 also rises with the displacement of the lower end of the sheet S when the blade 43 pushes the sheet S into the nip part 42.

**[0055]** The sheet S placed on the stacker 55 is positioned (aligned) in the sheet conveyance direction D due to the support from the lower end thereof by the support claw 56. As shown in Fig. 3, at both sides in the sheet width direction of the stacker 55, a pair of aligning members 55a for positioning the sheet S in a sheet width direction W is arranged.

**[0056]** As shown in Fig. 1, the discharge roller 44 which discharges the folded body toward the downstream side in the conveyance direction is arranged at a part separated from the downstream side in the conveyance direction of the folding roller 41.

**[0057]** The discharge roller 44 includes a pair of rollers forming a nip part 45. One of the pair of rollers of the discharge roller 44 is a driving roller. The other of the pair of rollers of the discharge roller 44 is a driven roller. The driving roller rotates at a fixed position without moving. The driven roller is detachable from the driving roller. The driven roller is energized towards the driving roller by an energization mechanism (not shown) . The folding body conveyed by the folding roller 41 is inserted into the nip part 45 of the discharge roller 44. The discharge roller 44 conveys the folded body inserted into the nip part 45 to the downstream side in the conveyance direction. The nip part 45 of the discharge roller 44 is opposed to the nip part 42 of the folding roller 41 in the sheet conveyance direction D.

**[0058]** Next, the post-processing controller 24 is described.

**[0059]** The post-processing controller 24 sets the front end edge of the blade 43 (hereinafter, also referred to as a "blade front end") below a target position at which the sheet S is folded in half. In the embodiment, the target position is the central position P1 (refer to Fig. 3) of the sheet S.

**[0060]** The post-processing controller 24 sets an amount of shift (hereinafter, also simply referred to as a "shift amount") of the front end of the blade from the central position P1 of the sheet S as an anticipated amount corresponding to a distance at which the sheet S is shifted downwards (hereinafter, also referred to simply as an "anticipated amount") until the sheet S is pushed into the nip part 42 by the blade 43.

**[0061]** For example, the post-processing controller 24 calculates the shift amount based on the coverage rate of a surface (hereinafter, also referred to as a "sheet surface") facing the front end of the blade of the sheet S. For example, in the case of the sheet bundle with a plurality of sheets S aligned, the sheet surface is a surface facing the front end of the blade of the sheet S located nearest to the blade front end side in the sheet bundle. The sheet S located nearest to the blade front end side in the sheet bundle becomes a final page in printing by the image forming apparatus 2.

**[0062]** Here, the coverage rate means a printing amount (a formation amount of a toner image) per unit area of the sheet surface. In other words, the coverage rate is the number of dots (dot rate) per unit area of the sheet surface. Information on the coverage rate is sent from the image forming apparatus 2 to the post-processing controller 24. For example, the image forming apparatus 2 sends the information on the coverage rate to the post-processing controller 24 based on image information sent from the scanner section 12 or an external device.

**[0063]** In the embodiment, the information on the coverage rate received by the post-processing controller 24 from the image forming apparatus 2 is limited to a range where the sheet contacts the front end of the blade in the sheet surface until the sheet S is pushed into the nip part 42 by the blade 43. In other words, the information on the coverage rate that the post-processing controller 24

receives from the image forming apparatus 2 is limited to a range obtained by adding the anticipated amount to the central position P1 of the sheet S. Thus, the information received from the image forming apparatus 2 by the post-processing controller 24 can be made as small as possible. For example, the range where the anticipated amount is added to the central position P1 of the sheet S is within a range of 3 mm above or below the central position P1 of the sheet S, or 3 mm above the central position P1.

**[0064]** For example, the post-processing controller 24 calculates the shift amount based on the number of sheets S. Here, the number of the sheets S means the number of the sheets S conveyed to the folding mechanism 40 from the image forming apparatus 2 via the sheet path 54 and stopped by the stacker 55. The number of sheets S is the number of sheets S (hereinafter, also referred to as "number of folded sheets") folded in half by the blade 43. Information on the number of folded sheets is sent from the image forming apparatus 2 to the post-processing controller 24. For example, the image forming apparatus 2 sends the information on the number of folded sheets input by the control panel 11 or an external device to the post-processing controller 24.

**[0065]** For example, the post-processing controller 24 calculates the shift amount based on a size of the sheet S. Here, the size of the sheet S means the size of the sheet S conveyed from the image forming apparatus 2 to the folding mechanism 40 via the sheet path 54 and stopped by the stacker 55. The size of the sheet S is the size (hereinafter also referred to simply as a "sheet size") of the sheet S folded in half by the blade 43. Information on the sheet size is sent from the image forming apparatus 2 to the post-processing controller 24. For example, the image forming apparatus 2 sends the information on the sheet size input by the control panel 11 or an external device to the post-processing controller 24.

**[0066]** Next, an example of a shift amount calculation method of the embodiment is described.

**[0067]** Fig. 4 is a flowchart illustrating an example of the shift amount calculation method according to the embodiment. The image forming system 1 operates by executing the processing in ACT 1 to ACT 12 shown in Fig. 4 in accordance with a flow shown in Fig. 4.

**[0068]** In ACT 1, the post-processing controller 24 determines whether or not the coverage rate is 75% or more.

**[0069]** If the coverage rate is 75% or more (Yes in ACT 1), ACT 2 is executed.

**[0070]** If the coverage rate is less than 75% (No in ACT 1), ACT 5 is executed.

**[0071]** In ACT 2, the post-processing controller 24 determines whether or not the number of folded sheets is 5 or more.

**[0072]** If the number of folded sheets is 5 or more (Yes in ACT 2), ACT 3 is executed.

**[0073]** If the number of folded sheets is less than 5 (No in ACT 2), ACT 4 is executed.

**[0074]** In ACT 3, the post-processing controller 24 sets the shift amount to 3 mm.

**[0075]** In ACT 4, the post-processing controller 24 sets the shift amount to 2 mm.

**[0076]** In ACT 5, the post-processing controller 24 determines whether or not the coverage rate is 50% or more.

**[0077]** If the coverage rate is 50% or more (Yes in ACT 5), ACT 6 is executed.

**[0078]** If the coverage rate is less than 50% (No in ACT 5), ACT 9 is executed.

**[0079]** In ACT 6, the post-processing controller 24 determines whether or not the number of folded sheets is 10 or more.

