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(54) **SHEET ATACKER AND FINISHER**

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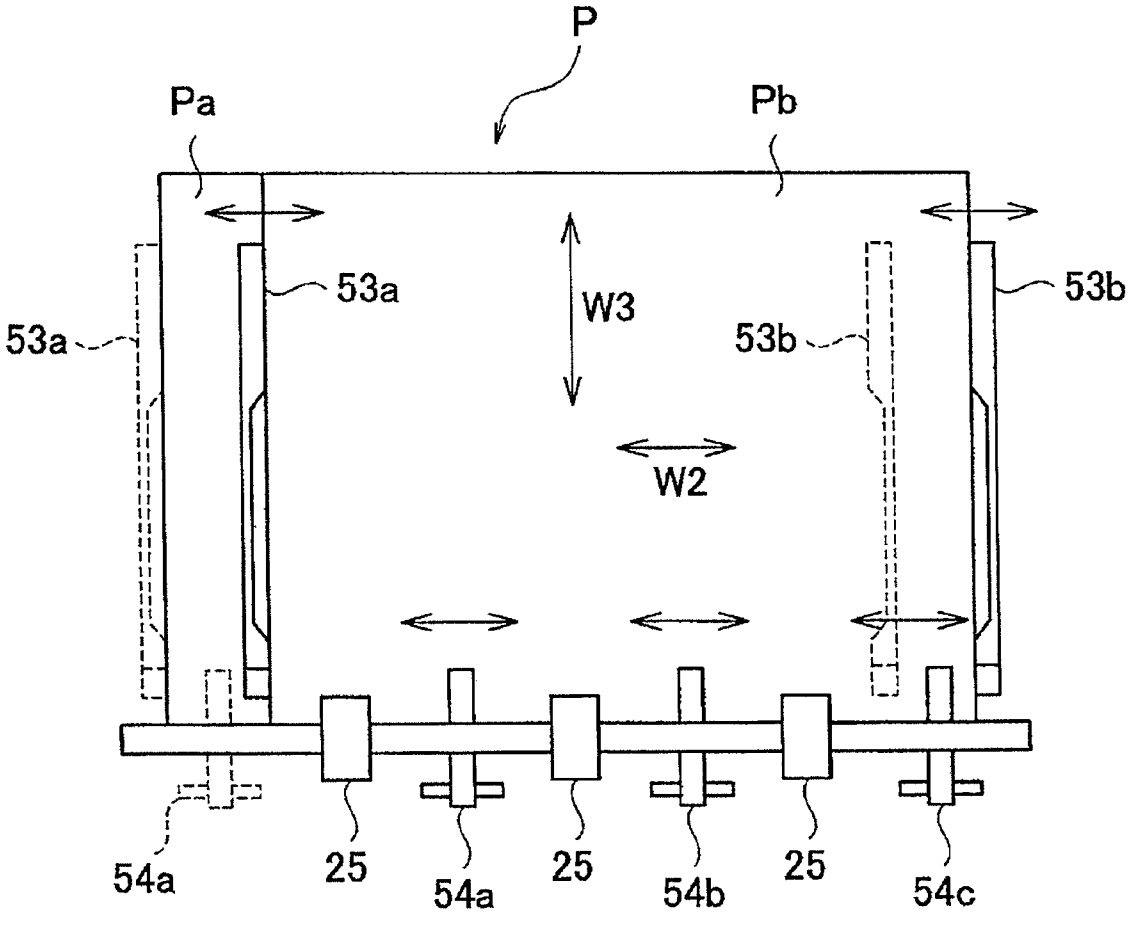
(57) **ABSTRACT**

An improved sheet stacking scheme is described which is applied to a copying machine, a printer, or the like. Even when printed sheets are sorted and stacked in different stacking positions, sheet alignment is achieved by inhibiting each sheet from being displaced. When sheets are sorted into a first stacking position and a second stacking position, the finisher control unit **200** determines the common area Rc which is shared by the first stacking position and the second stacking position. Then, a finisher control unit **200** sets the positions of the pair of holding members for holding a tail edge in order to perform the tail edge holding motion in the positions F**1** and F**2** respectively which are located within the common area Rc and symmetrical about the center position Rcc of the common area Rc.



