(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 812 160 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.04.2021 Bulletin 2021/17

(51) Int Cl.:
B41J 13/00 *(2006.01)* ***B41J 13/10*** *(2006.01)*

(21) Application number: **20202730.6**

(22) Date of filing: **20.10.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **25.10.2019 JP 2019194655**

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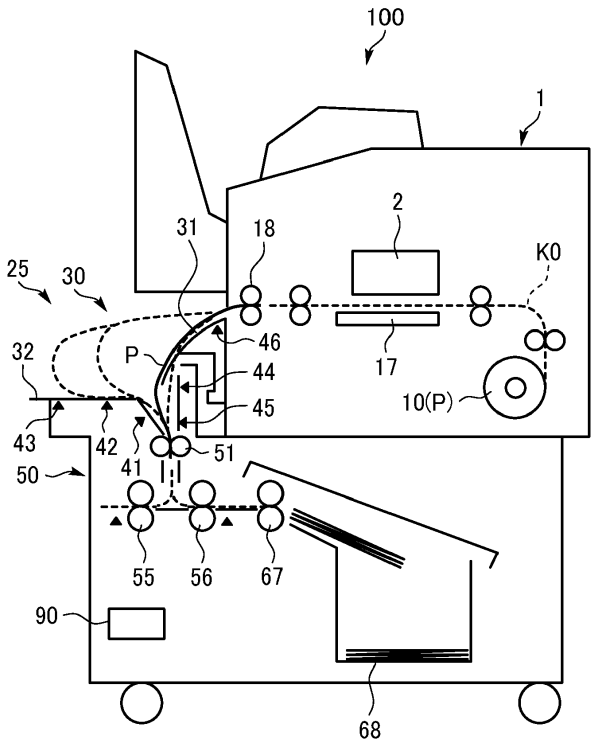
(54) **SHEET GUIDING DEVICE, POST-PROCESSING SYSTEM INCORPORATING THE SHEET GUIDING DEVICE, AND IMAGE FORMING SYSTEM INCORPORATING THE POST-PROCESSING SYSTEM**

(57) A sheet guiding device (30) for guiding a sheet (P) ejected from an image forming apparatus (1) to a post-processing apparatus (50) includes a sheet warp detector (41, 42, 43, 44). The sheet warp detector (41, 42, 43, 44) is configured to detect a warp amount of the sheet (P) in a sheet conveyance passage from the image forming apparatus (1) to the post-processing apparatus (50).

FIG. 1



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Description

BACKGROUND

Technical Field

[0001] Embodiments of the present disclosure relate to a sheet guiding device that guides a sheet ejected from an image forming apparatus to a post-processing apparatus, a post-processing system incorporating the sheet guiding device and the post-processing apparatus such as a sheet folding apparatus, and an image forming system incorporating the post-processing system and the image forming apparatus such as a copier, printer, facsimile machine, and a multi-functional peripherals including at least two functions of the copier, printer, and facsimile machine.

Discussion of the Background Art

[0002] Various types of image forming systems are known to employ a technique to perform a post-processing operation such as a sheet folding operation with respect to a sheet that is ejected from an image forming apparatus such as copier and printer while conveying the sheet toward a post-processing apparatus such as a sheet folding apparatus (for example, refer to JP 2006-290618-A(JP 5102449-B)).

[0003] To be more specific, in the image forming system disclosed in JP 2006-290618-A, a sheet folding apparatus (paper folding apparatus) is connected to an image forming apparatus. Then, the sheet is transferred from the image forming apparatus to the sheet folding apparatus while being conveyed in a substantially horizontal direction, and a sheet folding operation is performed to the sheet in the sheet folding apparatus. Further, various kinds of information such as the length of a sheet and a conveying speed of the sheet are exchanged between the image forming apparatus and the sheet folding apparatus via a communication unit that is connected to the image forming apparatus and the sheet folding apparatus, so that the sheet folding apparatus performs the sheet folding operation to the sheet.

[0004] However, the known technique is applicable to a configuration in which no communication unit is provided to exchange information between the image forming apparatus and the post-processing apparatus. Therefore, in a case in which the conveying speed of a sheet ejected from the image forming apparatus toward the post-processing apparatus is not constant, the post-processing apparatus could not grasp that the warp amount of the sheet (the length of the sheet) from the image forming apparatus to the post-processing apparatus changes. As a result, the post-processing apparatus could not perform a desired post-processing operation reliably.

SUMMARY

[0005] In view of the above-described disadvantages, an object of the present disclosure is to provide a sheet guiding device, a post-processing system, and an image forming system, in which the warp amount of a sheet (the degree of warp of a sheet or the length of a sheet) from the image forming apparatus to the post-processing apparatus is stable to perform a preferable post-processing operation.

[0006] Embodiments of the present disclosure described herein provide a novel sheet guiding device for guiding a sheet ejected from an image forming apparatus to a post-processing apparatus and that includes a sheet warp detector. The sheet warp detector is configured to detect a warp amount of the sheet in a sheet conveyance passage from the image forming apparatus to the post-processing apparatus.

[0007] Further, embodiments of the present disclosure described herein provides a post-processing system that includes the above-described sheet guiding device and a post-processing apparatus configured to perform a post-processing operation to the sheet guided by the sheet guiding device.

[0008] Further, embodiments of the present disclosure described herein provides a post-processing system that includes the sheet guiding device further including a first sheet guide and a second sheet guide, a post processing apparatus configured to perform a sheet folding operation to the sheet, a pair of sheet conveyors, and a controller. The first sheet guide of the sheet guiding device is disposed near a sheet ejection port of the image forming apparatus and is configured to guide the sheet ejected from the sheet ejection port toward a sheet receiving port of the post-processing apparatus. The second sheet guide of the sheet guiding device is disposed near the sheet receiving port and is configured to guide a warped portion of the sheet from the sheet ejection port to the sheet receiving port. The sheet warp detector includes a plurality of first sheet detectors aligned along a sheet conveyance direction in which the second sheet guide conveys the sheet and spaced apart from each other, and a second sheet detector disposed close to the sheet receiving port of the post-processing apparatus and facing the second sheet guide, between which the sheet passes. The pair of sheet conveyors is configured to convey the sheet detected by the plurality of first sheet detectors and the second sheet detector. The controller is configured to control at least one of a sheet folding timing at which the post-processing apparatus performs a sheet folding operation and a sheet conveying speed at which the pair of sheet conveyors conveys the sheet, based on a detection result of the plurality of first sheet detectors or a detection result of the second sheet detector.

[0009] Further, embodiments of the present disclosure described herein provides an image forming system that includes an image forming apparatus configured to form an image, and the above-described post-processing sys-

tem.

[0010] According to the present disclosure, the sheet guiding device, the post-processing apparatus, and the image forming system are capable of making the warp amount of a sheet (the degree of warp of a sheet or the length of a sheet) from the image forming apparatus to the post-processing apparatus to be stable to perform a preferable post-processing operation.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0011] Exemplary embodiments of the present disclosure will be described in detail based on the following figures, wherein:

FIG. 1 is a diagram illustrating an overall configuration of an image forming system according to an embodiment of the present disclosure;

FIG. 2 is a diagram illustrating an image forming device of the image forming apparatus of FIG. 1;

FIGS. 3A, 3B, 3C, 3D, and 3E are diagrams each illustrating a series of operations of a sheet folding apparatus according to an embodiment of the present disclosure;

FIG. 4 is an enlarged view illustrating a sheet guiding device and components disposed near the sheet guiding device of FIGS. 3A to 3E;

FIGS. 5A, 5B, 5C, 5D, and 5E are diagrams each illustrating a series of operations of the sheet guiding device of FIGS. 3A to 3E;

FIG. 6 is a flowchart of a control process executed when starting a sheet folding operation in the sheet folding apparatus of FIGS. 3A to 3E;

FIG. 7 is a flowchart of a control process executed when conveying the first side of a sheet during the sheet folding operation in the sheet folding apparatus of FIGS. 3A to 3E;

FIG. 8 is a flowchart of a subsequent control process subsequent from the flowchart of FIG. 7, executed when making a fold on the sheet in the sheet folding apparatus of FIGS. 3A to 3E; and

FIG. 9 is a flowchart of a control process executed when conveying the trailing end of the sheet during the sheet folding operation in the sheet folding apparatus of FIGS. 3A to 3E.

[0012] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION

[0013] It will be understood that if an element or layer is referred to as being "on," "against," "connected to" or "coupled to" another element or layer, then it can be directly on, against, connected or coupled to the other element or layer, or intervening elements or layers may be present. In contrast, if an element is referred to as being "directly on," "directly connected to" or "directly coupled to" another element or layer, then there are no intervening elements or layers present. Like numbers referred to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0014] Spatially relative terms, such as "beneath," "below," "lower," "above," "upper" and the like may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements describes as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, term such as "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors herein interpreted accordingly.

[0015] The terminology used herein is for describing particular embodiments and examples and is not intended to be limiting of exemplary embodiments of this disclosure. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes" and/or "including," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0016] Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings for explaining the following embodiments, the same reference codes are allocated to elements (members or components) having the same function or shape and redundant descriptions thereof are omitted below.

[0017] Next, a description is given of a configuration and functions of a sheet guiding device, a post-processing system, and an image forming system, according to an embodiment of the present disclosure, with reference to drawings. Note that identical parts are given identical reference numerals and redundant descriptions are summarized or omitted accordingly.

[0018] Initially with reference to FIG. 1, a description is given of the overall configuration and operations of an image forming system 100 according to an embodiment of this disclosure.

[0019] FIG. 1 is a diagram illustrating an overall configuration of an image forming system 100 according to an embodiment of the present disclosure.

[0020] In the present embodiment, the image forming system 100 includes a sheet guiding device 30, an image forming apparatus 1, and a sheet folding apparatus 50. The sheet guiding device 30 that also functions as a sheet transfer device is detachably attached to at least one of the image forming apparatus 1 and the sheet folding apparatus 50 that functions as a post-processing apparatus. The sheet folding apparatus 50 is detachably attached to the image forming apparatus 1. (Alternatively, the image forming apparatus 1 is placed on top of the sheet folding apparatus 50.) In the present embodiment, the image forming system 100 is constructed of the image forming apparatus 1, the sheet guiding device 30, and the sheet folding apparatus 50. Further, in the present embodiment, a post-processing system 25 is constructed of the sheet guiding device 30 and the sheet folding apparatus 50.

[0021] The sheet guiding device 30 guides (in other words, receives and transfers) a sheet P ejected from the image forming apparatus 1 to the sheet folding apparatus 50 that functions as a post-processing apparatus. Note that the sheet P is a sheet having an image formed on the surface. The post-processing apparatus performs a post-processing operation to the sheet P. The sheet folding apparatus 50 performs a sheet folding operation to the sheet P. In particular, in the present embodiment, the sheet guiding device 30 includes photosensors 41 to 46 that function as a plurality of sheet detectors disposed in the sheet guiding device 30, and the sheet folding apparatus 50 includes a controller 90 including a controller of the sheet folding apparatus 50. Signals of the photosensors 41 to 46 are transmitted to the controller 90 of the sheet folding apparatus 50. The sheet guiding device 30 is shipped from factory, in a state in which the sheet guiding device 30 is attached to the sheet folding apparatus 50 (or is ready to be attached to the sheet folding apparatus 50 by a user after delivery), and is distributed in the market. Therefore, the sheet guiding device 30 also functions as a device (sheet receiving device) that receives a sheet in the sheet folding apparatus 50.

[0022] Note that, in the present embodiment, the controller 90 controls the sheet folding apparatus 50 but is not limited to this configuration. For example, the controller 90 may be configured to control the whole operations of the post-processing system 25. In that case, the controller 90 may be provided in the sheet guiding device 30 or may be provided in a separate part from the sheet guiding device 30 and the sheet folding apparatus 50.

[0023] Note that, in the present embodiment, no communication unit (with wired or wireless) is connected to the sheet folding apparatus 50 (and the sheet guiding device 30) and the image forming apparatus 1 to exchange various information (such as information related to the sheet size and the conveyance conditions of the sheet and signals of various sensors) between the sheet folding apparatus 50 (and the sheet guiding device 30) and the image forming apparatus 1. In other words, the sheet folding apparatus 50 (and the sheet guiding device 30) and the image forming apparatus 1 exchange various information without using a communication unit. Therefore, in the image forming system 100 according to the present embodiment, the sheet folding apparatus 50 (and the sheet guiding device 30) is not connected to the image forming apparatus 1 via a communication unit but is mechanically coupled with the image forming apparatus 1.

[0024] In FIG. 1, the image forming apparatus 1 is a serial type inkjet printer, an image forming device 2 forms an image on a sheet P, a conveyance table 17 is disposed facing the image forming device 2 to convey the sheet P, and a pair of sheet feed rollers 18 is provided at a sheet ejection port 20 of the image forming apparatus 1 (see FIG. 4).

[0025] In the present embodiment, the image forming apparatus 1 is capable of cutting a roll-shaped sheet P (roll paper) by a sheet feeding unit 10 to a desired length and of forming an image on a sheet P having various large (wide) sizes such as A0 and A1 sizes.