**[0080]** If the number of folded sheets is 10 or more (Yes in ACT 6), ACT 7 is executed.

**[0081]** If the number of folded sheets is less than 10 (No in ACT 6), ACT 8 is executed.

**[0082]** In ACT 7, the post-processing controller 24 sets the shift amount to 2 mm.

**[0083]** In ACT 8, the post-processing controller 24 sets the shift amount to 1 mm.

**[0084]** In ACT 9, the post-processing controller 24 determines whether or not the coverage rate is 25% or more.

**[0085]** If the coverage rate is 25% or more (Yes in ACT 9), ACT 10 is executed.

**[0086]** If the coverage rate is less than 25% (No in ACT 9), ACT 12 is executed.

**[0087]** In ACT 10, the post-processing controller 24 determines whether or not the number of folded sheets is 15 or more.

**[0088]** If the number of folded sheets is 15 or more (Yes in ACT 10), ACT 11 is executed.

**[0089]** If the number of folded sheets is less than 15 (No in ACT 10), ACT 12 is executed.

**[0090]** In ACT 11, the post-processing controller 24 sets the shift amount to 1 mm.

**[0091]** In ACT 12, the post-processing controller 24 sets the shift amount to 0 mm. In other words, in ACT 12, the post-processing controller 24 sets the front end edge of the blade to the same position as the central position P1 of the sheet S.

**[0092]** The post-processing controller 24 sets the front end edge of the blade below the central position P1 of the sheet S based on the calculated shift amount. The post-processing controller 24 sets the front end edge of the blade below the central position P1 of the sheet S by controlling the folding mechanism 40 (refer to Fig. 3) . In the embodiment, the post-processing controller 24 sets the front end edge of the blade below the central position P1 of the sheet S by moving the stacker 55 up and down (refer to Fig. 3).

**[0093]** Next, the effect of controlling the folding mechanism 40 of the embodiment is described.

**[0094]** Fig. 5 and Fig. 6 are views illustrating the effect of controlling the folding mechanism 40 according to the embodiment. In Fig. 5 and Fig. 6, a reference numeral

V1 indicates an advancing direction of the blade 43.

**[0095]** First, a comparative example is described. In the comparative example, the folding mechanism 40 in the embodiment is not controlled.

**[0096]** As shown in Fig. 5, in the case of the comparative example, the front end edge of the blade is set at the same position as a central position PX of the sheet S. The blade 43 advances towards the nip part 42 while pushing the central position PX of the sheet S into the nip part 42. However, there is a possibility that a slipping occurs between the blade 43 and the sheet S before the blade 43 pushes the sheet S into the nip part 42. For example, the slipping between the blade 43 and the sheet S is caused by an own weight of the sheet S or the coverage rate of the sheet surface.

**[0097]** As shown in Fig. 6, if the slipping occurs between the blade 43 and the sheet S, there is a possibility that the central position PX of the sheet S cannot be pushed into the nip part 42 correctly. For example, a coefficient of friction decreases as the coverage rate of a portion where the blade 43 and the sheet S contact with each other increases, and there is a high possibility that the slipping occurs between the blade 43 and the sheet S. In addition, the possibility that the slipping occurs between the blade 43 and the sheet S becomes higher as the number of folded sheets becomes larger or the sheet size becomes larger. If the slipping occurs between the blade 43 and the sheet S, the sheet S cannot be pushed into the nip part 42 correctly and the folding position (central position PX) of the sheet S is possibly deviated. In Fig. 5 and Fig. 6, reference symbol PX denotes the central position of the sheet S in the comparative example.

**[0098]** In contrast, according to the embodiment, the post-processing apparatus 3 has a pair of the folding rollers 41, the blade 43, and the post-processing controller 24. The blade 43 can fold the sheet S in half by pushing the sheet S into the nip part 42 between the pair of folding rollers 41. The post-processing controller 24 sets the front end edge of the blade below the central position P1 at which the sheet S is folded in half. With the above arrangement, the following effects are achieved. Compared to the case in which the front end edge of the blade is set at the same position as the central position PX of the sheet S (refer to the comparative example in Fig. 5), the shift of the sheet S at a timing at which the sheet S is guided to the pair of the folding rollers 41 can be suppressed. The shift amount between the front end edge of the blade and the central position P1 of the sheet S in the vertical direction (gravity direction G1 shown in Fig. 6) can be offset by the set shift amount until the sheet S is pushed into the nip part 42 by the blade 43. Therefore, it is possible to prevent the folding position of the sheet S from shifting. In Fig. 5 and Fig. 6, the reference symbol P1 denotes the central position of the sheet S in the embodiment.

**[0099]** The post-processing controller 24 sets the shift amount of the front end of the blade from the central position P1 of the sheet S to the anticipated amount corresponding to the distance at which the sheet S shifts downwards until the sheet S is pushed into the nip part 42 by the blade 43, and in this way, the following effect is achieved. The amount by which the front end edge of the blade and the central position P1 of the sheet S are deviated in the vertical direction can be offset only by the anticipated amount until the blade 43 pushes the sheet S into the nip part 42. Therefore, it is possible to more effectively suppress the folding position of the sheet S from shifting.

**[0100]** The post-processing controller 24 calculates the shift amount of the front end of the blade from the central position P1 of the sheet S based on the coverage rate of the surface of the sheet S facing the front end edge of the blade, and in this way, the following effect is achieved. The amount by which the front end edge of the blade and the central position P1 of the sheet S are deviated in the vertical direction until the sheet S is pushed into the nip part 42 by the blade 43 can be offset only by the shift amount calculated based on the coverage rate. Therefore, even if the slipping occurs between the blade 43 and the sheet S due to the coverage rate of the sheet surface, it is possible to suppress the folding position of the sheet S from shifting.

**[0101]** The post-processing controller 24 calculates the shift amount of the blade front end from the central position P1 of the sheet S based on the number of folded sheets S, and in this way, the following effect is achieved. The amount by which the front end edge of the blade and the central position P1 of the sheet S are deviated in the vertical direction until the sheet S is pushed into the nip part 42 by the blade 43 can be offset only by the shift amount calculated based on the number of folded sheets. Therefore, even if the slipping occurs between the blade 43 and the sheet S due to the number of folded sheets S, it is possible to suppress the folding position of the sheet S from shifting.

**[0102]** The post-processing controller 24 calculates the shift amount of the front end of the blade from the central position P1 of the sheet S based on the coverage rate and the number of folded sheets, and in this way, the following effect is achieved. The amount by which the front end edge of the blade and the central position P1 of the sheet S are deviated in the vertical direction until the sheet S is pushed into the nip part 42 by the blade 43 can be offset only by the shift amount calculated based on the coverage rate and the number of folded sheets. Therefore, even if the slipping occurs between the blade 43 and the sheet S due to the coverage rate and the number of folded sheets, it is possible to suppress the folding position of the sheet S from shifting.