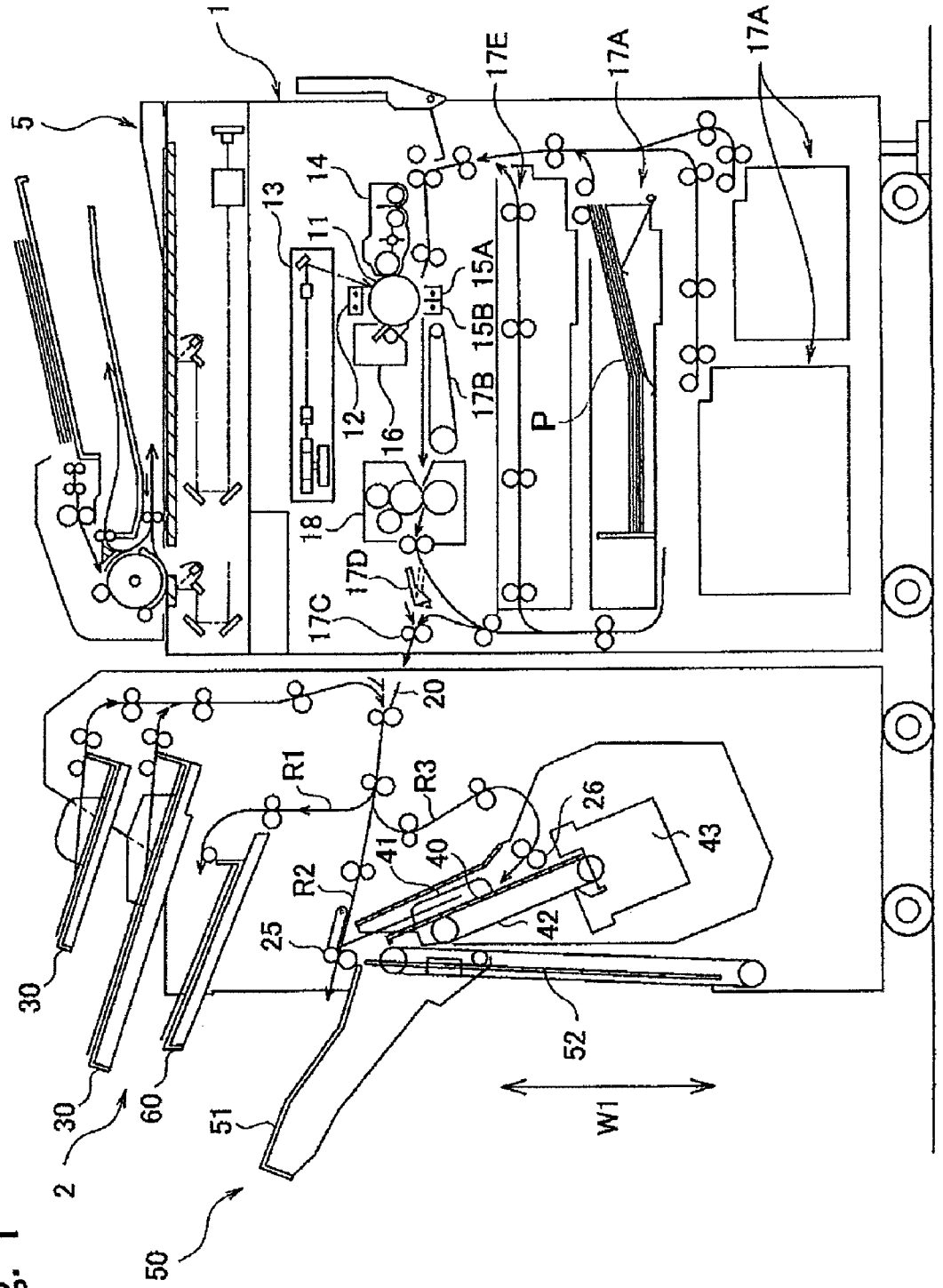

1
5
17E
17A
17A
13
14
11
15A
15B
17B
12
16
18
17D
17C
P
20
R1
R3
26
43
41
40
R2
25
42
52
30
30
60
51
2
50
W1

Fig. 1

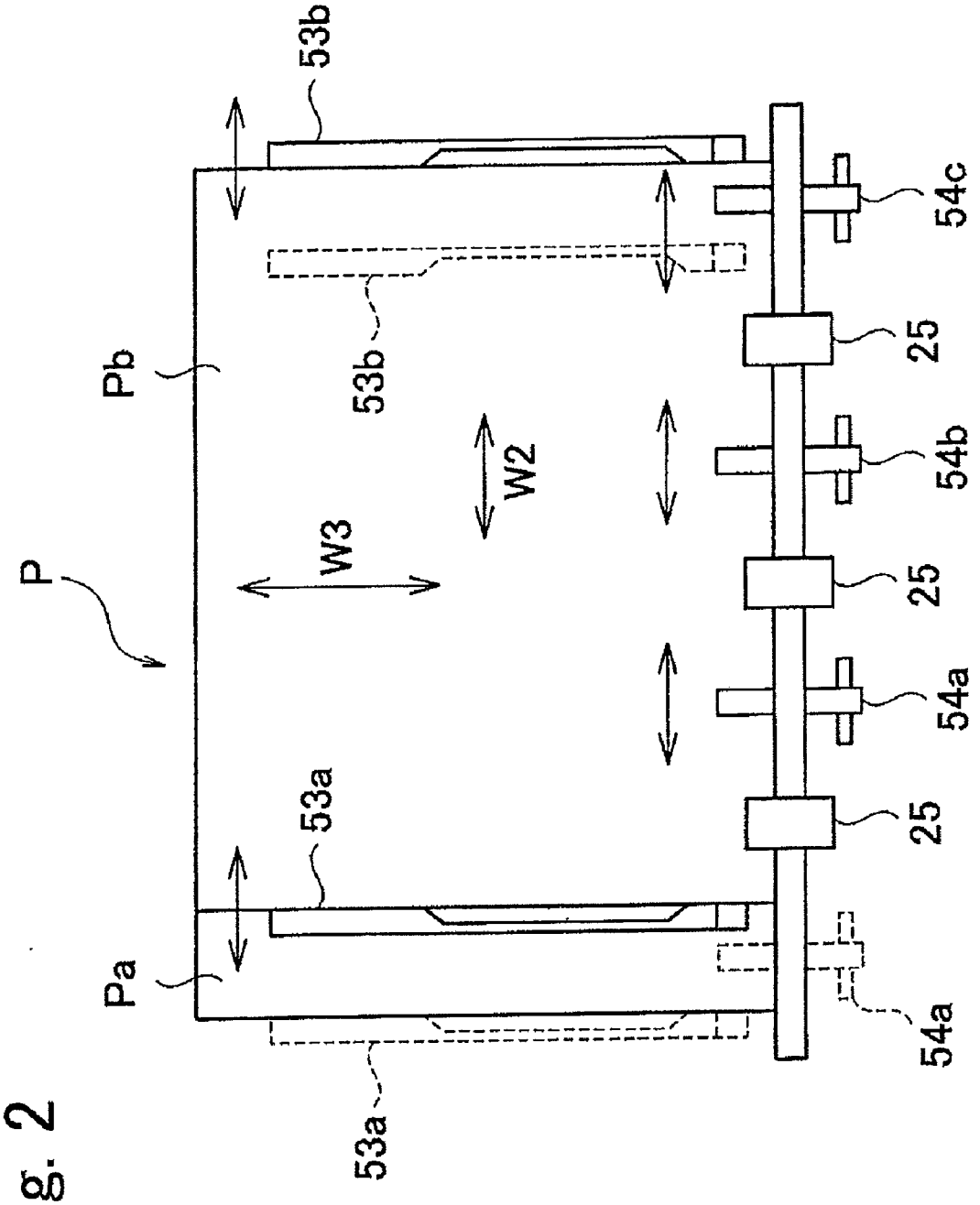


Fig. 2