[0026] Further, in FIG. 1 (and FIG. 4), the sheet guiding device 30 includes a first sheet guide 31 and a second sheet guide 32. The first sheet guide 31 guides the sheet P that is ejected from the sheet ejection port 20 of the image forming apparatus 1, toward a sheet receiving port 60 of the sheet folding apparatus 50 (see FIG. 4). The second sheet guide 32 guides the sheet P having a warp between the image forming apparatus 1 and the sheet folding apparatus 50.

[0027] The sheet guiding device 30 further includes a first photosensor 41, a second photosensor 42, and a third photosensor 43 that collectively function as a plurality of first sheet detectors. The first photosensor 41, the second photosensor 42, and the third photosensor 43 are aligned spaced apart along a sheet guide (conveyance) direction of the second sheet guide 32 (or along a sheet guide (conveyance) face of the second sheet guide 32). The sheet guiding device 30 further includes a fourth photosensor 44 disposed near the sheet receiving port 60 as illustrated in FIG. 4 and facing the second sheet guide 32 via the sheet P. The fourth photosensor 44 functions as a second sheet detector to detect that the warp amount of the sheet P is equal to or smaller than the predetermined warp amount. In other words, the fourth photosensor 44 detects that the warp amount of the sheet P is the predetermined warp amount or smaller. The sheet guiding device 30 further includes a fifth photosensor 45 that functions as a third sheet detector near the sheet receiving port 60 as illustrated in FIG. 4 and downstream from the fourth photosensor 44 in the sheet guide direction. The sheet guiding device 30 further includes a sixth photosensor 46 near the sheet ejection port 20 as illustrated in FIG. 4 and upstream from the fourth photosensor 44 in the sheet guide direction. The sixth photosensor 46 functions as a fourth sheet detector to detect the leading end of the sheet P of the trailing end of the sheet P.

[0028] Each of these sensors (that is, the first photosensor 41, the second photosensor 42, the third photosensor 43, the fourth photosensor 44, the fifth photosensor 45, and the sixth photosensor 46) is a sensor that optically detects whether or not the sheet P is present at the position where each sensor is disposed.

[0029] Further, the first sheet guide 31, the second sheet guide 32, the first photosensor 41, the second photosensor 42, the third photosensor 43, the fourth photosensor 44, the fifth photosensor 45, and the sixth photosensor 46 are provided in the sheet guiding device 30.

[0030] In addition, in FIG. 1 (and FIG. 4), the sheet folding apparatus 50 functions as a post-processing apparatus that performs a sheet folding operation as a post-processing operation, to the sheet P that is ejected from the image forming apparatus 1 and conveyed to the sheet folding apparatus 50.

[0031] Further, referring to FIG. 3, the sheet folding apparatus 50 includes a pair of sheet conveying rollers 51, a pair of sheet guides including a first movable guide 53 and a second movable guide 54, a pair of sheet folding rollers 55, and a pair of sheet folding rollers 56. The pair of sheet conveying rollers 51 is disposed extreme upstream in the sheet conveyance direction of the sheet folding apparatus 50 to convey the sheet P toward sheet folding units, which correspond, in the present embodiment, to the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56. The pair of sheet guides (including the first movable guide 53 and the second movable guide 54) guides the sheet P conveyed by the pair of sheet conveying rollers 51, toward the pairs of sheet folding rollers 55 and 56. The pair of sheet folding rollers 55 and the pair of sheet folding rollers 56 form folds on the sheet P. Each of the pair of sheet conveying rollers 51, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56 functions as a pair of sheet conveyors that conveys the sheet P detected by the first photosensor 41, the second photosensor 42, and the third photosensor 43 (collectively, a plurality of first sheet detectors) or the fourth photosensor 44 (a second sheet detector).

[0032] Further, with reference to FIGS. 1 and 3, the sheet folding apparatus 50 further includes a pair of sheet ejection rollers 67, a sheet ejection tray 68, and a controller 90. The pair of sheet ejection rollers 67 ejects the sheet P to the sheet ejection tray 68. The sheet ejection tray 68 is a tray on which the sheet P ejected by the pair of sheet ejection rollers 67 is loaded and stacked. The controller 90 controls the operations performed by the sheet folding apparatus 50 (and the sheet guiding device 30).

[0033] Further, the sheet folding apparatus 50 further includes the fifth photosensor 45, a first sensor 62, and a second sensor 63. The fifth photosensor 45 is an entrance sensor disposed near the sheet receiving port 60 of the sheet folding apparatus 50. The first sensor 62 is disposed near the nip region of the first pair of sheet folding rollers 55. The second sensor 63 is disposed near the nip region of the second pair of sheet folding rollers 56. Each of these sensors (that is, the fifth photosensor 45, the first sensor 62, and the second sensor 63) is a photosensor that optically detects whether or not the sheet P is present at the position where each sensor is disposed.

[0034] Now, a description is given of a regular image forming operation performed by the image forming system 100, with reference to FIG. 1.

[0035] First, the sheet P that is wound around the sheet feeding unit 10 provided in the image forming apparatus 1 in a roll shape is cut by a cutting unit in accordance with image data that is input from an external terminal such as a personal computer. Then, the cut sheet P is conveyed along a sheet conveyance passage K0 in the image forming apparatus 1.

[0036] Then, the sheet P conveyed along the sheet conveyance passage K0 reaches the position at which the image forming device 2 is disposed. Here, the image forming device 2 is a serial-type inkjet image forming device in which conveyance of the sheet P is stopped intermittently to move a carriage 3 (see FIG. 2) in the width direction of the image forming device 2 (that is, the vertical direction to the drawing sheet in FIG. 1 and the left and right directions and the main scanning direction of the image forming device 2 in FIG. 2), so that a desired image is formed on the sheet P in the sub-scanning direction (sheet conveyance direction) of the image forming device 2. That is, under the control of a sheet conveyance mechanism including the sheet feeding unit 10 or the pair of sheet feed rollers 18, a desired image is formed on the sheet P while repeating conveyance of the sheet P and stop of conveyance of the sheet P. Therefore, the conveying speed of the sheet P in the image forming apparatus 1 changes (not being constant).

[0037] Then, the sheet P having the image on the surface is ejected by the pair of sheet feed rollers 18 in the order from the leading end of the sheet P, from the sheet ejection port 20 of the image forming apparatus 1. At this time, the conveying speed of the sheet P ejected from the sheet ejection port 20 of the image forming apparatus 1 also changes (not being constant), and conveyance of the sheet P and stop of conveyance of the sheet P are repeated. Then, the sheet P ejected from the image forming apparatus 1 is conveyed into the sheet folding apparatus 50 via the sheet guiding device 30.

[0038] Here, in the present embodiment, in a case in which an image is formed by the image forming device 2, on the sheet P that is relatively long in the sheet conveyance direction, it is likely that the portion of the sheet P ejected from the image forming apparatus 1 is folded in the sheet folding apparatus 50 or that the sheet P is left uncut by the sheet feeding unit 10.

[0039] Note that the sheet guiding device 30 according to the present embodiment includes the first photosensor 41, the second photosensor 42, the third photosensor 43, and the fourth photosensor 44, each of which func-

tions as a sheet warp detector to detect the warp amount of the sheet P from the image forming apparatus 1 to the sheet folding apparatus 50 that functions as a post-processing apparatus. Even when the conveying speed of the sheet P conveyed from the image forming apparatus 1 to the sheet folding apparatus 50 changes (in other words, even when the conveying speed of the sheet P conveyed from the image forming apparatus 1 to the sheet folding apparatus 50 is not constant), the sheet folding apparatus 50 performs the sheet folding operation preferably while maintaining a constant warp amount of the sheet P. The detailed description of the above-described operations is given below.

[0040] Hereinafter, a detailed description is given of the image forming device 2 of the image forming apparatus 1, with reference to FIG. 2.

[0041] The image forming device 2 includes a carriage 3, a timing belt 8, a motor 9, a drive pulley 11, a driven pulley 12, a guide rod 13, a sub guide 14, side plates 15, and an encoder sheet 16. The carriage 3 includes two recording heads 4, a belt holder 5, a sub guide receiver 6, and an encoder sensor 7.

[0042] The carriage 3 mounts the two recording heads 4 that are capable of discharging liquids (inks) of respective four colors (black, cyan, magenta, and yellow).

[0043] The guide rod 13 and the sub guide 14 are bridged between the side plates 15 respectively disposed on both sides in the width direction of the image forming device 2. The guide rod 13 is inserted into a through hole of the carriage 3. The sub guide 14 is fitted in the sub guide receiver 6 of the carriage 3. With such a configuration, in the image forming device 2, the carriage 3 is held so as to be movable in the main scanning direction (width direction) of the image forming device 2.

[0044] Further, the timing belt 8 is stretched and supported by the drive pulley 11 and the driven pulley 12. The drive pulley 11 is disposed on the motor shaft of the motor 9 of the forward and reverse rotation type. Further, the carriage 3 is fixedly held by a part of the timing belt 8 via the belt holder 5. With such a configuration, the carriage 3 moves in the left-right direction in FIG. 2 while being guided by the guide rod 13 and the sub guide 14 as the timing belt 8 is driven to move by the motor 9. Then, the image forming device 2 moves the carriage 3 in the main scanning direction to drive the recording heads 4 in accordance with the image data input to the image forming device 2, to discharge liquids from the recording head 4 while intermittently conveying the sheet P to form a desired image on the sheet P.

[0045] Note that an encoder sensor 7 is mounted on the carriage 3. The encoder sensor 7 detects the encoder sheet 16 while the carriage 3 moves in the main scanning direction. Accordingly, the image forming device 2 forms an image on the sheet P with high accuracy in position while grasping the position of the carriage 3 and the recording heads 4 in the main scanning direction of the image forming device 2.

[0046] Next, a detailed description is given of an example of a sheet folding operation performed by the sheet folding apparatus 50, with reference to FIGS. 3A to 3E.

[0047] As described above, the sheet P ejected from the image forming apparatus 1 is conveyed into the sheet folding apparatus 50 via the sheet guiding device 30. Then, the sheet folding apparatus 50 performs the sheet folding operation to the sheet P. Specifically, in other words, the controller 90 causes the sheet folding apparatus 50 to perform the sheet folding operation to the sheet P.

[0048] To be more specific, first, as the fifth photosensor 45, which is disposed near the entrance of the nip region of the pair of sheet conveying rollers 51, detects the leading end of the sheet P, the pair of sheet conveying rollers 51 is driven to rotate. Then, the first pair of sheet folding rollers 55 is driven to rotate in the normal direction. Further, the first movable guide 53 is moved from the home position (i.e., the position indicated by a broken line in FIG. 3A) to the guide position (i.e., the position indicated by a solid line in FIG. 3A). Thus, as illustrated in FIG. 3A, the sheet P conveyed by the pair of sheet conveying rollers 51 is guided by the first movable guide 53 to the nip region of the first pair of sheet folding rollers 55.

[0049] Thereafter, the first movable guide 53 is returned to the home position, and the first pair of sheet folding rollers 55 stops the rotation. Then, as illustrated in FIG. 3B, the first pair of sheet folding rollers 55 and the second pair of sheet folding rollers 56 are driven to rotate in the reverse direction, and the second movable guide 54 is moved from the home position (i.e., the position indicated by a broken line in FIG. 3B) to the guide position (i.e., the position indicated by a solid line in FIG. 3B). Thus, as illustrated in FIG. 3B, the sheet P is lightly folded to form a lightly folded portion. Then, while being conveyed by the pair of sheet conveying rollers 51 and the first pair of sheet folding rollers 55, the sheet P with the lightly folded portion is guided by the second movable guide 54 toward the nip region of the second pair of sheet folding rollers 56.

[0050] Then, as illustrated in FIG. 3C, when the leading end of the sheet P, in other words, the lightly folded portion of the sheet P reaches the nip region of the second pair of sheet folding rollers 56, a fold A1 (first fold) is firmly formed on the sheet P by the pressure applied in the nip region of the second pair of sheet folding rollers 56. Then, the second movable guide 54 is returned from the guide position to the home position.

[0051] Then, referring to FIG. 3C, after a predetermined time has elapsed since detection of the fold A1 of the sheet P by the second sensor 63, respective rotations of the first pair of sheet folding rollers 55 and the second pair of sheet folding rollers 56 are stopped.

[0052] Then, as illustrated in FIG. 3D, the first pair of sheet folding rollers 55 and the second pair of sheet folding rollers 56 are driven to rotate in the normal direction, and the first movable guide 53 is moved from the home position to the guide position. Thus, the sheet P is lightly

folded to form another lightly folded portion. Then, while being conveyed by the pair of sheet conveying rollers 51 and the second pair of sheet folding rollers 56, the sheet P with the lightly folded portion is guided by the first movable guide 53 toward the nip region of the first pair of sheet folding rollers 55. Then, as illustrated in FIG. 3D, when the leading end of the sheet P, in other words, the lightly folded portion of the sheet P reaches the nip region of the first pair of sheet folding rollers 55, a fold A2 (second fold) is firmly formed on the sheet P by the pressure applied in the nip region of the first pair of sheet folding rollers 55. Then, the first movable guide 53 is returned from the guide position to the home position.

[0053] Then, referring to FIG. 3D, after a predetermined time has elapsed since detection of the fold A2 of the sheet P by the first sensor 62, respective rotations of the first pair of sheet folding rollers 55 and the second pair of sheet folding rollers 56 are stopped.