**[0103]** Modifications of the embodiment are described.

**[0104]** First, a first modification of the embodiment is described with reference to Fig. 7.

**[0105]** Fig. 7 is a flowchart illustrating an example of the shift amount calculation method according to the first modification of the embodiment.

**[0106]** The image forming system 1 operates by exe-

cuting the processing in ACT 101 to ACT 107 shown in Fig. 7 in accordance with a flow shown in Fig. 7.

**[0107]** In ACT 101, the post-processing controller 24 determines whether or not the sheet size is A3 or LDR (Tabloid Ledger).

**[0108]** If the sheet size is A3 or LDR (Yes in ACT 101), ACT 102 is executed.

**[0109]** If the sheet size is not A3 or LDR (No in ACT 101), ACT 103 is executed.

**[0110]** In ACT 102, the post-processing controller 24 sets the shift amount to 3 mm.

**[0111]** In ACT 103, the post-processing controller 24 determines whether or not the sheet size is B4 or LGL (Legal).

**[0112]** If the sheet size is B4 or LGL (Yes in ACT 103), ACT 104 is executed.

**[0113]** If the sheet size is not B4 or LGL (No in ACT 103), ACT 105 is executed.

**[0114]** In ACT 104, the post-processing controller 24 sets the shift amount to 2 mm.

**[0115]** In ACT 105, the post-processing controller 24 determines whether or not the sheet size is A4R or LTR (Letter).

**[0116]** If the sheet size is A4R or LTR (Yes in ACT 105), ACT 106 is executed.

**[0117]** If the sheet size is not A4R or LTR (No in ACT 105), ACT 107 is executed.

**[0118]** In ACT 106, the post-processing controller 24 sets the shift amount to 1 mm.

**[0119]** In ACT 107, the post-processing controller 24 sets the shift amount to 0 mm. In other words, in ACT 107, the post-processing controller 24 sets the front end edge of the blade to the same position as the central position P1 of the sheet S.

**[0120]** According to the first modification, the post-processing controller 24 calculates the shift amount of the blade front end from the central position P1 of the sheet S based on the sheet size, and in this way, the following effect is achieved. The amount by which the front end edge of the blade and the central position P1 of the sheet S are deviated in the vertical direction until the sheet S is pushed into the nip part 42 by the blade 43 can be offset only by the shift amount calculated based on the sheet size. Therefore, even if the slipping occurs between the blade 43 and the sheet S due to the sheet size, it is possible to suppress the folding position of the sheet S from shifting.

**[0121]** Next, a second modification of the embodiment is described with reference to Fig. 8.

**[0122]** Fig. 8 is a flowchart illustrating an example of the shift amount calculation method according to the second modification of the embodiment.

**[0123]** The image forming system 1 operates by executing the processing in ACT 201 to ACT 214 shown in Fig. 8 in accordance with a flow shown in Fig. 8.

**[0124]** In ACT 201, the post-processing controller 24 determines whether or not the sheet size is A3 or LDR.

**[0125]** If the sheet size is A3 or LDR (Yes in ACT 201), ACT 202 is executed.

**[0126]** If the sheet size is not A3 or LDR (No in ACT 201), ACT 207 is executed.

**[0127]** In ACT 202, the post-processing controller 24 determines whether or not the number of folded sheets is 5 or more.

**[0128]** If the number of folded sheets is 5 or more (Yes in ACT 202), ACT 203 is executed.

**[0129]** If the number of folded sheets is less than 5 (No in ACT 202), ACT 205 is executed.

**[0130]** In ACT 203, the post-processing controller 24 determines whether or not the number of folded sheets is 10 or more.

**[0131]** If the number of folded sheets is 10 or more (Yes in ACT 203), ACT 204 is executed.

**[0132]** If the number of folded sheets is less than 10 (No in ACT 203), ACT 206 is executed.

**[0133]** In ACT 204, the post-processing controller 24 sets the shift amount to 3 mm.

**[0134]** In ACT 206, the post-processing controller 24 sets the shift amount to 2 mm.

**[0135]** In ACT 205, the post-processing controller 24 sets the shift amount to 1 mm.

**[0136]** In ACT 207, the post-processing controller 24 determines whether or not the sheet size is B4 or LGL.

**[0137]** If the sheet size is B4 or LGL (Yes in ACT 207), ACT 208 is executed.

**[0138]** If the sheet size is not B4 or LGL (No in ACT 207), ACT 211 is executed.

**[0139]** In ACT 208, the post-processing controller 24 determines whether or not the number of folded sheets is 10 or more.

**[0140]** If the number of folded sheets is 10 or more (Yes in ACT 208), ACT 209 is executed.

**[0141]** If the number of folded sheets is less than 10 (No in ACT 208), ACT 210 is executed.

**[0142]** In ACT 209, the post-processing controller 24 sets the shift amount to 2 mm.

**[0143]** In ACT 210, the post-processing controller 24 sets the shift amount to 1 mm.

**[0144]** In ACT 211, the post-processing controller 24 determines whether or not the sheet size is A4R or LTR.

**[0145]** If the sheet size is A4R or LTR (Yes in ACT 211), ACT 212 is executed.

**[0146]** If the sheet size is not A4R or LTR (No in ACT 211), ACT 214 is executed.

**[0147]** In ACT 212, the post-processing controller 24 determines whether the number of folded sheets is 15 or more.

**[0148]** If the number of folded sheets is 15 or more (Yes in ACT 212), ACT 213 is executed.

**[0149]** If the number of folded sheets is less than 15 (No in ACT 212), ACT 214 is executed.

**[0150]** In ACT 213, the post-processing controller 24 sets the shift amount to 1 mm.

**[0151]** In ACT 214, the post-processing controller 24 sets the shift amount to 0 mm. In other words, in ACT 214, the post-processing controller 24 sets the front end

edge of the blade to the same position as the central position P1 of the sheet S.

**[0152]** According to the second modification, the post-processing controller 24 calculates the shift amount of the blade front end from the central position P1 of the sheet S based on the sheet size and the number of folded sheets, and in this way, the following effect is achieved. The amount by which the front end edge of the blade and the central position P1 of the sheet S are deviated in the vertical direction until the blade 43 pushes the sheet S into the nip part 42 can be offset only by the shift amount calculated based on the sheet size and the number of folded sheets. Therefore, even if the slipping occurs between the blade 43 and the sheet S due to the sheet size and the number of folded sheets, it is possible to suppress the folding position of the sheet S from shifting.