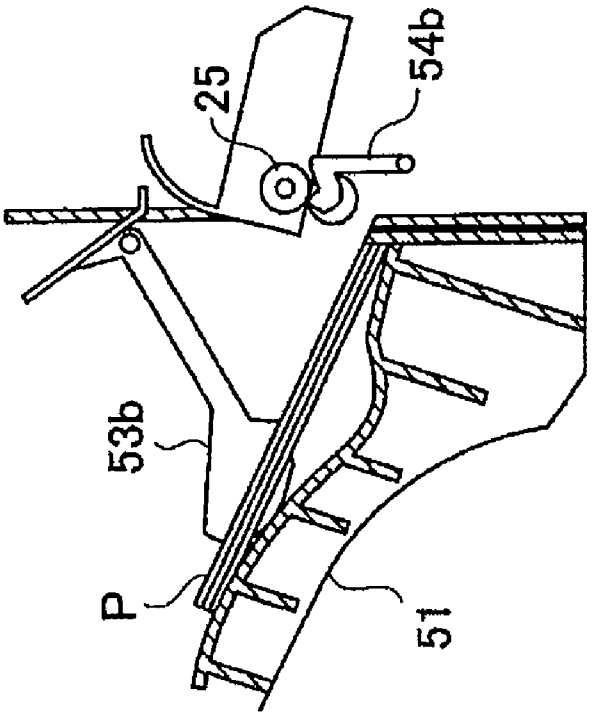


Fig. 3B

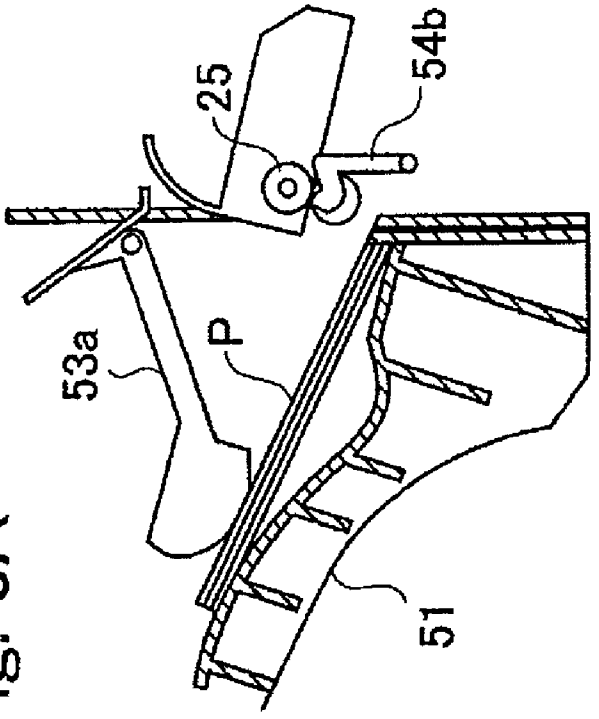


Fig. 3A

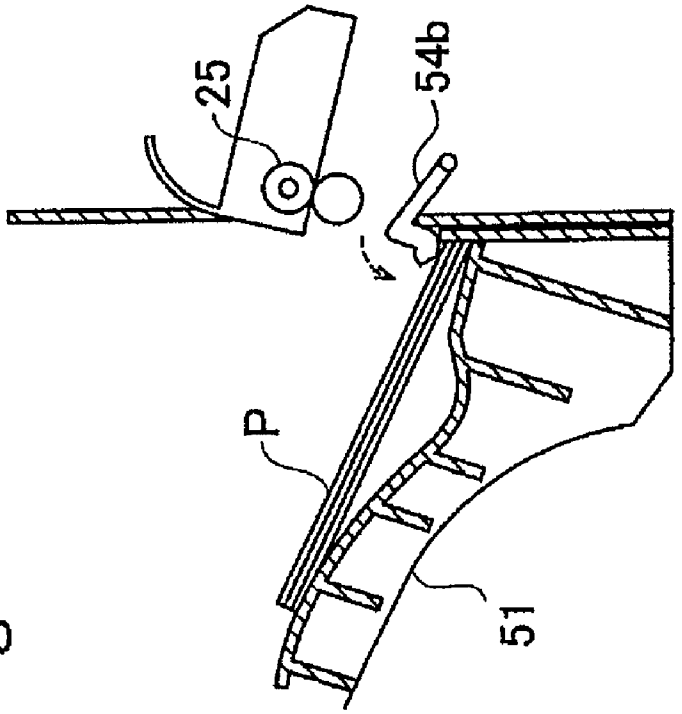


Fig. 4B

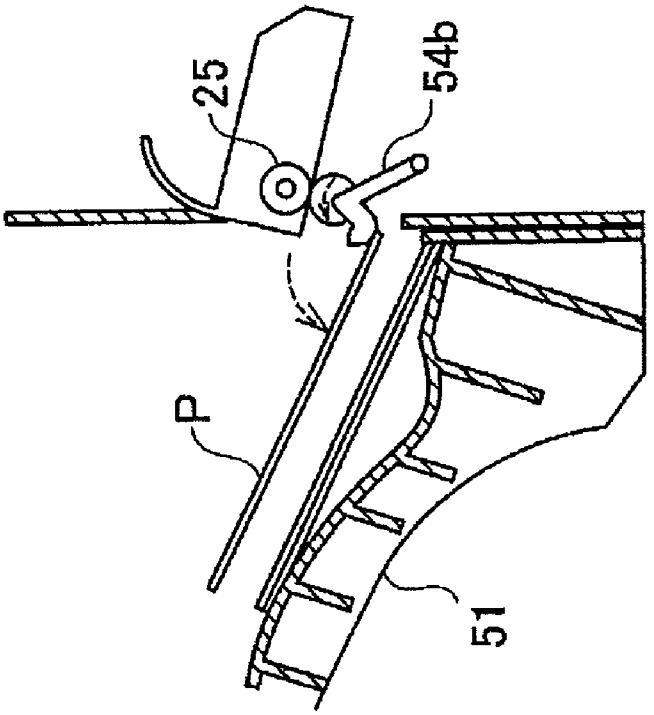


Fig. 4A

Fig. 5