[0054] Then, as illustrated in FIG. 3E, the first pair of sheet folding rollers 55 and the second pair of sheet folding rollers 56 are driven to rotate in the reverse direction, and the second movable guide 54 is moved from the home position to the guide position. Thus, the sheet P is lightly folded to form yet another lightly folded portion. Then, while being conveyed by the pair of sheet conveying rollers 51 and the first pair of sheet folding rollers 55, the sheet P with the lightly folded portion is guided by the second movable guide 54 toward the nip region of the second pair of sheet folding rollers 56. Then, as illustrated in FIG. 3E, when the leading end of the sheet P, in other words, the lightly folded portion of the sheet P reaches the nip region of the second pair of sheet folding rollers 56, a fold A3 (third fold) is firmly formed on the sheet P by the pressure applied in the nip region of the second pair of sheet folding rollers 56. Then, the second movable guide 54 is returned from the guide position to the home position.

[0055] In the example of the sheet folding operation in FIGS. 3A to 3E, the fold A1 (first fold), the fold A2 (second fold), and the fold A3 (third fold) are formed. After the folds A1, A2, and A3 are formed, the sheet P is ejected toward the sheet ejection tray 68.

[0056] Hereinafter, a detailed description is given of some features of the sheet guiding device 30 according to the present embodiment.

[0057] As described above with reference to FIG. 1, the sheet guiding device 30 according to the present embodiment includes a plurality of photosensors, which are the first photosensor 41 to the sixth photosensor 46. The sheet guiding device 30 is connected to the sheet folding apparatus 50 to be capable of communicating with the sheet folding apparatus 50.

[0058] To be more specific, as illustrated in FIGS. 3A to 3E, the sheet guiding device 30 is configured to transmit respective signals of the plurality of photosensors, in other words, the first photosensor 41 to the sixth photosensor 46, provided in the sheet guiding device 30 to the controller 90 of the sheet folding apparatus 50.

[0059] Note that respective signals of the fifth photosensor 45, the first sensor 62, and the second sensor 63 provided in the sheet folding apparatus 50 are also transmitted to the controller 90 of the sheet folding apparatus 50. The controller 90 further controls a motor that drives the pair of sheet conveying rollers 51 and a sheet folding motor that drives the sheet folding units, which correspond to the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56.

[0060] Then, each of the first photosensor 41 to the fourth photosensor 44 provided in the sheet guiding device 30 functions as a sheet warp detector to detect the warp amount (in other words, the warp state) of the sheet P conveyed from the image forming apparatus 1 to the sheet folding apparatus 50 that functions as a post-processing apparatus.

[0061] As described above, in the present embodiment, the sheet P is intermittently conveyed from the serial-type inkjet image forming apparatus 1 toward the sheet folding apparatus 50, and therefore the conveying speed of the sheet P is not constant. If the first photosensor 41 to the fourth photosensor 44, each of which functioning as a sheet warp detector, are not provided in the sheet guiding device 30, the change of the length (warp amount) of the sheet P conveyed from the sheet ejection port 20 of the image forming apparatus 1 to the sheet receiving port 60 of the sheet folding apparatus 50 is not grasped. Consequently, when the sheet P is stretched taut or when the warp amount of the sheet P is short of or beyond an appropriate warp amount of the sheet P, a sheet folding operation failure may occur in the sheet folding apparatus 50.

[0062] In particular, in the present embodiment, since no communication unit is provided between the image forming apparatus 1 and the sheet folding apparatus 50, an inexpensive and highly versatile image forming system may be provided, but on the other hand, the information of change in the length of the sheet P may not be transmitted from the image forming apparatus 1 to the sheet folding apparatus 50. Therefore, the operation timing of the sheet folding apparatus 50 is not finely controlled to perform the sheet folding operation, and the above-described inconvenience becomes remarkable.

[0063] By contrast, in the present embodiment, the first photosensor 41 to the fourth photosensor 44, each of which functioning as a sheet warp detector, detect the warp amount of the sheet P from the image forming apparatus 1 to the sheet folding apparatus 50. According to this configuration, even though the length (warp amount) of the sheet P from the image forming apparatus 1 to the sheet folding apparatus 50 changes, the sheet folding operation performed by the sheet folding apparatus 50 is controlled accordingly. Therefore, the sheet P is guided to the sheet folding apparatus 50 reliably, without causing buckling of the sheet P. Accordingly, the sheet folding apparatus 50 performs a preferable sheet folding operation.

[0064] Note that, as illustrated in FIG. 4, in the present embodiment, the sheet conveyance passage, which is defined by the first sheet guide 31 disposed near the sheet ejection port 20 of the image forming apparatus 1, runs from upward to downward in a substantially vertical direction.

[0065] That is, in the present embodiment, the sheet receiving port 60 of the sheet folding apparatus 50 is provided below the sheet ejection port 20 of the image forming apparatus 1.

[0066] According to this configuration, the installation area of the image forming system 100 is reduced.

[0067] Further, a supplemental description is given of the above-described various effects.

[0068] If a guide is configured to transfer the sheet P from an image forming apparatus to a sheet folding apparatus in a substantially horizontal direction, the installation area of the image forming system increases. By contrast, in the present embodiment, since the sheet receiving port 60 of the sheet folding apparatus 50 is provided below the sheet ejection port 20 of the image forming apparatus 1, the installation area of the image forming system 100 is reduced.

[0069] Further, if a communication unit is provided to communicate between the controller of the image forming apparatus and the controller of the sheet folding apparatus, the cost of the image forming apparatus and the sheet folding apparatus increases, and the versatility to other models of the sheet folding apparatus is limited. By contrast, in the present embodiment, since such a communication unit is not provided, the cost of the image forming apparatus 1 and the sheet folding apparatus 50 is reduced, and the versatility of the sheet folding apparatus 50 is enhanced.

[0070] Here, referring to FIG. 4, the sheet guiding device 30 according to the present embodiment includes the first sheet guide 31 and the second sheet guide 32.

[0071] The first sheet guide 31 is disposed near the sheet ejection port 20 of the image forming apparatus 1 (where the pair of sheet feed rollers 18 is provided) to guide the sheet P that is ejected from the sheet ejection port 20 of the image forming apparatus 1, toward the sheet receiving port 60 of the sheet folding apparatus 50 that functions as a post-post-processing apparatus. The first sheet guide 31 includes a sheet guide face that is warped in a substantially arc shape, so as to guide the sheet P from the sheet ejection port 20 to the sheet receiving port 60 smoothly. At this time, the sheet P is in a state K1 indicated by a solid line in FIG. 4.

[0072] Further, the first sheet guide 31 is provided with an elastic guide 31a at a downstream end in the sheet guide direction to guide the sheet P to the second sheet guide 32. The elastic guide 31a is a thin plate-like member made of a polyethylene terephthalate (PET) resin having optical transparency and flexibility. The elastic guide 31a is adhered to the housing (rigid body portion) of the first sheet guide 31 in a cantilever manner. By providing the elastic guide 31a, even if the sheet P is likely to be in a stretched state between the first sheet guide 31 and the pair of sheet conveying rollers 51, the elastic guide 31a is elastically deformed to warp due to the force received from the sheet P, as illustrated in FIG. 5D, the sheet P (in a state K4 indicated by a broken line in FIG. 4) is not easily affected by a strong stretching force.

[0073] The second sheet guide 32 is provided near the sheet receiving port 60 (where the pair of sheet conveying rollers 51 is provided) and is configured to guide the warped portion of the sheet P from the sheet ejection port 20 to the sheet receiving port 60. The second sheet guide 32 has a horizontal guide face and a diagonal guide face. The horizontal guide face of the second sheet guide 32 extends from a portion below the sheet ejection port 20 and above the sheet receiving port 60 in a substantially horizontal direction to separate from the sheet ejection port 20 and the sheet receiving port 60. The diagonal guide face of the second sheet guide 32 extends obliquely from the end portion (portion) of the horizontal guide face toward the sheet receiving port 60. Then, the second sheet guide 32 thus configured guides the sheet P in a warp state K2 indicated by a broken line in FIG. 4 or a warp state K3 indicated by a broken line in FIG. 4. According to this configuration, a failure in which the warped sheet P is buckled, bent, or hooked by another part is reduced.

[0074] Here, the sheet warp detector in the present embodiment corresponds to each of the first photosensor 41, the second photosensor 42, and the third photosensor 43, which collectively function as a plurality of first sheet detectors, and the fourth photosensor 44, which functions as a second sheet detector.

[0075] The first photosensor 41 to the third photosensor 43, collectively functioning as a plurality of first sheet detectors, are aligned spaced apart along the sheet conveyance direction of the second sheet guide 32. To be more specific, the first photosensor 41 is disposed at the center of the diagonal guide face in the sheet conveyance direction of the second sheet guide 32. The second photosensor 42 is disposed at the position on the horizontal guide face of the second sheet guide 32 and near the sheet receiving port 60. The third photosensor 43 is disposed at the position on the horizontal guide face of the second sheet guide 32 and far from the sheet receiving port 60. Note that the second sheet guide 32 has a window to provide an optical path so as not to interfere with emission and receipt of light by the first photosensor 41, the second photosensor 42, and the third photosensor 43.

[0076] The warp amount of the sheet P is detected by the first photosensor 41, the second photosensor 42, and the third photosensor 43 disposed as described above.

[0077] To be more specific, when the first photosensor 41, the second photosensor 42, and the third photosensor 43 have detected the sheet P, the sheet P has a largest warp amount, which is illustrated as the warp state K3 indicated by a broken line in FIG. 4. On the other

hand, when the first photosensor 41 and the second photosensor 42 have detected the sheet P while the third photosensor 43 has not detected the sheet P, the sheet P has a medium warp amount, which is illustrated as the warp state K2 indicated by a broken line in FIG. 4. In the warp state K2, the warped portion of the sheet P is formed between the second photosensor 42 and the third photosensor 43. Further, when the first photosensor 41 has detected the sheet P while the second photosensor 42 and the third photosensor 43 have not detected the sheet P, the sheet P has a small warp amount, which is illustrated as a warp state indicated by broken line in FIG. 5A.

[0078] Further, the fourth photosensor 44 that functions as a second sheet detector is provided near the downstream end of (the elastic guide 31a of) the first sheet guide 31 in the sheet conveyance direction. Then, the fourth photosensor 44 detects that the warp amount of the sheet P is equal to or smaller than the predetermined warp amount. In other words, the fourth photosensor 44 detects that the sheet P has no warp amount or a significantly small warp amount.

[0079] To be more specific, when the fourth photosensor 44 has detected the sheet P while the first photosensor 41, the second photosensor 42, and the third photosensor 43 have not detected the sheet P, the sheet P is hardly warped and the elastic guide 31a is warped, as illustrated in FIG. 5D.

[0080] Then, based on the detection results of the first photosensor 41 to the fourth photosensor 44, the controller 90 controls the sheet folding operation performed by the sheet folding apparatus 50.

[0081] To be more specific, at the timing of detection of the sheet P by the first photosensor 41, the second photosensor 42, and the third photosensor 43 (collectively functioning as a plurality of first sheet detectors) and the fourth photosensor 44 (functioning as a second sheet detector), the controller 90 controls the timing of the sheet folding operation performed by the sheet folding apparatus 50, the conveying speed V of the sheet P, or both. In other words, based on the detection results of the first photosensor 41, the second photosensor 42, and the third photosensor 43 (collectively functioning as a plurality of first sheet detectors) and the fourth photosensor 44 (functioning as a second sheet detector), the controller 90 controls at least one of the timing of the sheet folding operation performed by the sheet folding apparatus 50 (functioning as a post-processing apparatus) and the conveying speed of the sheet P conveyed by the pair of sheet conveying rollers 51, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56 (each functioning as a pair of sheet conveyors).

[0082] Note that the sheet folding apparatus 50 according to the present embodiment is capable of changing the rotation speed of the motor that drives the pair of sheet conveying rollers 51 and the rotation speed of the sheet folding motor that drives sheet folding units, that is, the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56. In the present disclosure, the rotation speeds of the above-described motors are changed to adjust the conveying speed of the sheet P and the sheet folding speed of the sheet P in the sheet folding apparatus 50. In this specification, the conveying speed of the sheet P and the sheet folding speed of the sheet P are collectively referred to as the "conveying speed V of the sheet folding apparatus 50."

[0083] More specifically, based on the warp amount of the sheet P detected by the first photosensor 41, the second photosensor 42, and the third photosensor 43 functioning as a plurality of first sheet detectors, when the controller 0 determines that the length of the sheet P from the image forming apparatus 1 to the sheet folding apparatus 50 is beyond an adequate length of the sheet P for performing a single round of the sheet folding operation in the sheet folding apparatus 50, the controller 90 causes the sheet folding apparatus 50 to perform the single round of the sheet folding operation.

[0084] To be more specific, when the state of the second photosensor 42 is changed from the OFF state to the ON state and has detected a state in which the sheet P is warped by a certain amount, the controller 90 causes the sheet folding apparatus 50 to start the sheet folding operation, which is described above with reference to FIGS. 3A to 3E.