**[0153]** Other modifications of the embodiment are described below.

**[0154]** In the above-mentioned embodiment, the post-processing controller 24 calculates the shift amount of the blade front end from the central position P1 of the sheet S based on the coverage rate and the number of folded sheets. However, the present invention is not limited thereto, and the post-processing controller 24 may calculate the shift amount of the blade front end from the central position P1 of the sheet S based on the coverage rate, the number of folded sheets and the sheet size. In other words, the post-processing controller 24 may calculate the shift amount of the blade front end from the central position P1 of the sheet S based on at least one of the coverage rate, the number of folded sheets and the sheet size.

**[0155]** In the above-described embodiment, the post-processing controller 24 moves the stacker 55 up and down to set the front end edge of the blade below the central position P1 of the sheet S. However, the present invention is not limited thereto, and the post-processing controller 24 can move the pair of the folding rollers 41 and the blade 43 upward and downward to set the front end edge of the blade below the center position P1 of the sheet S.

**[0156]** In the above-described embodiment, the information on the coverage rate that the post-processing controller 24 receives from the image forming apparatus 2 is limited to the range obtained by adding the anticipated amount to the central position P1 of the sheet S. However, the present invention is not limited thereto, and the information on the coverage rate that the post-processing controller 24 receives from the image forming apparatus 2 may be based on the whole surface of the sheet.

**[0157]** In the above-mentioned embodiment, a case in which the target position is the central position P1 of the sheet S is described. However, the present invention is not limited thereto, and the target position may be a position deviated from the central position P1 of the sheet S in the standing direction of the sheet S.

**[0158]** According to the sheet post-processing apparatus of at least one embodiment described above, it is possible to suppress the folding position of the sheet from shifting.

**[0159]** The functions of the image forming system according to the foregoing embodiments may be realized by a computer. In this case, the functions may be realized by recording programs for realizing the functions in a computer-readable recording medium, and then reading the programs recorded in the recording medium into a computer system to execute the programs. Further, it is assumed that the "computer system" described herein contains an OS or hardware such as peripheral devices. Further, the "computer-readable recording medium" refers to a portable medium such as a flexible disc, a magneto-optical disk, a ROM, a CD-ROM and the like or a storage device such as a hard disk built in the computer system. Furthermore, the "computer-readable recording medium" may include a medium for dynamically holding the programs for a short time such as a communication wire in a case in which the programs are sent via a communication line such as a network such as the Internet or a telephone line, or may include a medium for holding the programs for a certain time such as a volatile memory in the computer system serving as a server and a client in that case. The foregoing programs may realize a part of the above-mentioned functions, or may realize the above-mentioned functions by combination with the programs already recorded in the computer.

**[0160]** While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the invention. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the invention. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the invention.

## Claims

1. A sheet post-processing apparatus (3), comprising:

   a pair of folding rollers (41);
   a blade (43) configured to fold a sheet (S) in half by pushing the sheet (S) into a nip part (42) between the pair of folding rollers (41); and
   a controller (24) configured to set a front end edge of the blade (43) below a target position (P1) where the sheet (S) is folded in half.

2. The sheet post-processing apparatus (3) according to claim 1, wherein
   the controller (24) is configured to set a shift amount of the front end edge from the target position (P1) to an anticipated amount, the anticipated amount corresponding to a distance the sheet (S) shifts down-

ward until the blade (43) pushes the sheet (S) into the nip part (42).

**3.** The sheet post-processing apparatus (3) according to claim 1, wherein
the controller (24) is configured to calculate a shift amount of the front end edge from the target position (P1) based on a coverage rate of a surface of the sheet (S) facing the front end edge.

**4.** The sheet post-processing apparatus (3) according to claim 2, wherein
the controller (24) is configured to calculate the shift amount of the front end edge from the target position (P1) based on a coverage rate of a surface of the sheet (S) facing the front end edge.

**5.** The sheet post-processing apparatus (3) according to one of claims 2 to 4, wherein
the sheet (S) is one of a plurality of sheets (S) to be folded, and
the controller (24) is configured to calculate the shift amount of the front end edge from the target position (P1) based on a number of the sheets (S).

**6.** The sheet post-processing apparatus (3) according to one of claims 2 to 5, wherein
the controller (24) is configured to calculate the shift amount of the front end edge from the target position (P1) based on a size of the sheet (S).

**7.** A method of folding a sheet (S), comprising:

setting a front end edge of a blade (43) below a target position (P1); and
folding a sheet (S) in half by the blade (43) pushing the sheet (S) into a nip part (42) between a pair of folding rollers (41) .

**8.** The method of folding a sheet (S) according to claim 7, further comprising setting a shift amount of the front end edge from the target position (P1) to an anticipated amount, the anticipated amount corresponding to a distance at which the sheet (S) shifts downward until the blade (43) pushes the sheet (S) into the nip part (42).

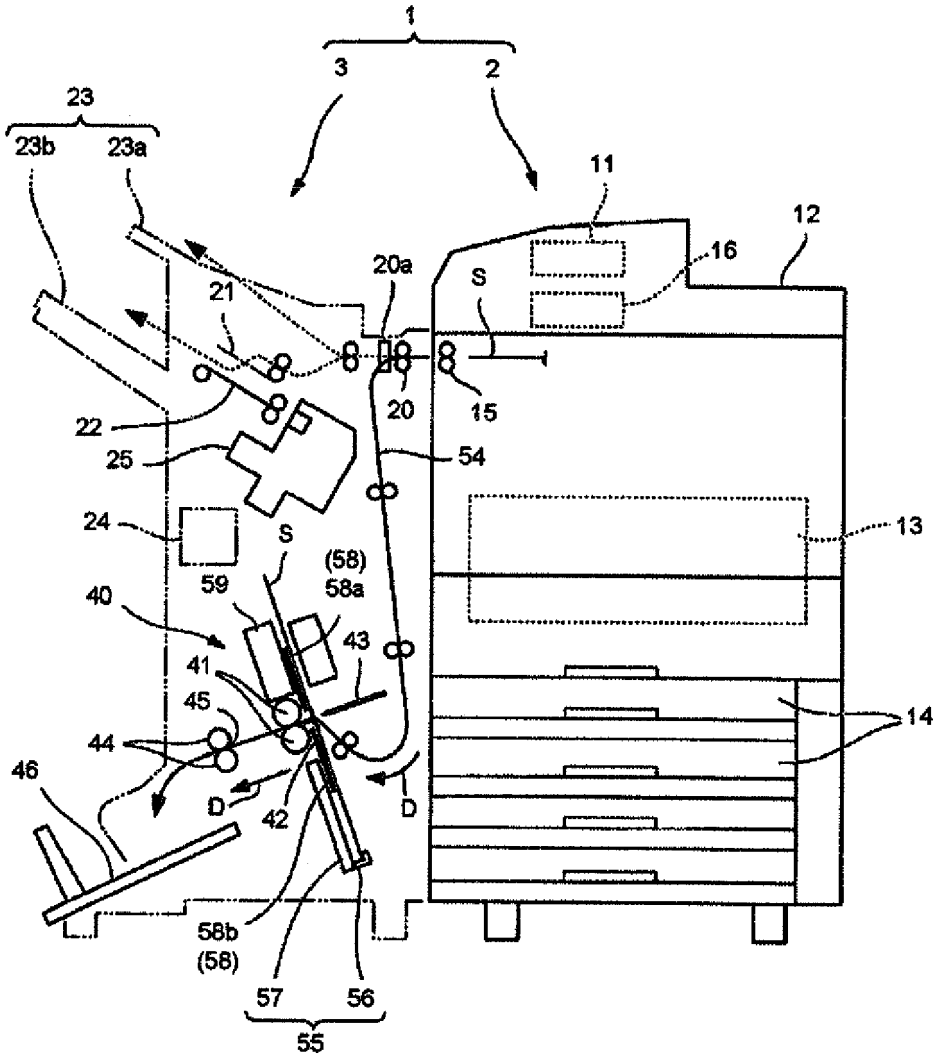
**9.** The method of folding a sheet (S) according to claim 7, further comprising calculating a shift amount of the front end edge from the target position (P1) based on a coverage rate of a surface of the sheet (S) facing the front end edge.