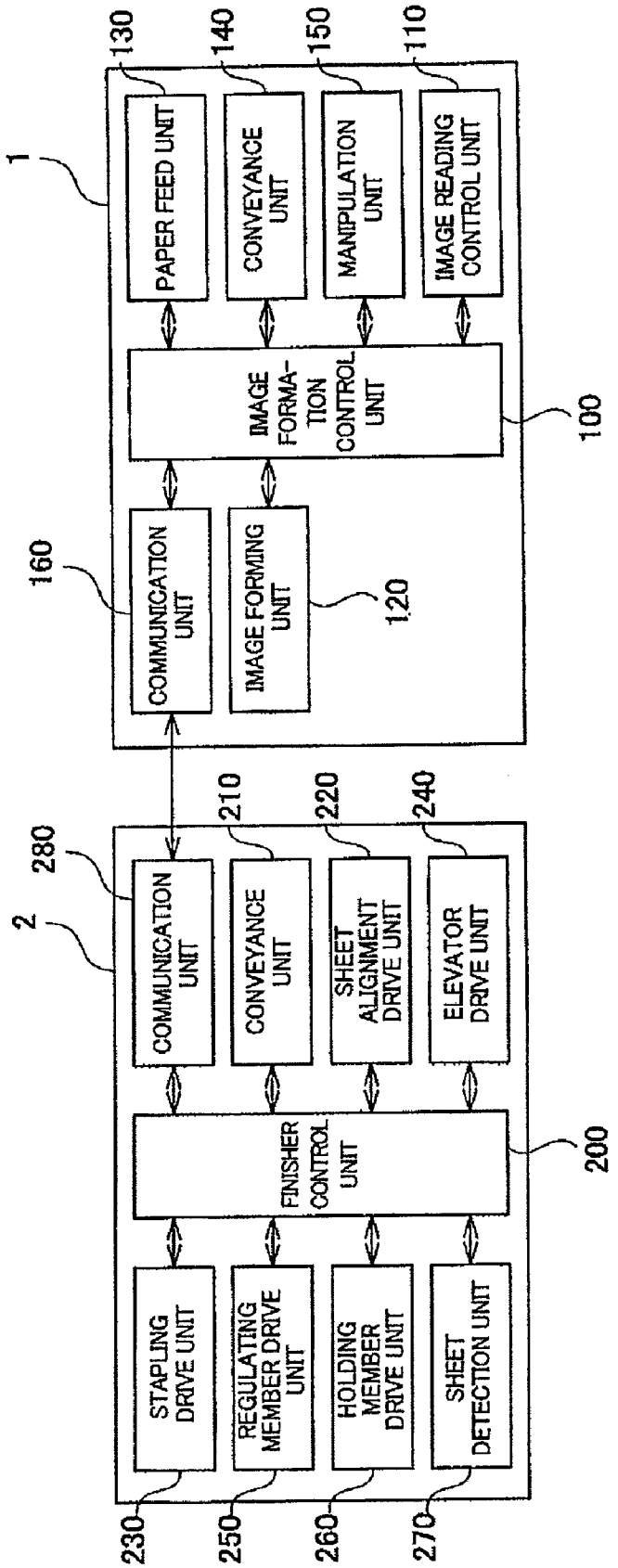

1
130
140
150
110
PAPER FEED UNIT
CONVEYANCE UNIT
MANIPULATION UNIT
IMAGE READING CONTROL UNIT
IMAGE FORMATION CONTROL UNIT
100
160
COMMUNICATION UNIT
IMAGE FORMING UNIT
120
2
280
210
220
240
COMMUNICATION UNIT
CONVEYANCE UNIT
SHEET ALIGNMENT DRIVE UNIT
ELEVATOR DRIVE UNIT
FINISHER CONTROL UNIT
200
STAPLING DRIVE UNIT
REGULATING MEMBER DRIVE UNIT
HOLDING MEMBER DRIVE UNIT
SHEET DETECTION UNIT
230
250
260
270