[0085] When the first photosensor 41, the second photosensor 42, and the third photosensor 43 (functioning as a plurality of first sheet detectors) have detected that the sheet P has a relatively small warp amount, the controller 90 decreases the conveying speed V of the sheet P in the sheet folding apparatus 50. On the other hand, when the first photosensor 41, the second photosensor 42, and the third photosensor 43 (functioning as a plurality of first sheet detectors) have detected that the sheet P has a relatively large warp amount, the controller 90 increases the conveying speed V of the sheet P.

[0086] To be more specific, when the state of the third photosensor 43 is changed from the OFF state to the ON state, the conveying speed V of the sheet P is increased. On the other hand, when the second photosensor 42, the first photosensor 41, or both are changed from the ON state to the OFF state, the conveying speed V of the sheet P is decreased.

[0087] According to the above-described control of the sheet folding apparatus 50 by the controller 90, the sheet P continuously has an adequate warp amount in the sheet guiding device 30. Accordingly, the sheet folding apparatus 50 performs a good sheet folding operation reliably.

[0088] Further, when the state of the fourth photosensor 44 that functions as a second sheet detector is changed from the OFF state to the ON state while the conveying speed V of the sheet P is decreasing, the controller 90 causes the sheet folding apparatus 50 to terminate the sheet folding operation. Then, after the state of the fourth photosensor 44 has been changed from the ON state to the OFF state, when the first photosensor 41

and the state of the second photosensor 42 are also changed from the OFF state to the ON state, the controller 90 causes the sheet folding apparatus 50 to start the sheet folding operation again.

[0089] That is, when the fourth photosensor 44 that functions as a second sheet detector has detected that the sheet P has a warp amount equal to or smaller than the predetermined warp amount (in other words, that the sheet P has the predetermined warp amount or smaller), the controller 90 causes the sheet folding apparatus 50 to stop conveyance of the sheet P. Then, after the sheet folding apparatus 50 has stopped conveyance of the sheet P, when the first photosensor 41, the second photosensor 42, and the third photosensor 43, functioning as a plurality of first sheet detectors, have detected that the sheet P has a warp amount equal to or greater than the predetermined warp amount (in other words, that the sheet P has the predetermined warp amount or greater), the controller 90 causes the sheet folding apparatus 50 to start conveyance of the sheet P again.

[0090] As described above, the controller 90 controls the conveying speed V of the sheet P in the sheet folding apparatus 50 and the start and stop timings of the sheet folding operation, depending on whether the first photosensor 41 to the fourth photosensor 44 are in the ON state or the OFF state. By so doing, in a case in which information of printing state of the sheet P, for example, the printing speed of the sheet P, is not obtained from the image forming apparatus 1, and even in a case in which the warp amount of the sheet P changes due to the state of the sheet P (for example, the thickness of the sheet P and the type of the sheet P) and the environment around the sheet P, the warp amount of the sheet P is properly adjusted between the image forming apparatus 1 and the sheet folding apparatus 50, so that the sheet folding apparatus 50 performs a good sheet folding operation reliably.

[0091] Here, in the present embodiment, in a case in which the first photosensor 41, the second photosensor 42, and the third photosensor 43, functioning as a plurality of first sheet detectors, do not detect the sheet P having a warp amount equal to or greater than the predetermined warp amount (in other words, when the warp amount of the sheet P detected by the plurality of first sheet detectors is less than or below the predetermined warp amount) even after a predetermined time has elapsed since the fifth photosensor 45 that functions as a third sheet detector or the sixth photosensor 46 that functions as a third sheet detector detected the leading end of the sheet P ejected from the sheet ejection port 20, the controller 90 causes the sheet folding apparatus 50 to start the sheet folding operation based on the data of the previous sheet folding operation.

[0092] In general, after the predetermined time has elapsed since the detection of the leading end of the sheet P ejected from the sheet ejection port 20 by the fifth photosensor 45 or the sixth photosensor 46, the sheet P is further ejected from the image forming apparatus 1 to form a warp of the sheet P between the sheet ejection port 20 and the sheet receiving port 60. Then the first photosensor 41, the second photosensor 42, and the third photosensor 43 detect the state of the sheet P, which triggers the start of the sheet folding operation performed by the sheet folding apparatus 50. However, when the warp amount of the sheet P between the sheet ejection port 20 and the sheet receiving port 60 cannot be detected by the first photosensor 41, the second photosensor 42, and the third photosensor 43, if the sheet folding apparatus 50 does not start the sheet folding operation, the sheet P is continuously ejected from the image forming apparatus 1. In order to address this inconvenience, in the present embodiment, when the first photosensor 41, the second photosensor 42, and the third photosensor 43 do not detect the warp of the sheet P even after the predetermined time at which the warp of the sheet P could generally be detected has passed, the controller 90 causes the sheet folding apparatus 50 to start the subsequent sheet folding operation based on the data of the previous sheet folding operation.

[0093] By controlling the sheet folding apparatus 50 as described above, even if the warp of the sheet P is in a state different from the warp of the sheet P in a regular state, the sheet folding apparatus 50 is enhanced to perform a good sheet folding operation. That is, the fail-safe operation is performed.

[0094] Here, in the present embodiment, in a case in which the first photosensor 41, the second photosensor 42, and the third photosensor 43 (functioning as a plurality of first sheet detectors) has not detected the warp amount of the sheet P equal to or greater than the predetermined warp amount, in other words, has detected the warp amount of the sheet P less than the predetermined warp amount, even after a predetermined time has elapsed while the sixth photosensor 46 (functioning as a fourth sheet detector) that is disposed near the sheet ejection port 20 has detected the sheet P and has not yet detected the trailing end of the sheet P, the controller 90 causes the sheet folding apparatus 50 to start the sheet folding operation.

[0095] In general, after the trailing end of the sheet P is ejected from the pair of sheet feed rollers 18, the trailing end of the sheet P passes through the sheet ejection port 20 to be detected by the sixth photosensor 46. Then, after a predetermined time has elapsed, the trailing end of the sheet P tilts toward the second sheet guide 32. Then, the first photosensor 41, the second photosensor 42, and the third photosensor 43 detect the state of tilt of the trailing end of the sheet P, which triggers the start of the sheet folding operation performed by the sheet folding apparatus 50. However, if the trailing end of the sheet P that is fed out from the pair of sheet feed rollers 18 cannot pass through the sheet ejection port 20, which is the state illustrated in FIG. 5E, neither the first photosensor 41, the second photosensor 42, and the third photosensor 43 detects the warp of the sheet P nor the sheet folding apparatus 50 starts the sheet folding operation.

Accordingly, the sheet folding operation continues endlessly without stopping. In order to address this inconvenience, in the present embodiment, when the first photosensor 41, the second photosensor 42, and the third photosensor 43 do not detect the warp of the sheet P even after the predetermined time at which the warp of the sheet P could generally be detected has passed, the sheet folding apparatus 50 stats the sheet folding operation.

[0096] By controlling the sheet folding operation performed by the sheet folding apparatus 50 as described above, when the trailing end of the sheet P is ejected from the image forming apparatus 1, even if the warp of the sheet P is in a state different from the warp of the sheet P in a regular state, the sheet folding apparatus 50 completes the whole sheet folding operation.

[0097] Next, a description is given of the overall flow of the above-described operation performed by the sheet guiding device 30, with reference to FIGS. 5A to 5E.

[0098] First, as illustrated in FIG. 5A, as the sheet P is ejected by the pair of sheet feed rollers 18 from the sheet ejection port 20 of the image forming apparatus 1, the sheet P is continuously conveyed toward the pair of sheet conveying rollers 51 and the sheet receiving port 60 of the sheet folding apparatus 50 while being guide by the first sheet guide 31. At this time, the leading end of the sheet P is detected by the fifth photosensor 45 or the sixth photosensor 46. Further, the pair of sheet conveying rollers 51 is stopped and is not rotating.

[0099] Then, as the sheet P is further ejected from the sheet ejection port 20, as indicated by a broken line in FIG. 5A, the sheet P is warped in the sheet guiding device 30 while the leading end of the sheet P is in contact with the pair of sheet conveying rollers 51. As the sheet P is further ejected from the sheet ejection port 20, the warp amount of the sheet P increases.

[0100] Then, as the warp amount of the sheet P increases and the warped portion of the sheet P is detected by the first photosensor 41, the detection timing of the warped portion of the sheet P triggers conveyance of the sheet P for a small amount by rotation of the pair of sheet conveying rollers 51, as illustrated in FIG. 5B. By so doing, the leading end of the sheet P is conveyed to the nip region of the pair of sheet conveying rollers 51. Then, in that state, rotation of the pair of sheet conveying rollers 51 is stopped temporarily. Accordingly, the warp amount of the sheet P increases each time the sheet P is further conveyed by the pair of sheet feed rollers 18 from the sheet ejection port 20 while being grasped between the rollers of the pair of sheet conveying rollers 51 and the rollers of the pair of sheet feed rollers 18 (see the warp states K2 and K3 each indicated by a broken line in FIG. 5B).

[0101] Thereafter, as the warp amount of the sheet P increases and the warped portion of the sheet P is detected by the second photosensor 42, the length of the sheet P for a single sheet folding operation performed by the sheet folding units, which correspond to the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56 (see FIG. 3), is assumed to be obtained as the warp of the sheet. Then, as illustrated in FIG. 5C, the detection timing of the warped portion of the sheet P triggers the start of rotation of the pair of sheet conveying rollers 51 again. This operation is to convey the leading end of the sheet P to the sheet folding units (that is, the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56), and the subsequent operation to drive the pair of sheet conveying rollers 51 and the sheet folding units (that is, the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56) is to actually make a fold or folds on the sheet P.

[0102] Here, the sheet folding operation performed by the sheet folding units (that is, the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56) provided in the sheet folding apparatus 50 has been described above, with reference to FIGS. 3A to 3E. However, the following control operations (1), (2), and (3) are performed during the sheet folding operation.

(1) When the state of the third photosensor 43 is changed from the OFF state to the ON state, the conveying speed V of the sheet folding apparatus 50 is increased.

(2) When the state of the second photosensor 42 is changed from the ON state to the OFF state, the conveying speed V of the sheet folding apparatus 50 is decreased.

(3) When the state of the fourth photosensor 44 is changed from the OFF state to the ON state, the conveyance and the sheet folding operation of the sheet P by the sheet folding apparatus 50 is stopped (see FIG. 5D).

[0103] Here, a detailed description is given of the above-described control operation (3), with reference to FIG. 5D.

[0104] As illustrated in FIG. 5D, when the sheet P is pulled and stretched taut between the pair of sheet feed rollers 18 and the pair of sheet conveying rollers 51, it is likely that the sheet P is also pulled and stretched taut in a part of the image forming device 2 to distort the image formed on the sheet P to a defect image. Therefore, in the present embodiment, as illustrated in FIG. 5D, when the fourth photosensor 44 detects that the sheet P hardly has a warped portion and is changed to the ON state, the sheet folding apparatus 50 stops conveyance of the sheet P by the pair of sheet conveying rollers 51. Then, under the condition in which the state of the fourth photosensor 44 is changed from the ON state to the OFF state, the sheet folding apparatus 50 starts conveyance of the sheet P by the pair of sheet conveying rollers 51 again. In particular, in the present embodiment, when the

first photosensor 41, the second photosensor 42, and the third photosensor 43 detect that the sheet P has a certain warp amount, the sheet folding apparatus 50 has already restarted conveyance of the sheet P, and the subsequent sheet folding operation is performed smoothly.

[0105] Thereafter, when the print job performed by the image forming apparatus 1 is finished, the trailing end of the sheet P is ejected from the nip region of the pair of sheet feed rollers 18. At this time, as illustrated in FIG. 5E, the trailing end of the sheet P may not be completely ejected from the sheet ejection port 20 and may remain in the image forming apparatus 1. In such a case, the sheet P is not warped sufficiently in the sheet guiding device 30. Due to this state of the sheet P, the second photosensor 42 remains in the OFF state, and the conveyance and the sheet folding operation of the sheet P by the sheet folding apparatus 50 are suspended.

[0106] In order to prevent such a failure, in the present embodiment, in a case in which the first photosensor 41, the second photosensor 42, and the third photosensor 43 do not detect that the sheet P has a certain warp amount, even after a predetermined time has elapsed since the sheet P is detected by the sixth photosensor 46 that functions as a fourth sheet detector and the trailing end of the sheet P is not detected, the controller 90 causes the sheet folding apparatus 50 to start the conveyance of the sheet P and the sheet folding operation again.

[0107] Next, a summary description is given of the control of the sheet folding apparatus 50 and the sheet guiding device 30 during the sheet folding operation, with reference to flowcharts of FIGS. 6 to 9.

[0108] FIG. 6 is a flowchart of a control process when conveying the leading end of the sheet P toward the sheet folding apparatus 50.

[0109] As illustrated in the flowchart of FIG. 6, when a print start command is input in the image forming apparatus 1, an initial check of the image forming apparatus 1 is performed (step S0).

[0110] When the initial check of the image forming apparatus 1 is finished (YES in step S0), the image forming apparatus 1 performs the printing operation and then stops the driving (step S1).

[0111] On the other hand, when the initial check of the image forming apparatus 1 is not finished (NO in step S0), the process goes to step S2.