**10.** The method of folding a sheet (S) according to claim 8, further comprising calculating the shift amount of the front end edge from the target position (P1) based on a coverage rate of a surface of the sheet facing the front end edge.

**11.** The method of folding a sheet (S) according to one of claims 8 to 10, wherein the sheet (S) is one of a plurality of sheets (S) to be folded, and further comprising calculating the shift amount of the front end edge from the target position (P1) based on a number of the sheets (S).

**12.** The method of folding a sheet (S) according to one of claims 8 to 11, further comprising calculating the shift amount of the front end edge from the target position (P1) based on a size of the sheet.

FIG.1


1
3
2
23
23b
23a
11
12
16
20a
21
S
20
15
22
25
54
24
13
S
(58)
58a
59
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43
41
45
14
44
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D
D
42
58b
(58)
57
56
55

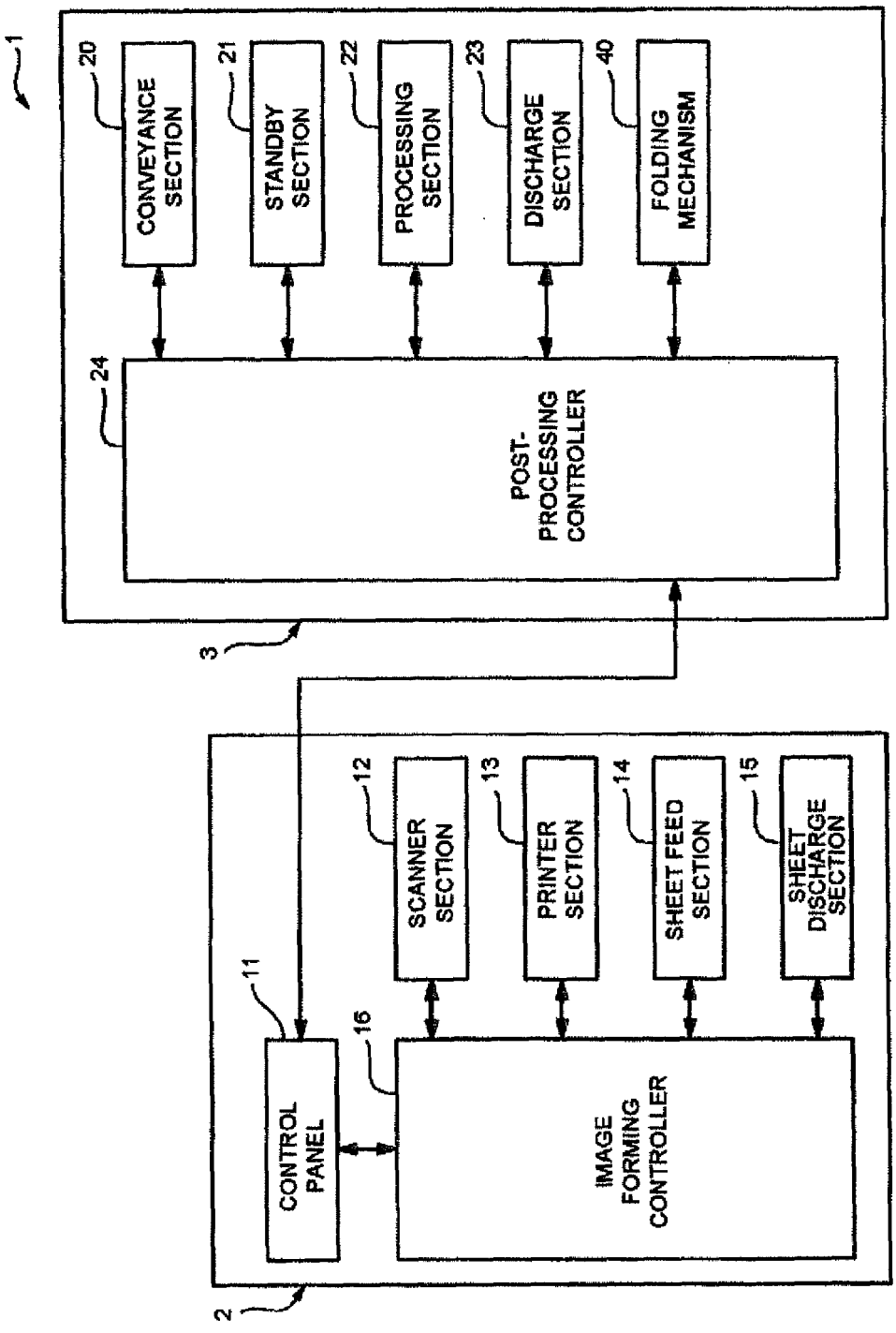
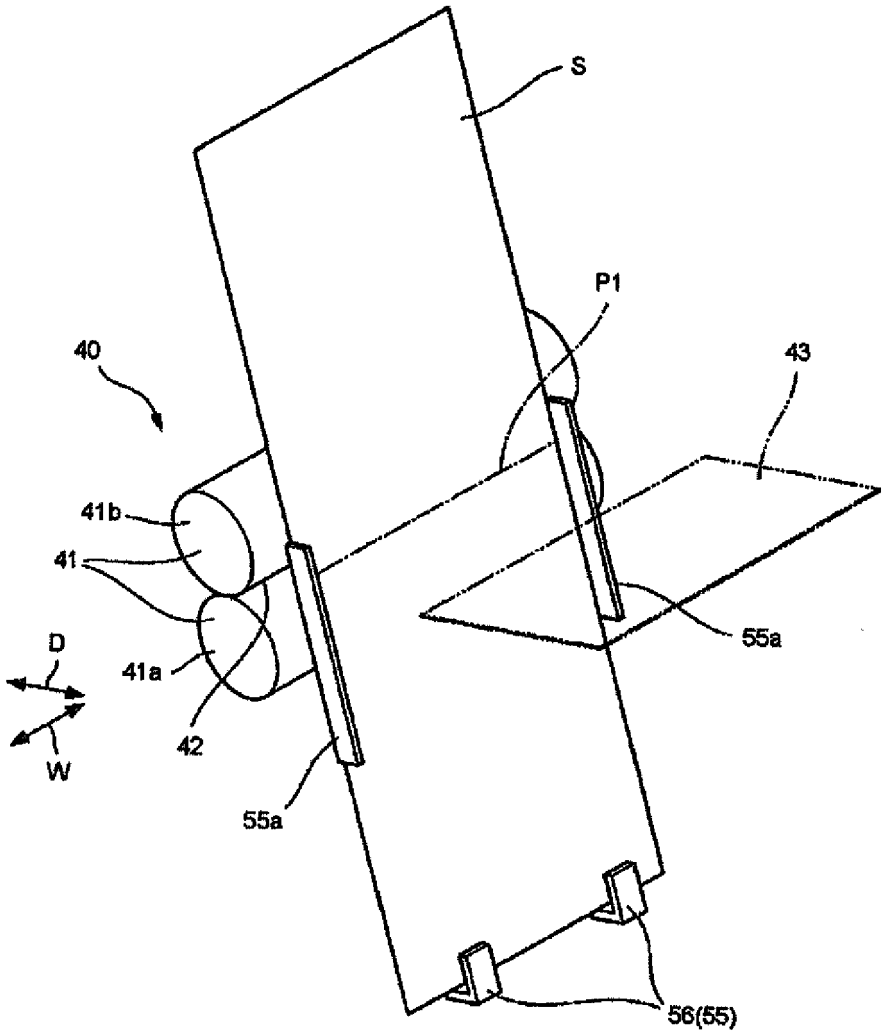