Fig. 6

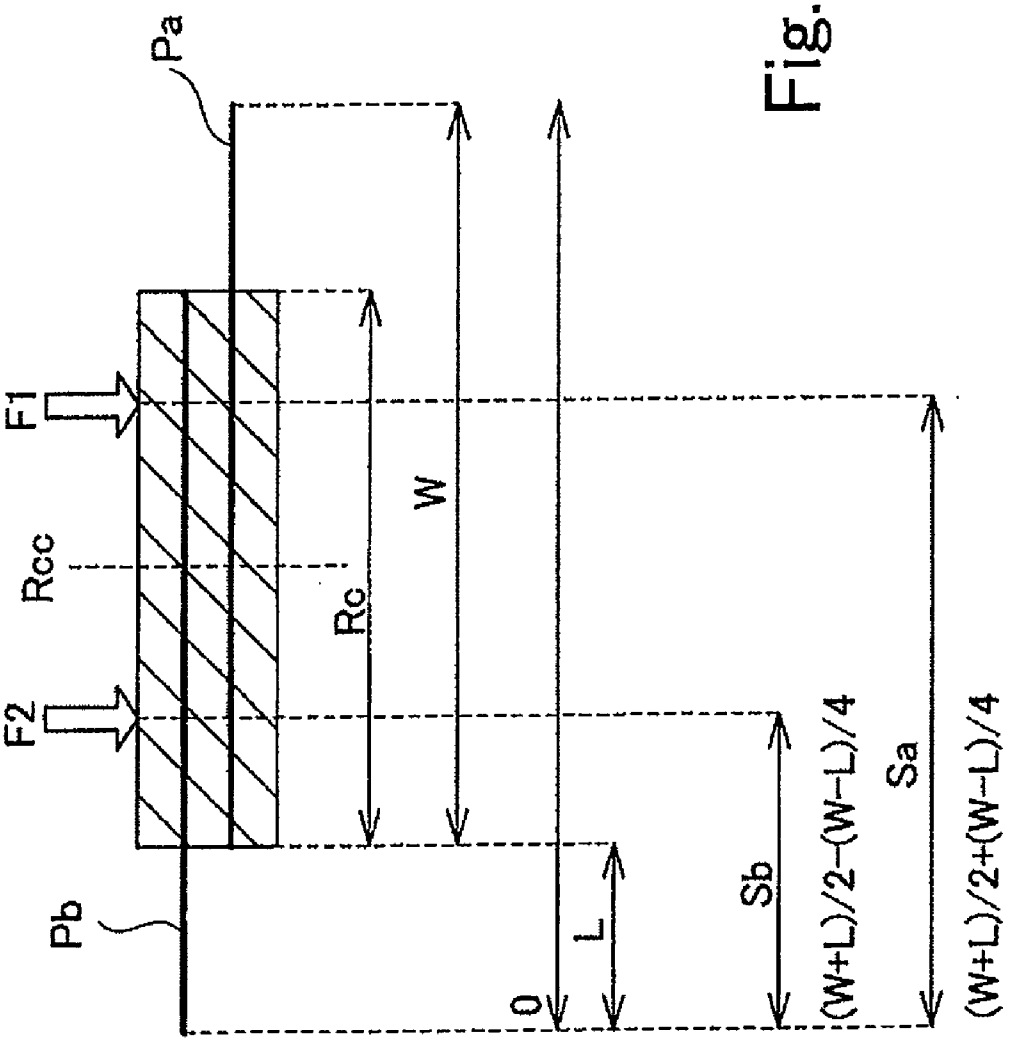


Fig. 7

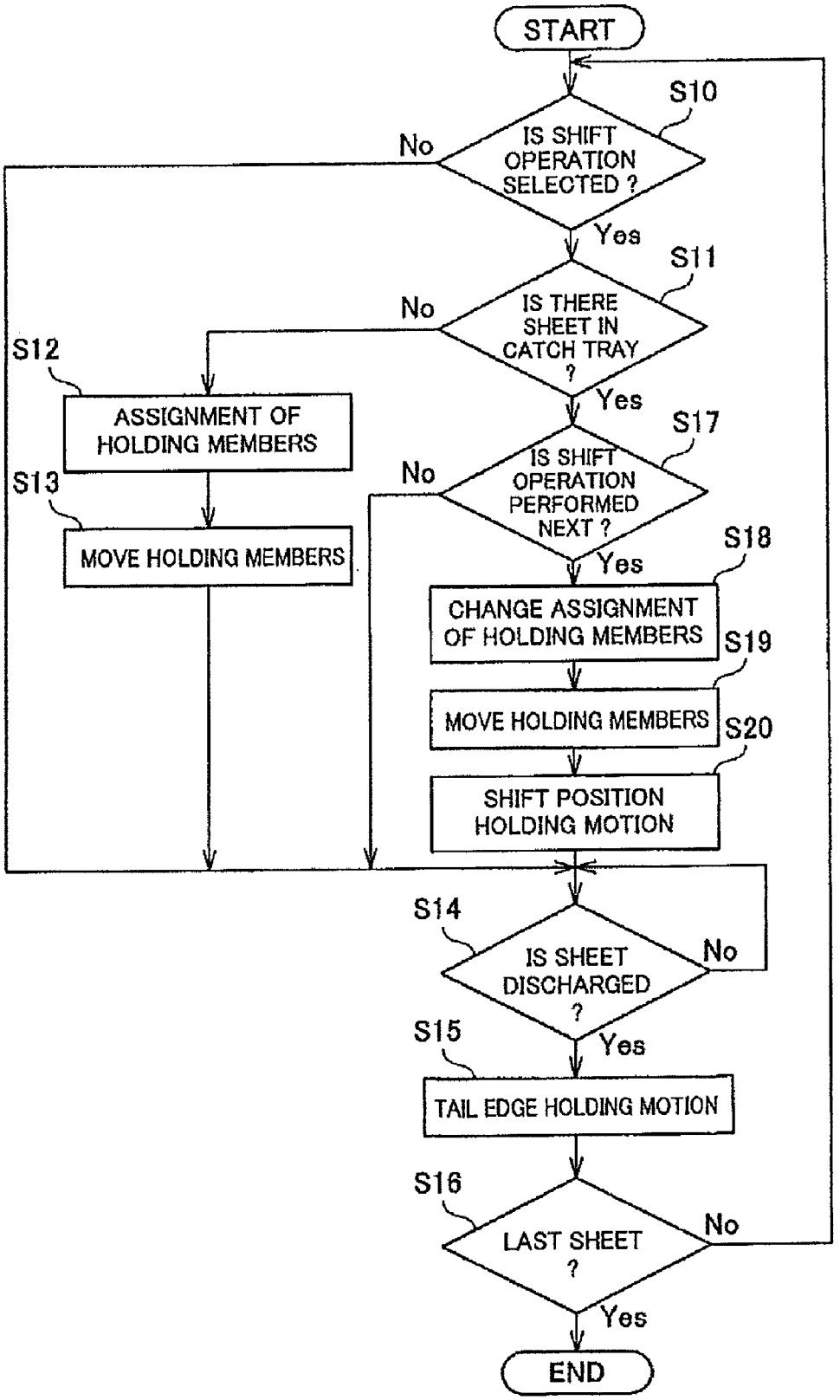

START
S10
IS SHIFT OPERATION SELECTED ?
No
Yes
S11
IS THERE SHEET IN CATCH TRAY ?
No
Yes
S12
ASSIGNMENT OF HOLDING MEMBERS
S13
MOVE HOLDING MEMBERS
S17
IS SHIFT OPERATION PERFORMED NEXT ?
No
Yes
S18
CHANGE ASSIGNMENT OF HOLDING MEMBERS
S19
MOVE HOLDING MEMBERS
S20
SHIFT POSITION HOLDING MOTION
S14
IS SHEET DISCHARGED ?
No
Yes
S15
TAIL EDGE HOLDING MOTION
S16
LAST SHEET ?
No
Yes
END