[0112] Then, the leading end of the sheet P is ejected from the sheet ejection port 20 while the sheet P is in the print job in the image forming apparatus 1, and the leading end of the sheet P is detected by the fifth photosensor 45 or the sixth photosensor 46 (step S2). When the leading end of the sheet P is not detected (NO in step S2), the sheet folding apparatus 50 waits (step S3) and the process goes back to step S2. On the other hand, when the leading end of the sheet P is detected (YES in step S2), the initial operation of the sheet folding apparatus 50 that had been in the waiting state is started (step S4).

[0113] Then, an initial check of the sheet folding apparatus 50 is performed (step S5). When the initial check presents an abnormal result (for example, an abnormal result in operation of the first photosensor 41 to the fifth photosensor 45, the first sensor 62, and the second sensor 63) (NO in step S5), while the driving of the sheet folding apparatus 50 is stopped, the abnormal result of the initial check is displayed on the display panel that is mounted on the exterior of the sheet folding apparatus 50 (step S6).

[0114] On the other hand, when the result of the initial operation is normal (YES in step S5), it is determined whether the first photosensor 41 detects the warp of the sheet P (step S7). When the first photosensor 41 does not detect the warp of the sheet P (NO in step S7), the sheet folding apparatus 50 waits (step S8) and the process goes back to step S7 to repeat until the first photosensor 41 detects the warp of the sheet P. On the other hand, the first photosensor 41 detects the warp of the sheet P (YES in step S7), the pair of sheet conveying rollers 51 conveys the sheet P by a predetermined distance (step S9), and the conveyance of the sheet P is stopped (step S10).

[0115] By executing the above-described control process, the sheet folding apparatus 50 stands by before starting conveyance of the first face of the sheet P to the sheet folding units (that is, the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56) while the leading end of the sheet P is conveyed into the sheet folding apparatus 50 as illustrated in FIG. 5B.

[0116] FIG. 7 is a flowchart of a control process executed by the controller 90 when the first face of the sheet P is conveyed toward the sheet folding units (that is, the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56) after the standby state of the sheet folding apparatus 50 in step S10 in the flowchart of FIG. 6.

[0117] As illustrated in the flowchart of FIG. 7, firstly, it is determined whether the first photosensor 41 and the second photosensor 42 have detected the warp of the sheet P (step S11). When the first photosensor 41 and the second photosensor 42 have not detected the warp of the sheet P (NO step S11), the sheet folding apparatus 50 remains in the waiting state (step S12) and the process goes back to step S11 to repeat until the first photosensor 41 and the second photosensor 42 detect the warp of the sheet P. On the other hand, when the first photosensor 41 and the second photosensor 42 have detected the warp of the sheet P (YES step S11), to be more specific, after the second photosensor 42 has detected the warp of the sheet P, the sheet folding apparatus 50 starts conveyance of the sheet P (step S13). The conveying speed V of the sheet P in the sheet folding apparatus 50 at this time is set to a constant speed V0 that corresponds to a middle speed.

[0118] Then, when the state of the second photosensor 42 is changed to the OFF state and it is determined that the warp amount of the sheet P is decreased (YES in

step S14), the conveying speed V of the sheet folding apparatus 50 is changed to a low speed V1 that is smaller than the constant speed V0 (step S15). On the other hand, when the state of the second photosensor 42 is not changed to the OFF state (NO in step S14), in other words, when the state of the third photosensor 43 is changed to the ON state and it is determined that the warp amount of the sheet P is increased (YES in step S16), the conveying speed V of the sheet folding apparatus 50 is changed to a high speed V2 that is greater than the constant speed V0 (step S17).

[0119] Further, when the state of the third photosensor 43 is not changed to the ON state (NO in step S16), in other words, when the state of the fourth photosensor 44 is changed to the ON state and it is determined that the sheet P is hardly warped (YES in step S18), conveyance of the sheet P by the sheet folding apparatus 50 is halted (step S19).

[0120] Then, the flow of steps S14 to S19 in the flowchart of FIG. 7 is repeated until the leading end of the sheet P is detected by the first sensor 62 (see FIG. 3A) (step S20). Then, when the leading end of the sheet P is detected by the first sensor 62 (YES in step S20), the driving of the sheet folding apparatus 50 is temporarily stopped (step S21).

[0121] Consequently, in the state in which the first face of the sheet P is conveyed to the sheet folding units (that is, the first movable guide 53, the second movable guide 54, the pair of sheet folding rollers 55, and the pair of sheet folding rollers 56) as illustrated in FIG. 3A, the sheet folding apparatus 50 stands by before starting the sheet folding operation to make a fold on the sheet P.

[0122] FIG. 8 is a flowchart of a control process executed when making the specified number of folds on the sheet P, after the standby state of the sheet folding apparatus 50 in step S21 in the flowchart of FIG. 7.

[0123] As illustrated in the flowchart of FIG. 8, firstly, it is determined whether the first photosensor 41 and the second photosensor 42 have detected the warp of the sheet P (step S31). When the first photosensor 41 and the second photosensor 42 have not detected the warp of the sheet P (NO step S31), the sheet folding apparatus 50 remains in the waiting state (step S32) and the process goes back to step S31 to repeat until the first photosensor 41 and the second photosensor 42 detect the warp of the sheet P. On the other hand, when the first photosensor 41 and the second photosensor 42 have detected the warp of the sheet P (YES step S31), to be more specific, after the second photosensor 42 has detected the warp of the sheet P, the sheet folding apparatus 50 starts conveyance of the sheet P (step S33). The conveying speed V of the sheet P in the sheet folding apparatus 50 at this time is set to a constant speed V0 that corresponds to the middle speed.

[0124] Then, when the state of the second photosensor 42 is changed to the OFF state and it is determined that the warp amount of the sheet P is decreased (YES in step S34), the conveying speed V of the sheet folding apparatus 50 is changed to the low speed V1 that is smaller than the constant speed V0 (step S35). On the other hand, when the state of the second photosensor 42 is not changed to the OFF state (NO in step S34), in other words, when the state of the third photosensor 43 is changed to the ON state and it is determined that the warp amount of the sheet P is increased (YES in step S36), the conveying speed V of the sheet folding apparatus 50 is changed to the high speed V2 that is greater than the constant speed V0 (step S37).

[0125] Further, when the state of the third photosensor 43 is not changed to the ON state (NO in step S36), in other words, when the state of the fourth photosensor 44 is changed to the ON state and it is determined that the sheet P is hardly warped (YES in step S38), conveyance of the sheet P by the sheet folding apparatus 50 is halted (step S39).

[0126] Then, when the state of the fourth photosensor 44 is not changed to the ON state (NO in step S38), it is determined whether the sheet folding operation is completed (step S40). When the sheet folding operation is not completed (NO in step S40), the process of steps S34 to S39 is repeated each time a single sheet folding operation of the sheet folding apparatus 50 is performed, in other words, each time a single fold is made on the sheet P (step S40).

[0127] On the other hand, when the sheet folding operation is completed (YES in step S40), it is determined whether the specified number of folds is completely made on the sheet P (step S41). When the specified number of folds is not completely made on the sheet P (NO step S41), the process of steps S31 to S40 is repeated until the specified number of folds is completely made on the sheet P.

[0128] When the specified number of folds is not completely made on the sheet P (YES step S41), finally the sheet P having the specified number of folds is ejected toward the sheet ejection tray 68 by the pair of sheet ejection rollers 67 (step S42).

[0129] Thus, the sheet folding operation to the sheet P is completed.

[0130] FIG. 9 is a flowchart of a control process executed when the warp of the sheet P is not normally detected in the sheet guiding device 30 while the trailing end of the sheet P is ejected from the pair of sheet feed rollers 18 or while the regular sheet folding operation is performed.

[0131] As illustrated in the flowchart of FIG. 9, in a case in which the sixth photosensor 46 has detected the trailing end of the sheet P, when the first photosensor 41 and the second photosensor 42 have detected the warp of the sheet P (YES in step S51), the sheet folding apparatus 50 starts the sheet folding operation and conveyance of the sheet P (step S54). The conveying speed V of the sheet P in the sheet folding apparatus 50 at this time is set to the constant speed V0 that corresponds to the middle speed. Further, when neither the first photosensor 41 nor the second photosensor 42 has detected

the warp of the sheet P (NO in step S51), the sheet folding apparatus 50 waits for the sheet folding operation and conveyance of the sheet P (step S52). When the second photosensor 42 has detected the warp of the sheet P (YES in step S53), the sheet folding apparatus 50 starts the sheet folding operation and conveyance of the sheet P (step S54). Further, when the second photosensor 42 has not detected the warp of the sheet P (NO in step S53), the sheet folding apparatus 50 remains the waiting state. In a case in which a predetermined time has elapsed in this state, in other words, in a case in which the second photosensor 42 has not detected the sheet P in the waiting state of the sheet folding apparatus 50, it is determined that the sheet P is not warped normally in the sheet guiding device 30 and the warp of the sheet P is not detected properly, and the sheet folding apparatus 50 starts the sheet folding operation and conveyance of the sheet P at the low speed V1 (step S55).

[0132] Further, while the sheet folding operation and conveyance of the sheet P are performed in steps S54 and S55, when the state of the fourth photosensor 44 is changed to the ON state and it is determined that the sheet P is hardly warped (YES in step S56), conveyance of the sheet P by the sheet folding apparatus 50 is halted (step S57).

[0133] Then, when the state of the fourth photosensor 44 is not changed to the ON state (NO in step S56), it is determined whether the sheet folding operation is completed (step S58). When the sheet folding operation is not completed (NO in step S58), the process of steps S56 and S57 is repeated each time a single sheet folding operation of the sheet folding apparatus 50 is performed, in other words, each time a single fold is made on the sheet P (step S58).

[0134] On the other hand, when the sheet folding operation is completed (YES in step S58), it is determined whether the specified number of folds is completely made on the sheet P (step S59). When the specified number of folds is not completely made on the sheet P (NO step S59), the process of steps S51 to S59 is repeated until the specified number of folds is completely made on the sheet P.

[0135] When the specified number of folds is not completely made on the sheet P (YES step S59), finally the sheet P having the specified number of folds is ejected toward the sheet ejection tray 68 by the pair of sheet ejection rollers 67 (step S60).

[0136] Thus, the sheet folding operation to the sheet P is completed.

[0137] As described above, the sheet guiding device 30 according to the present embodiment is the sheet guiding device that guides the sheet ejected from the image forming apparatus 1 toward the sheet folding apparatus 50 that functions as a post-processing apparatus, and includes the first photosensor 41 to the fourth photosensor 44 each detecting the warp amount of the sheet P from the image forming apparatus 1 to the sheet folding apparatus 50. Each of the first photosensor 41, the second photosensor 42, the third photosensor 43, and the fourth photosensor 44 functions as a sheet warp detector.

[0138] Accordingly, the warp amount of the sheet P from the image forming apparatus 1 to the sheet folding apparatus 50 that functions as a post-processing apparatus maintains a constant warp amount, so that the sheet folding apparatus 50 achieves a good sheet folding operation (good post-processing operation).

[0139] Note that, in the present embodiment, the present disclosure is applied to the sheet guiding device 30 that guides the sheet P ejected from the serial-type inkjet image forming apparatus 1 toward the post-processing apparatus. However, the present disclosure is not limited to the above-described sheet guiding device 30. For example, the present disclosure may be applied to a sheet guiding device that guides a sheet ejected from an image forming apparatus of another type, such as a line-type inkjet image forming apparatus or an electrophotographic image forming apparatus, toward a post-processing apparatus. In such a case, the present disclosure is useful, in particular, when no communication unit is provided to communicate between the image forming apparatus and the post-processing apparatus and the conveying speed of the sheet ejected from the image forming apparatus is not constant.

[0140] Any of the cases described above exhibits the same advantages as the advantages of the present embodiment.

[0141] Further, in the present embodiment, the sheet folding apparatus 50 is employed as a post-processing apparatus to which the sheet guiding device 30 is connected. However, a post-processing apparatus to which the sheet guiding device 30 is connected is not limited to the sheet folding apparatus 50. Alternatively, for example, the present disclosure may be applied to a post-processing apparatus capable of separately performing a post-processing operation such as a punching process, a binding process, and a stamping process or a sheet guiding device connected to a post-processing apparatus capable of performing a plurality of processes.

[0142] This case exhibits substantially the same advantages as the advantages of the present embodiment.

[0143] Further, in the present embodiment, three photosensors (that is, the first photosensor 41, the second photosensor 42, and the third photosensor 43, collectively functioning as a plurality of first sheet detectors) are aligned spaced apart along the sheet guide direction of the second sheet guide 32. However, two, four or more photosensors that collectively function as a plurality of first sheet detectors may be aligned spaced apart along the sheet guide direction of the second sheet guide 32.

[0144] This case exhibits substantially the same advantages as the advantages of the present embodiment.

[0145] The above-described embodiments are illustrative and do not limit this disclosure. Thus, numerous additional modifications and variations are possible in light of the above teachings. For example, elements at least

one of features of different illustrative and exemplary embodiments herein may be combined with each other at least one of substituted for each other within the scope of this disclosure and appended claims. Further, features of components of the embodiments, such as the number, the position, and the shape are not limited the embodiments and thus may be preferably set.