1
20
CONVEYANCE SECTION
21
STANDBY SECTION
22
PROCESSING SECTION
23
DISCHARGE SECTION
40
FOLDING MECHANISM
24
POST-PROCESSING CONTROLLER
3
12
SCANNER SECTION
13
PRINTER SECTION
14
SHEET FEED SECTION
15
SHEET DISCHARGE SECTION
11
CONTROL PANEL
16
IMAGE FORMING CONTROLLER
2

FIG.2

FIG.3



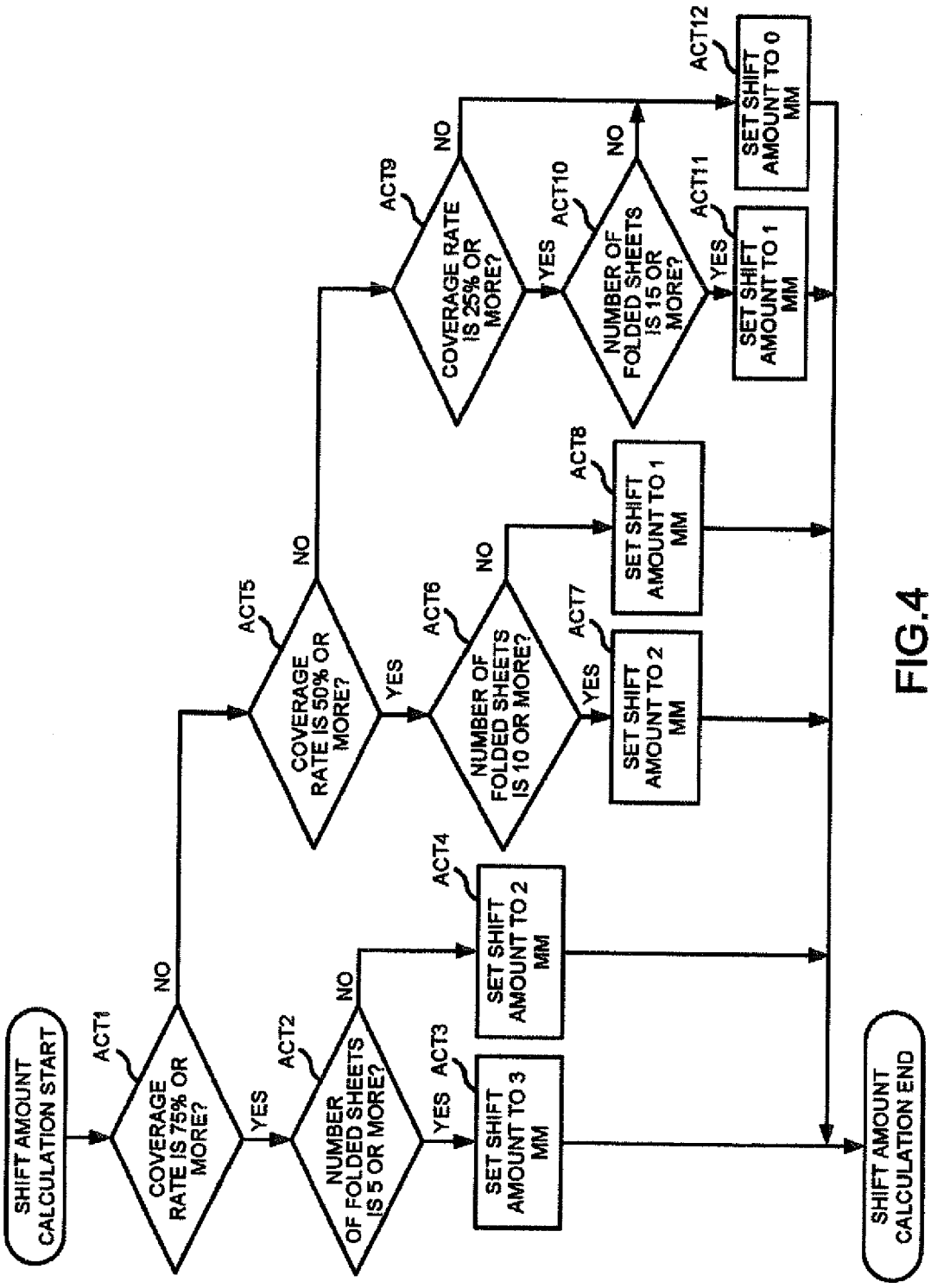

SHIFT AMOUNT CALCULATION START
ACT1
COVERAGE RATE IS 75% OR MORE?
NO
YES
ACT2
NUMBER OF FOLDED SHEETS IS 5 OR MORE?
NO
YES
ACT3
SET SHIFT AMOUNT TO 3 MM
ACT4
SET SHIFT AMOUNT TO 2 MM
ACT5
COVERAGE RATE IS 50% OR MORE?
NO
YES
ACT6
NUMBER OF FOLDED SHEETS IS 10 OR MORE?
NO
YES
ACT7
SET SHIFT AMOUNT TO 2 MM
ACT8
SET SHIFT AMOUNT TO 1 MM
ACT9
COVERAGE RATE IS 25% OR MORE?
NO
YES
ACT10
NUMBER OF FOLDED SHEETS IS 15 OR MORE?
NO
YES
ACT11
SET SHIFT AMOUNT TO 1 MM
ACT12
SET SHIFT AMOUNT TO 0 MM
SHIFT AMOUNT CALCULATION END

FIG.4

FIG.5

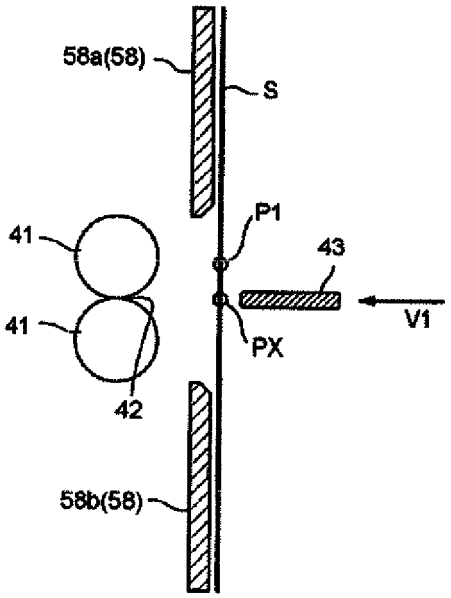
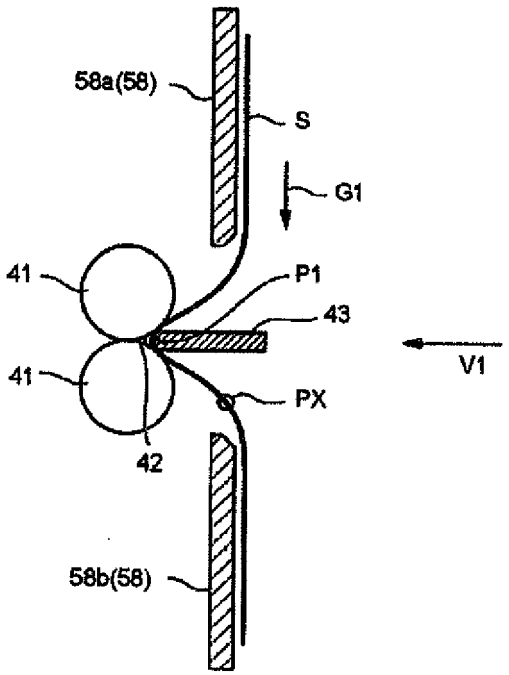

58a(58)
S
P1
43
41
41
V1
PX
42
58b(58)

FIG.6


58a(58)
S
G1
41
P1
43
41
V1
PX
42
58b(58)