Fig. 8

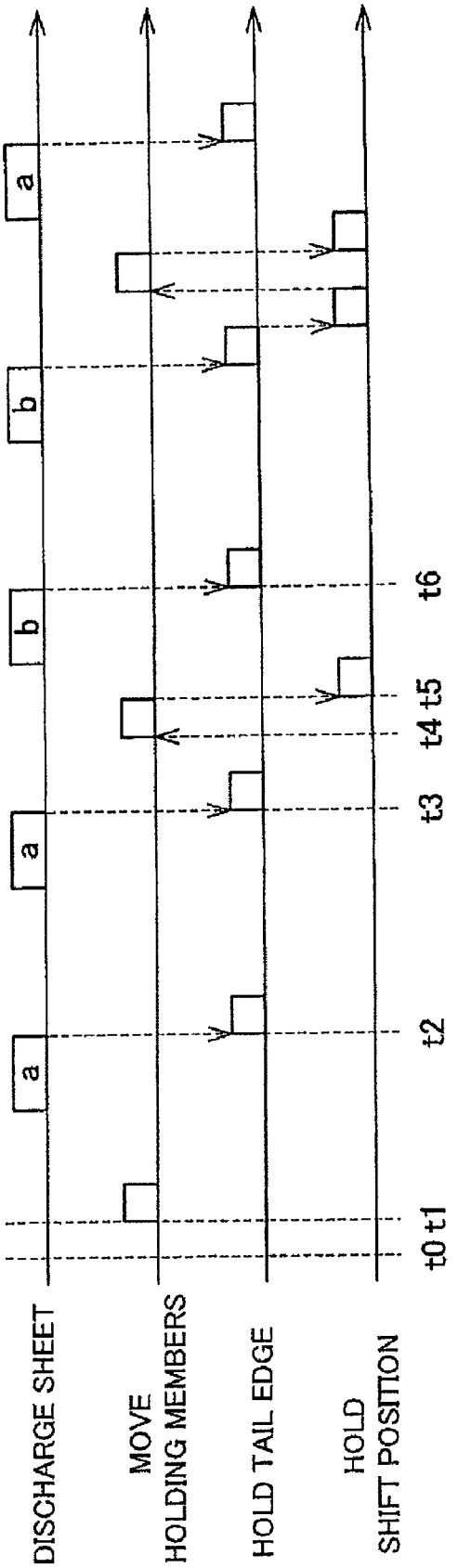

DISCHARGE SHEET
MOVE HOLDING MEMBERS
HOLD TAIL EDGE
HOLD SHIFT POSITION
a
b
t0 t1
t2
t3
t4 t5
t6

Fig. 9A

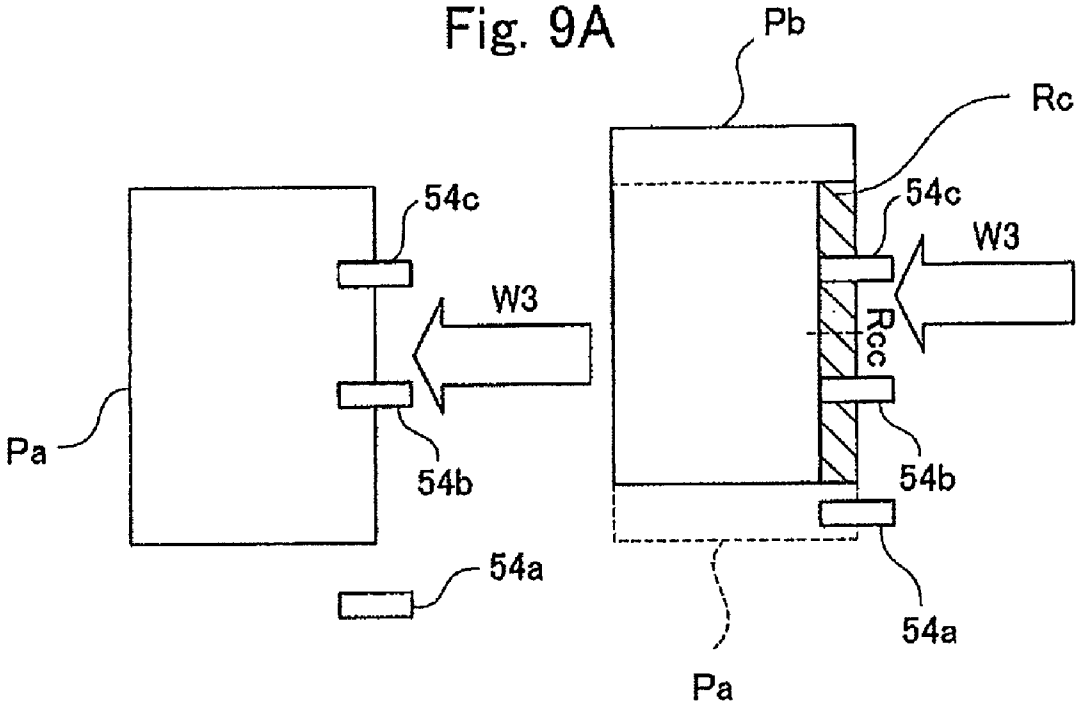

Pb
Rc
54c
54c
W3
W3