[0146] The present disclosure is not limited to specific embodiments described above, and numerous additional modifications and variations are possible in light of the teachings within the technical scope of the appended claims. It is therefore to be understood that, the disclosure of this patent specification may be practiced otherwise by those skilled in the art than as specifically described herein, and such, modifications, alternatives are within the technical scope of the appended claims. Such embodiments and variations thereof are included in the scope and gist of the embodiments of the present disclosure and are included in the embodiments described in claims and the equivalent scope thereof.

[0147] The above-described embodiments are illustrative and do not limit the present invention. Thus, numerous additional modifications and variations are possible in light of the above teachings. For example, elements and/or features of different illustrative embodiments may be combined with each other and/or substituted for each other within the scope of this disclosure.

[0148] Any one of the above-described operations may be performed in various other ways, for example, in an order different from the one described above.

Claims

1. A sheet guiding device (30) for guiding a sheet (P) ejected from an image forming apparatus (1) to a post-processing apparatus (50), the sheet guiding device (30) comprising:
   a sheet warp detector (41, 42, 43, 44) configured to detect a warp amount of the sheet (P) in a sheet conveyance passage from the image forming apparatus (1) to the post-processing apparatus (50).

2. The sheet guiding device (30) according to claim 1, further comprising:

   a first sheet guide (31) disposed near a sheet ejection port (20) of the image forming apparatus (1), the first sheet guide (31) being configured to guide the sheet (P) ejected from the sheet ejection port (20) toward a sheet receiving port (60) of the post-processing apparatus (50); and
   a second sheet guide (32) disposed near the sheet receiving port (60), the second sheet guide (32) configured to guide a warped portion of the sheet (P) from the sheet ejection port (20) to the sheet receiving port (60),
   wherein the sheet warp detector (41, 42, 43, 44) includes:

   a plurality of first sheet detectors (41, 42, 43) aligned spaced apart from each other along a sheet conveyance direction in which the second sheet guide (32) conveys the sheet (P); and
   a second sheet detector (44) disposed close to the sheet receiving port (60) of the post-processing apparatus (50) and facing the second sheet guide (32), the sheet (P) being configured to pass between the second sheet detector (44) and the second sheet guide (32).

3. The sheet guiding device (30) according to claim 2, wherein the first sheet guide (31) includes an elastic guide (31a) configured to guide the sheet (P) toward the second sheet guide (32).

4. A post-processing system (25) comprising:

   the sheet guiding device (30) according to claim 2 or claim 3; and
   a post-processing apparatus (50) configured to perform a post-processing operation to the sheet (P) guided by the sheet guiding device (30).

5. The post-processing system (25) according to claim 4, further comprising:

   a pair of sheet conveyors (51, 55, 56) configured to convey the sheet (P) detected by the plurality of first sheet detectors (41, 42, 43) and the second sheet detector (44); and
   a controller (90) configured to control at least one of a sheet folding timing at which the post-processing apparatus (50) performs a sheet folding operation and a sheet conveying speed (V) at which the pair of sheet conveyors (51, 55, 56) conveys the sheet (P), based on a detection result of the plurality of first sheet detectors (41, 42, 43) or a detection result of the second sheet detector (44).

6. The post-processing system (25) according to claim 5,
   wherein the controller (90) is configured to decrease the sheet conveying speed when the warp amount of the sheet (P) is smaller than a predetermined warp amount.

7. The post-processing system (25) according to claim 5 or claim 6,
   wherein the controller (90) is configured to increase the sheet conveying speed when the warp amount of the sheet (P) is greater than a predetermined warp

amount.

8. The post-processing system (25) according to any one of claims 5 to 7, wherein the post-processing apparatus (50) includes a sheet folding apparatus (50).

9. The post-processing system (25) according to claim 8,
wherein the controller (90) is configured to cause the sheet folding apparatus (50) to start a single run of the sheet folding operation when the controller (90) determines that a length of the sheet (P) from the image forming apparatus (1) to the sheet folding apparatus (50) is beyond a length of the sheet (P) for the single run of the sheet folding operation performed by the sheet folding apparatus (50) based on the warp amount of the sheet (P) detected by the plurality of first sheet detectors (41, 42, 43).

10. The post-processing system (25) according to claim 8 or claim 9, further comprising:

a third sheet detector (45) disposed near the sheet receiving port (60) of the post-processing apparatus (50); and
a fourth sheet detector (46) disposed near the sheet ejection port (20) of the image forming apparatus (1),
wherein the controller (90) is configured to cause the sheet folding apparatus (50) to start a subsequent sheet folding operation based on data of a previous sheet folding operation, when the warp amount of the sheet (P) detected by the plurality of first sheet detectors (41, 42, 43) is less than a predetermined warp amount even after a predetermined time has elapsed from detection of a leading end of the sheet (P) ejected from the sheet ejection port (20) with the third sheet detector (45) or the fourth sheet detector (46).

11. The post-processing system according to any one of claims 8 to 10, further comprising a fourth sheet detector (46) disposed near the sheet ejection port (20) of the image forming apparatus (1),
wherein the controller (90) is configured to cause the sheet folding apparatus (50) to start a sheet folding operation when the warp amount of the sheet (P) detected by the plurality of first sheet detectors (41, 42, 43) is less than a predetermined warp amount even after a predetermined time has elapsed while the fourth sheet detector (46) has detected the sheet (P) and has not detected a trailing end of the sheet (P).

12. The post-processing system (25) according to any one of claims 8 to 11, wherein the controller (90) is configured to cause the sheet folding apparatus (50) to stop conveyance of the sheet (P) when the warp amount of the sheet (P) detected by the second sheet detector (44) is equal to or smaller than a predetermined warp amount.

13. The post-processing system (25) according to claim 12,
wherein, after causing the sheet folding apparatus (50) to stop conveyance of the sheet (P), the controller (90) is configured to cause the sheet folding apparatus (50) to start conveyance of the sheet (P) again when the warp amount of the sheet (P) detected by the plurality of first sheet detectors (41, 42, 43) is equal to or greater than a predetermined warp amount.

14. A post-processing system (25) comprising:

the sheet guiding device (30) according to claim 1; and
a post-processing apparatus (50) configured to perform a post-processing operation to the sheet (P) guided by the sheet guiding device (30).

15. An image forming system (100) comprising:

an image forming apparatus (1) configured to form an image on a sheet (P); and
the post-processing system (25) according to any one of claims 4 to 14.