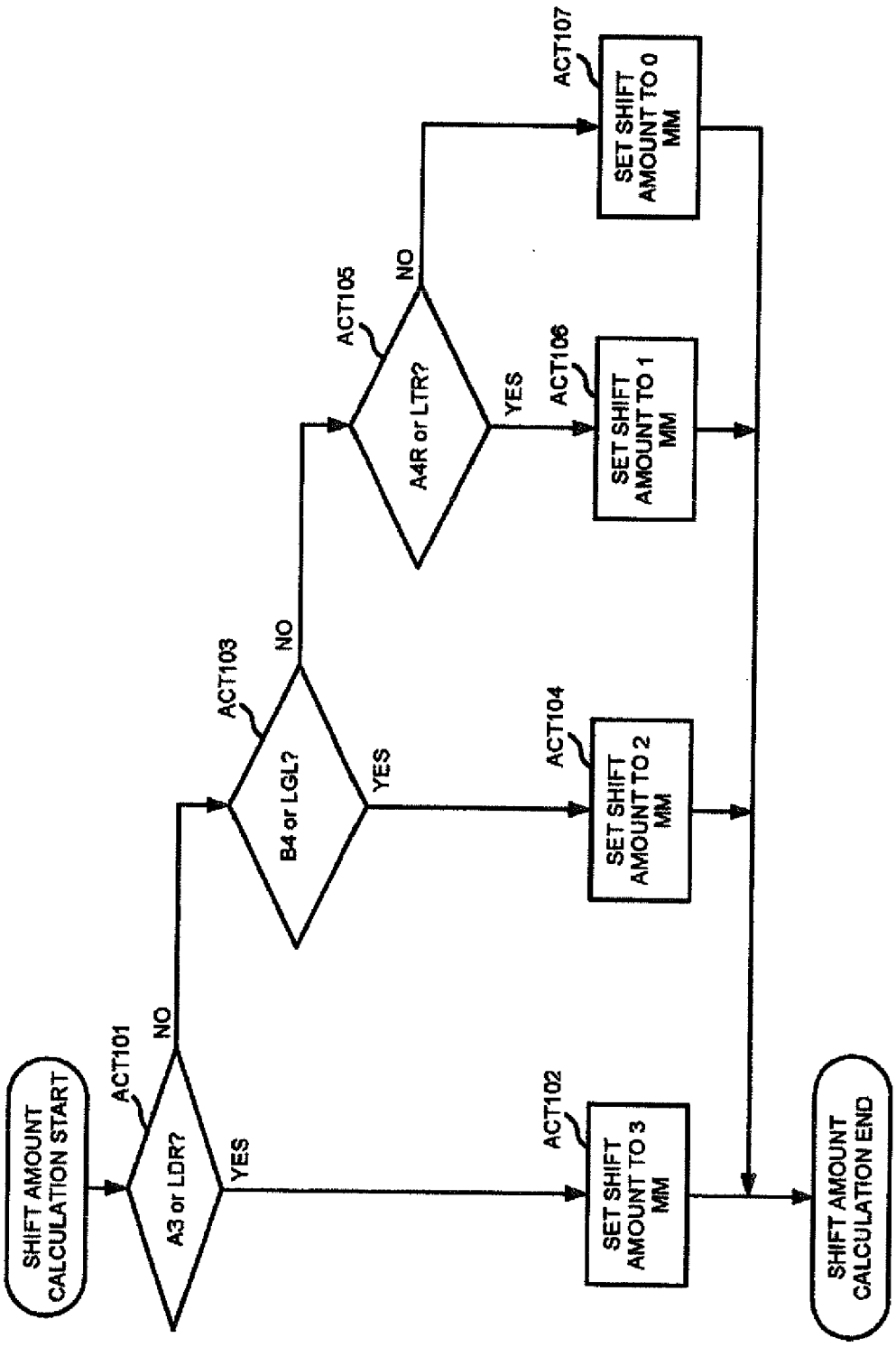

SHIFT AMOUNT CALCULATION START
ACT101
A3 or LDR?
YES
NO
ACT102
SET SHIFT AMOUNT TO 3 MM
ACT103
B4 or LGL?
YES
NO
ACT104
SET SHIFT AMOUNT TO 2 MM
ACT105
A4R or LTR?
YES
NO
ACT106
SET SHIFT AMOUNT TO 1 MM
ACT107
SET SHIFT AMOUNT TO 0 MM
SHIFT AMOUNT CALCULATION END

FIG.7

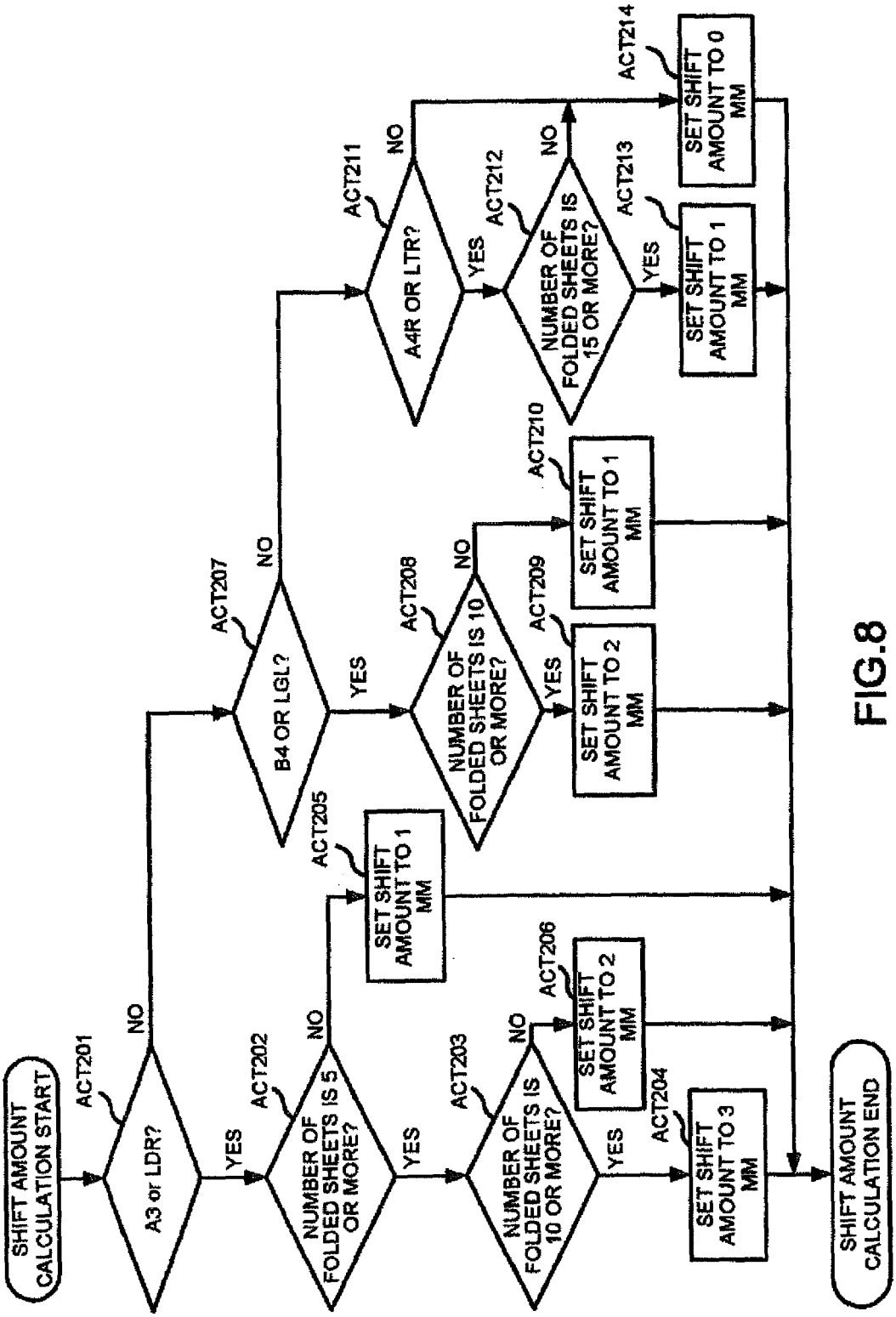

SHIFT AMOUNT CALCULATION START
ACT201
A3 or LDR?
NO
YES
ACT202
NUMBER OF FOLDED SHEETS IS 5 OR MORE?
NO
YES
ACT203
NUMBER OF FOLDED SHEETS IS 10 OR MORE?
NO
YES
ACT204
SET SHIFT AMOUNT TO 3 MM
ACT205
SET SHIFT AMOUNT TO 1 MM
ACT206
SET SHIFT AMOUNT TO 2 MM
ACT207
B4 OR LGL?
NO
YES
ACT208
NUMBER OF FOLDED SHEETS IS 10 OR MORE?
NO
YES
ACT209
SET SHIFT AMOUNT TO 2 MM
ACT210
SET SHIFT AMOUNT TO 1 MM
ACT211
A4R OR LTR?
NO
YES
ACT212
NUMBER OF FOLDED SHEETS IS 15 OR MORE?
NO
YES
ACT213
SET SHIFT AMOUNT TO 1 MM
ACT214
SET SHIFT AMOUNT TO 0 MM
SHIFT AMOUNT CALCULATION END

FIG.8

Europäisches Patentamt
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# EUROPEAN SEARCH REPORT

Application Number
EP 18 16 0947

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| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
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B65H
G03G

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 14 December 2018 | Ureta, Rolando |

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 16 0947

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14-12-2018

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EPO FORM P0459

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