FIG. 1

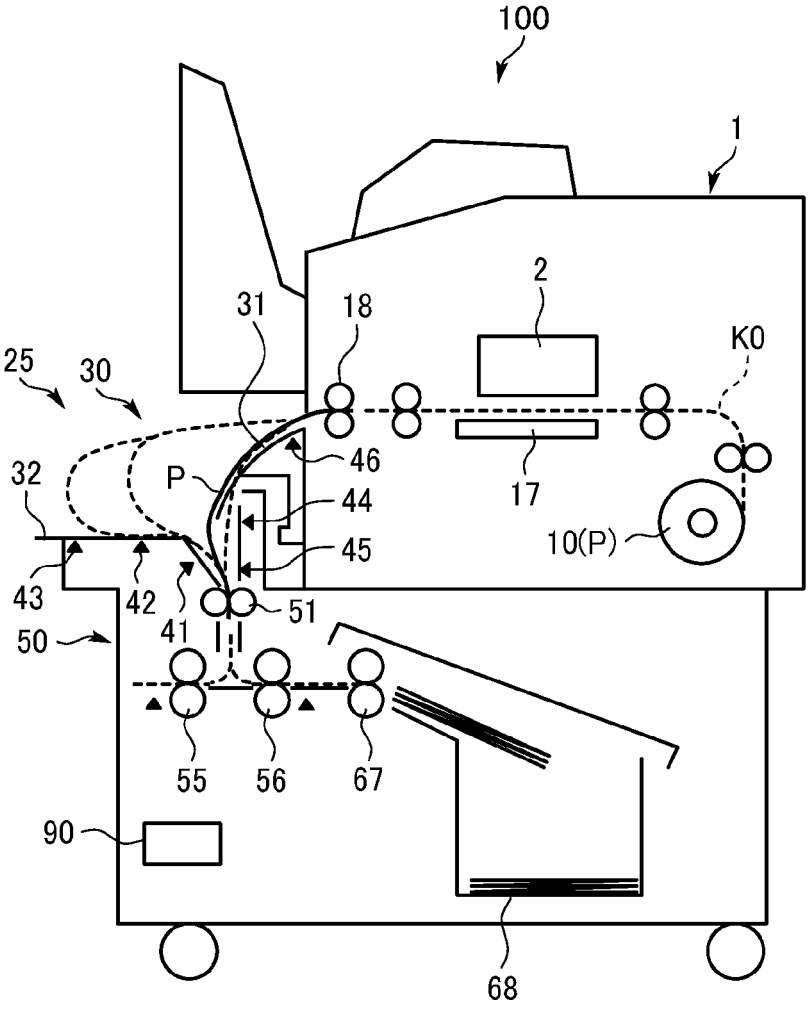

100
1
2
31
18
K0
25
30
46
P
44
32
17
45
10(P)
43
42
41
51
50
55
56
67
90
68

FIG. 2

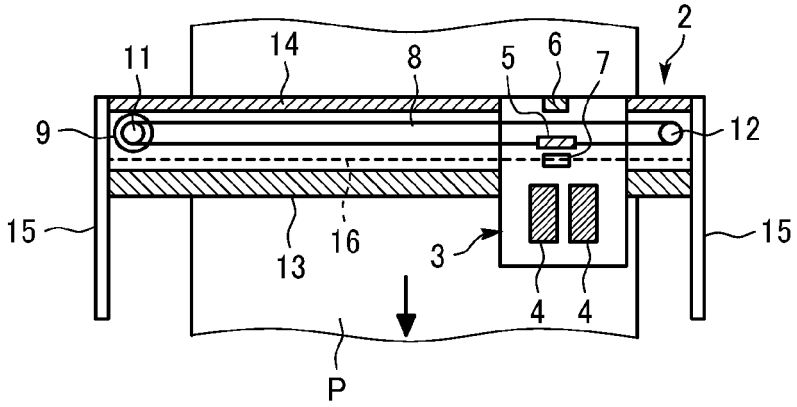

2
11
14
8
5
6
7
9
12
15
16
13
3
15
4
4
P

FIG. 3A

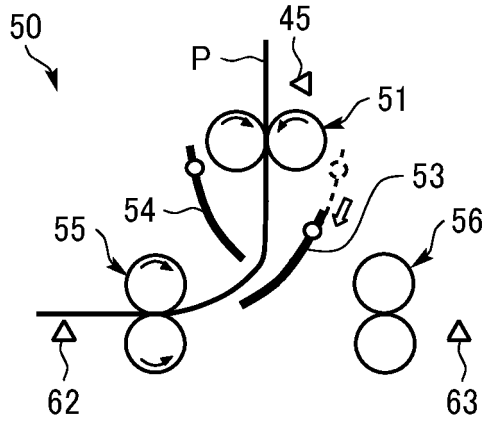


FIG. 3B

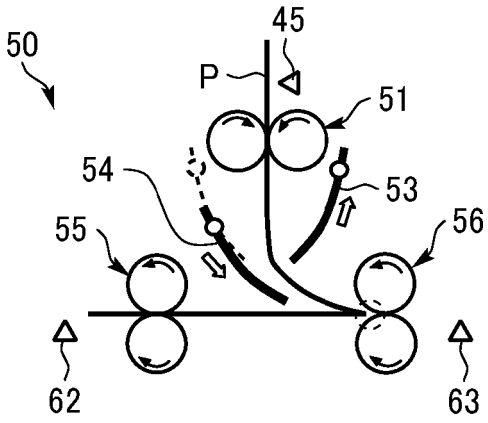


FIG. 3C

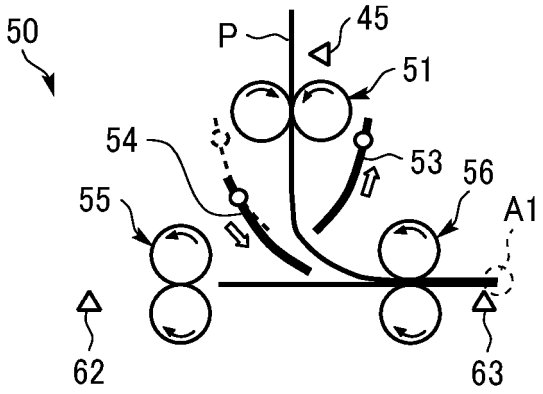


FIG. 3D

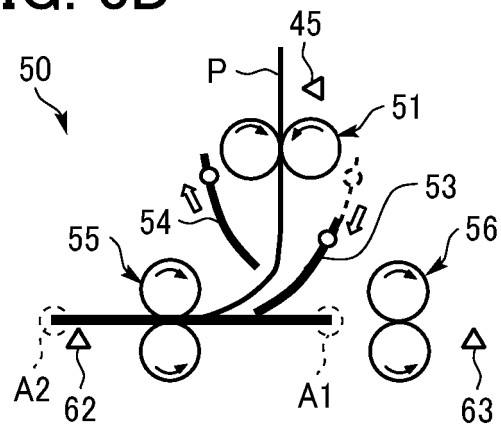


FIG. 3E

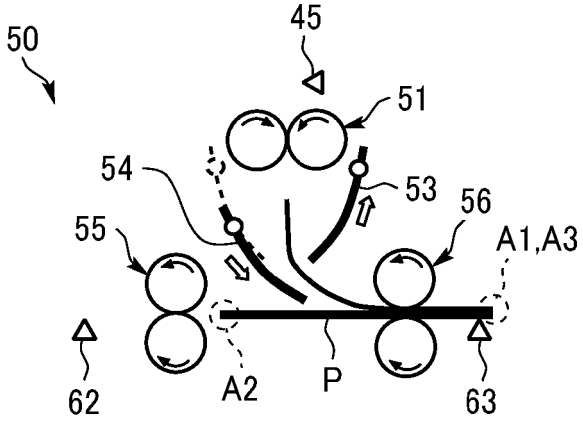


FIG. 4

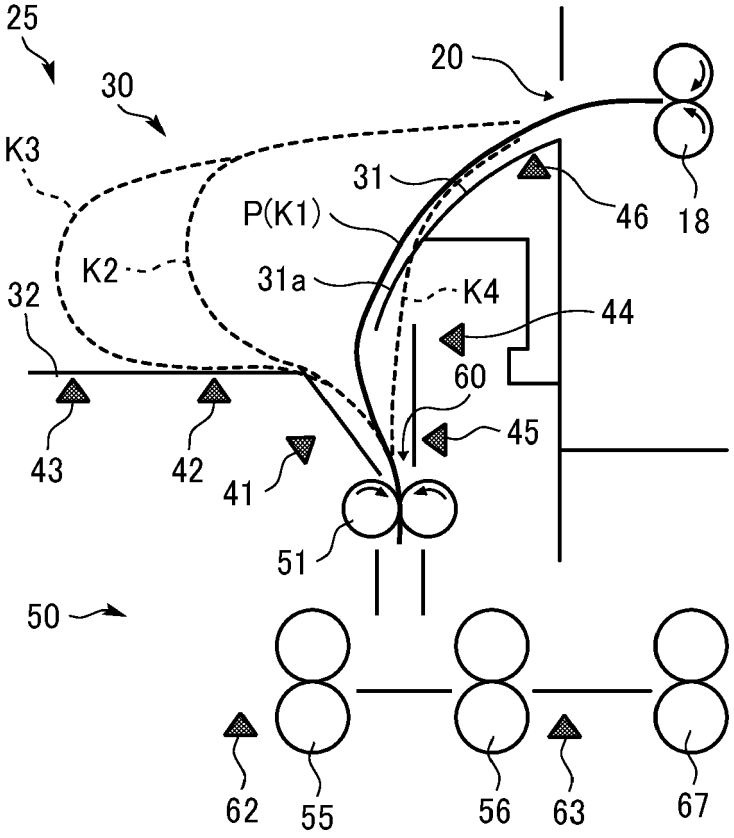

25
30
20
K3
31
P(K1)
46
18
K2
31a
K4
44
32
60
45
43
42
41
51
50
62
55
56
63
67

FIG. 5A

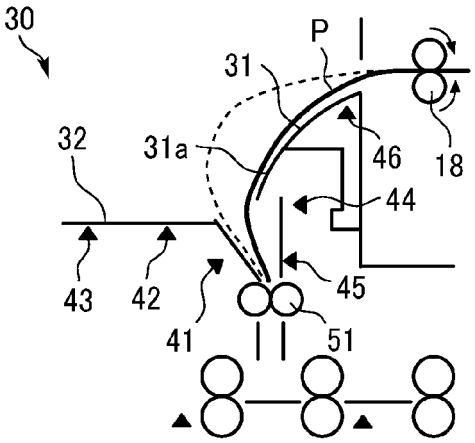


FIG. 5B

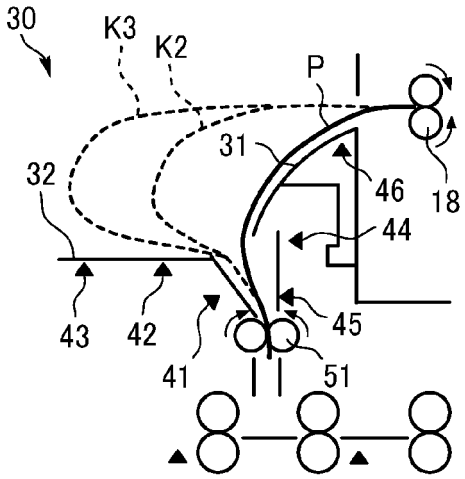


FIG. 5C

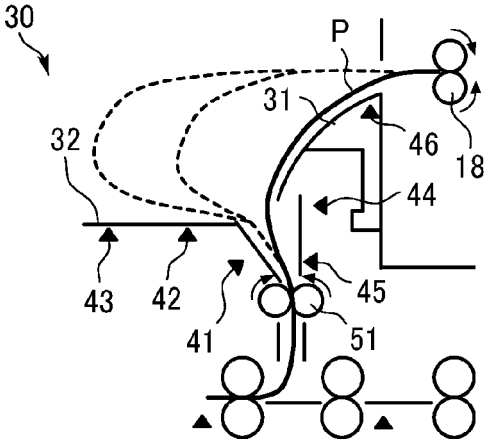


FIG. 5D

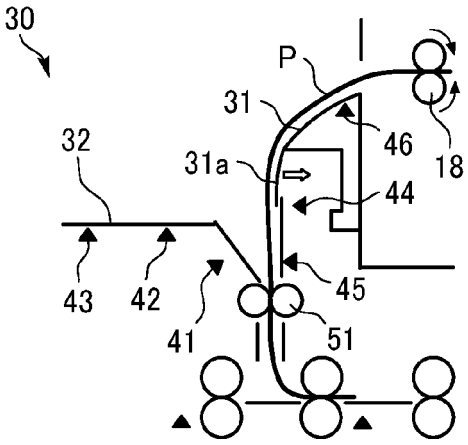


FIG. 5E

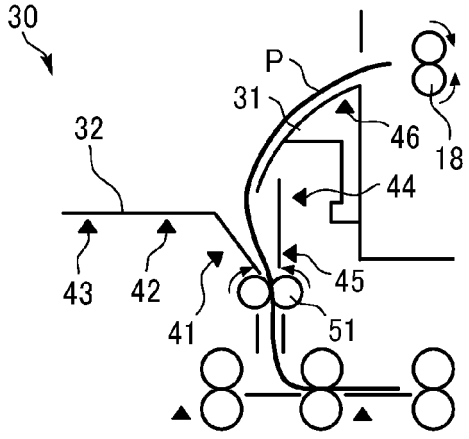


FIG. 6

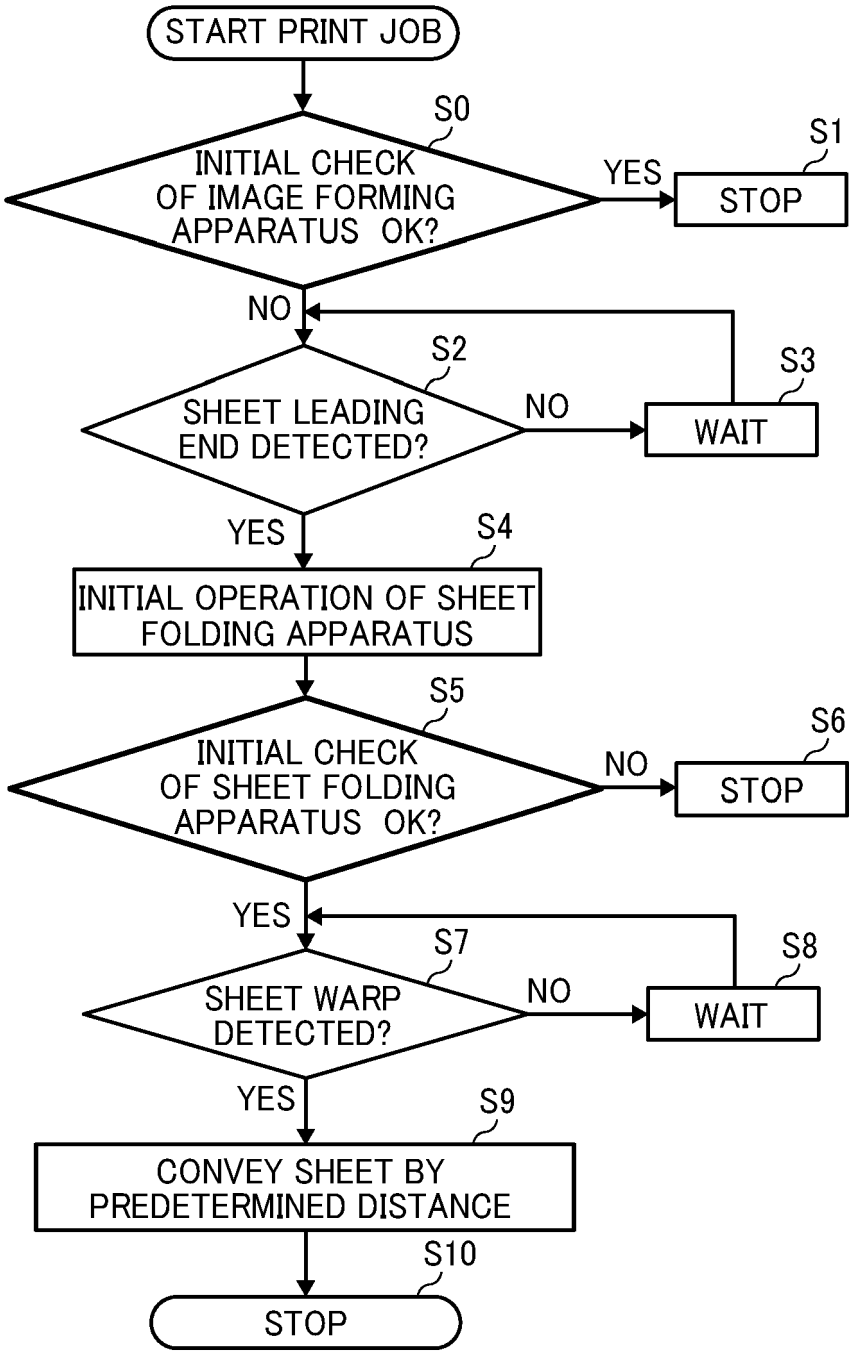

START PRINT JOB
S0
INITIAL CHECK OF IMAGE FORMING APPARATUS OK?
YES
S1
STOP
NO
S2
SHEET LEADING END DETECTED?
NO
S3
WAIT
YES
S4
INITIAL OPERATION OF SHEET FOLDING APPARATUS
S5
INITIAL CHECK OF SHEET FOLDING APPARATUS OK?
NO
S6
STOP
YES
S7
SHEET WARP DETECTED?
NO
S8
WAIT
YES
S9
CONVEY SHEET BY PREDETERMINED DISTANCE
S10
STOP

FIG. 7

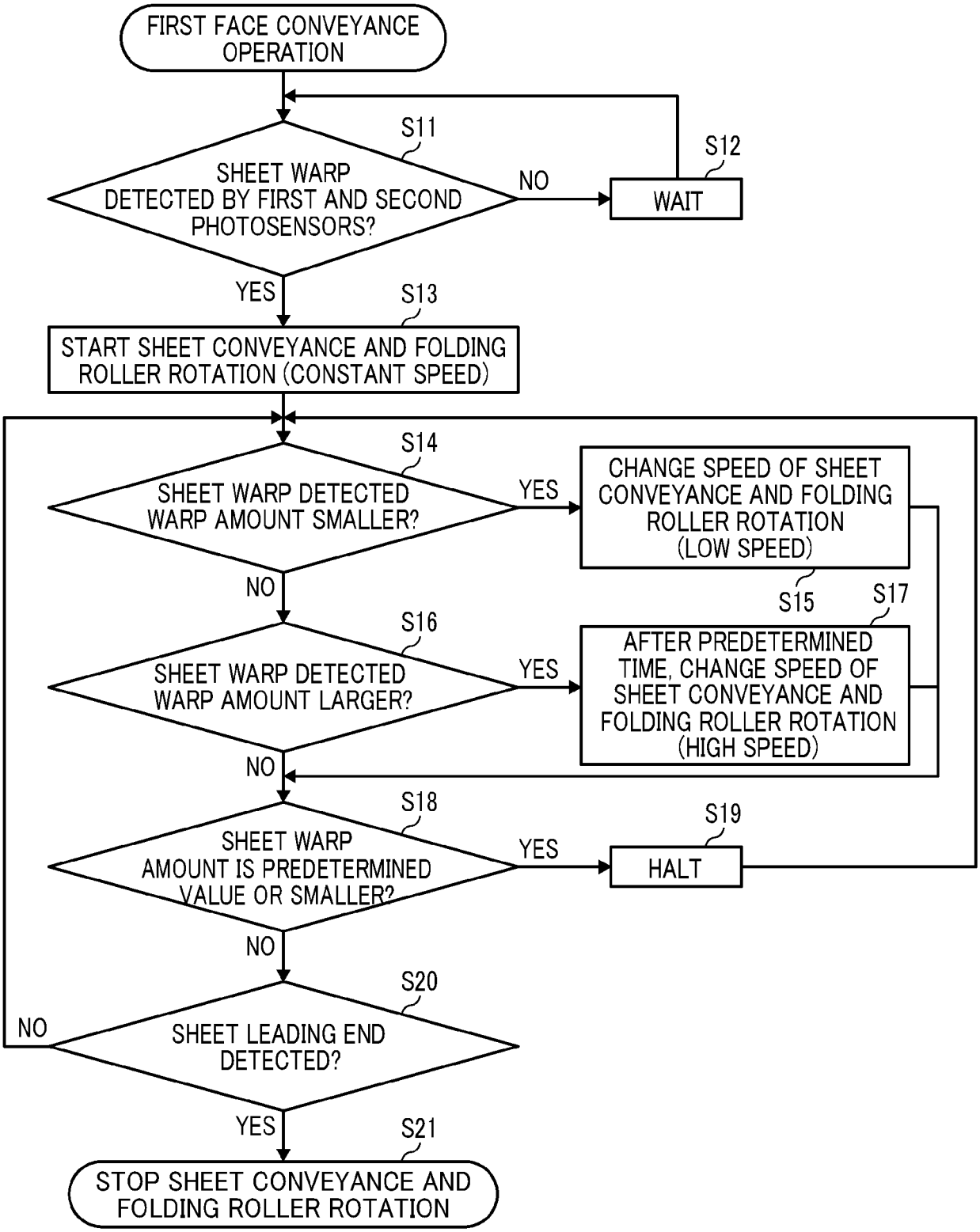

FIRST FACE CONVEYANCE OPERATION
S11
SHEET WARP DETECTED BY FIRST AND SECOND PHOTOSENSORS?
NO
S12
WAIT
YES
S13
START SHEET CONVEYANCE AND FOLDING ROLLER ROTATION (CONSTANT SPEED)
S14
SHEET WARP DETECTED WARP AMOUNT SMALLER?
YES
CHANGE SPEED OF SHEET CONVEYANCE AND FOLDING ROLLER ROTATION (LOW SPEED)
S15
S17
NO
S16
SHEET WARP DETECTED WARP AMOUNT LARGER?
YES
AFTER PREDETERMINED TIME, CHANGE SPEED OF SHEET CONVEYANCE AND FOLDING ROLLER ROTATION (HIGH SPEED)
NO
S18
SHEET WARP AMOUNT IS PREDETERMINED VALUE OR SMALLER?
YES
S19
HALT
NO
S20
NO
SHEET LEADING END DETECTED?
YES
S21
STOP SHEET CONVEYANCE AND FOLDING ROLLER ROTATION

FIG. 8

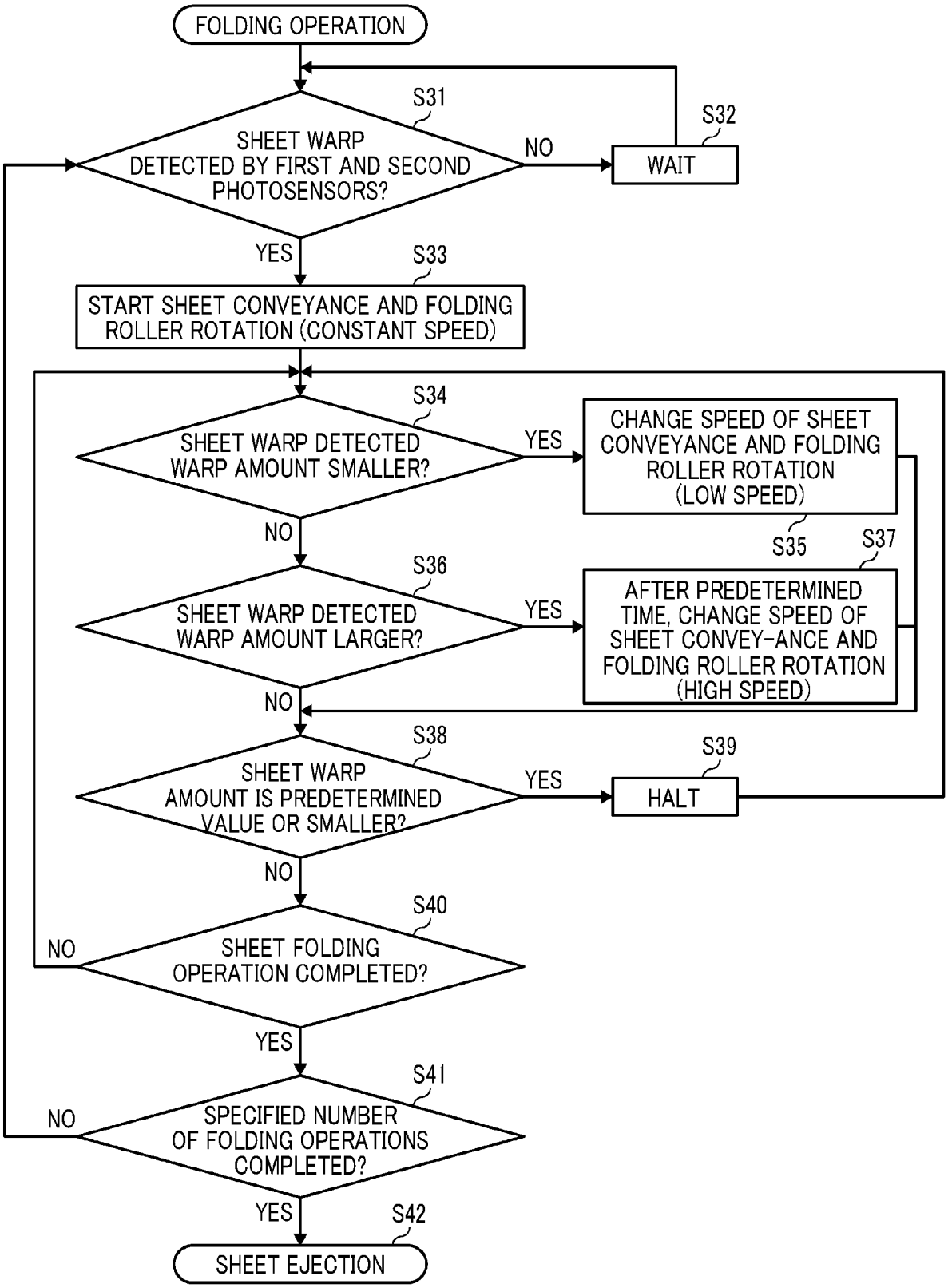
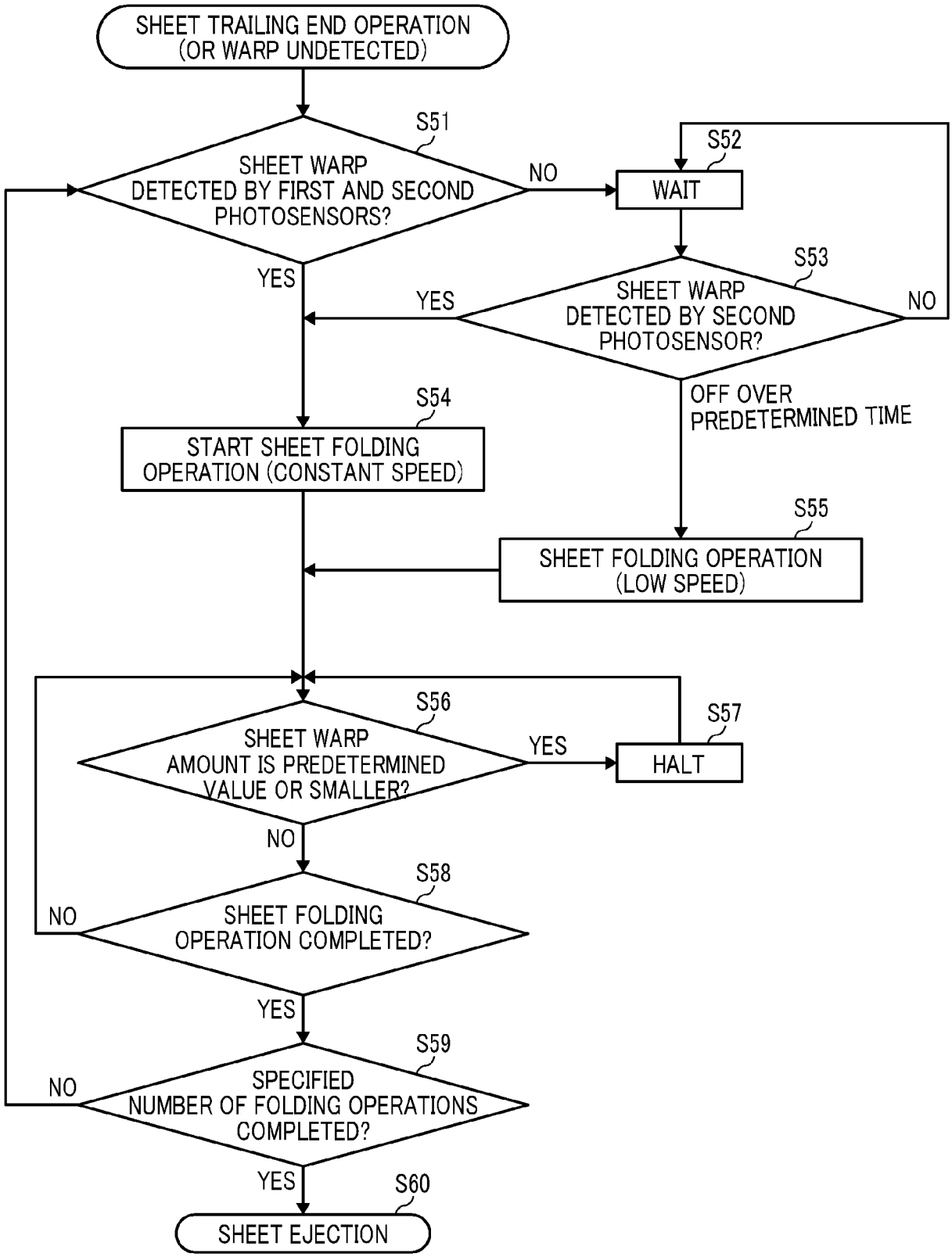

FOLDING OPERATION
S31
SHEET WARP DETECTED BY FIRST AND SECOND PHOTOSENSORS?
NO
S32
WAIT
YES
S33
START SHEET CONVEYANCE AND FOLDING ROLLER ROTATION (CONSTANT SPEED)
S34
SHEET WARP DETECTED WARP AMOUNT SMALLER?
YES
CHANGE SPEED OF SHEET CONVEYANCE AND FOLDING ROLLER ROTATION (LOW SPEED)
S35
S37
NO
S36
SHEET WARP DETECTED WARP AMOUNT LARGER?
YES
AFTER PREDETERMINED TIME, CHANGE SPEED OF SHEET CONVEY-ANCE AND FOLDING ROLLER ROTATION (HIGH SPEED)
NO
S38
SHEET WARP AMOUNT IS PREDETERMINED VALUE OR SMALLER?
YES
S39
HALT
NO
S40
NO
SHEET FOLDING OPERATION COMPLETED?
YES
S41
NO
SPECIFIED NUMBER OF FOLDING OPERATIONS COMPLETED?
YES
S42
SHEET EJECTION

FIG. 9


SHEET TRAILING END OPERATION (OR WARP UNDETECTED)
S51
SHEET WARP DETECTED BY FIRST AND SECOND PHOTOSENSORS?
NO
S52
WAIT
YES
S53
SHEET WARP DETECTED BY SECOND PHOTOSENSOR?
YES
NO
OFF OVER PREDETERMINED TIME
S54
START SHEET FOLDING OPERATION (CONSTANT SPEED)
S55
SHEET FOLDING OPERATION (LOW SPEED)
S56
SHEET WARP AMOUNT IS PREDETERMINED VALUE OR SMALLER?
YES
S57
HALT
NO
S58
NO
SHEET FOLDING OPERATION COMPLETED?
YES
S59
NO
SPECIFIED NUMBER OF FOLDING OPERATIONS COMPLETED?
YES
S60
SHEET EJECTION

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 2730

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Y	US 2011/215517 A1 (MIZUTANI KIKUO [JP] ET AL) 8 September 2011 (2011-09-08) * paragraphs [0023] - [0077], [0088]; figures 1-14 *	1-15	INV. B41J13/00 B41J13/10
Y	US 6 338 481 B1 (MARUCHI NORITOSHI [JP]) 15 January 2002 (2002-01-15) * column 1, line 11 - column 5, line 67; figures 1-7 *	1-15	
Y	US 9 108 811 B1 (WALSH MARTIN RICHARD [GB] ET AL) 18 August 2015 (2015-08-18) * column 1, line 39 - column 4, line 67; figures 1-6 *	1-15	
A	US 2017/341885 A1 (SUZUKI MICHITAKA [JP] ET AL) 30 November 2017 (2017-11-30) * paragraphs [0004] - [0051], [0070] - [0102]; figures 1-10 *	1-15	
A	US 2005/206075 A1 (YAGO ATSUSHI [JP]) 22 September 2005 (2005-09-22) * paragraphs [0002] - [0041]; figures 1-8 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) B41J
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 March 2021	Bitane, Rehab

CATEGORY OF CITED DOCUMENTS

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09-03-2021

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