Rcc
Pa
54b
54b
54a
54a
Pa

Fig. 9B

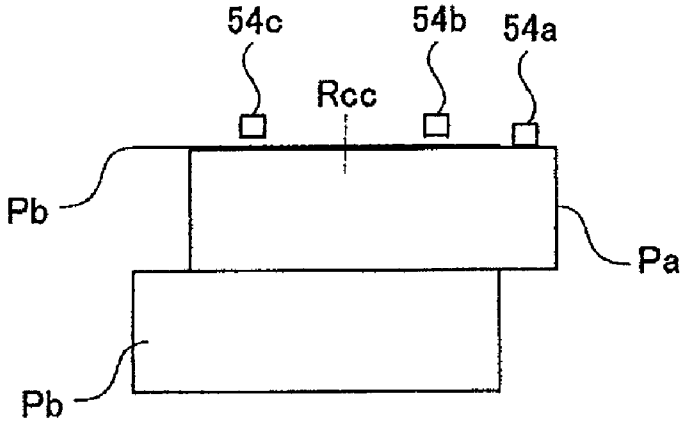

54c
54b
54a
Rcc
Pb
Pa
Pb

Fig. 10

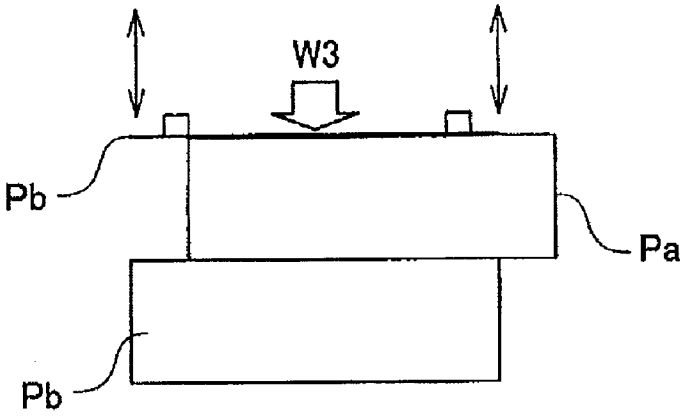


Fig. 11

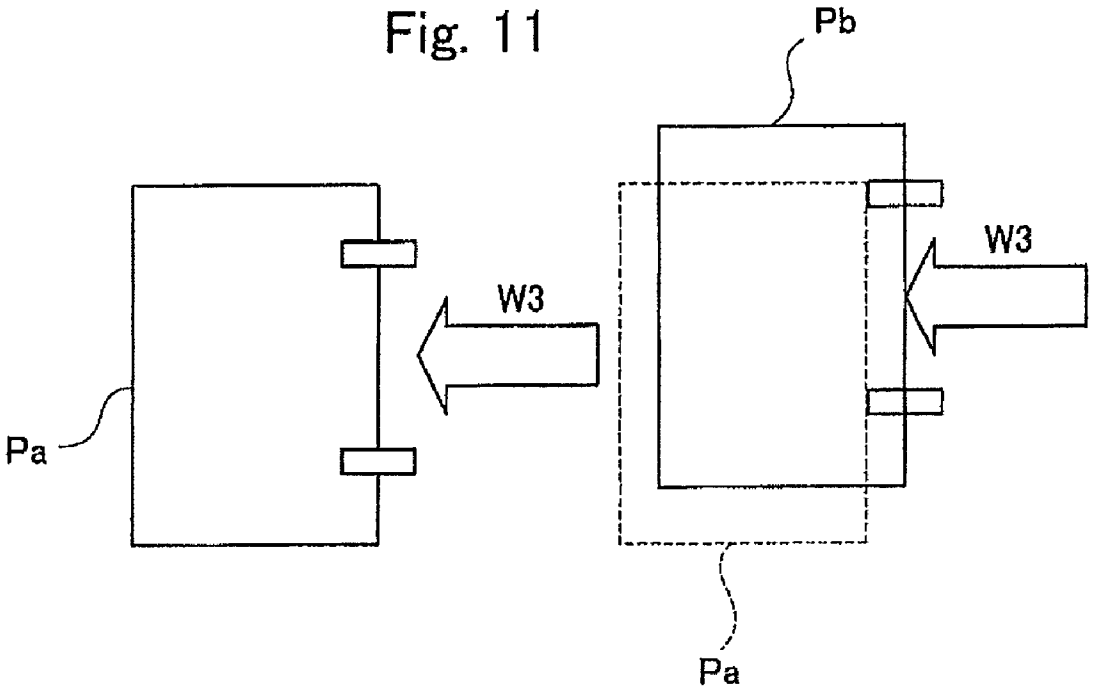


Fig. 12A

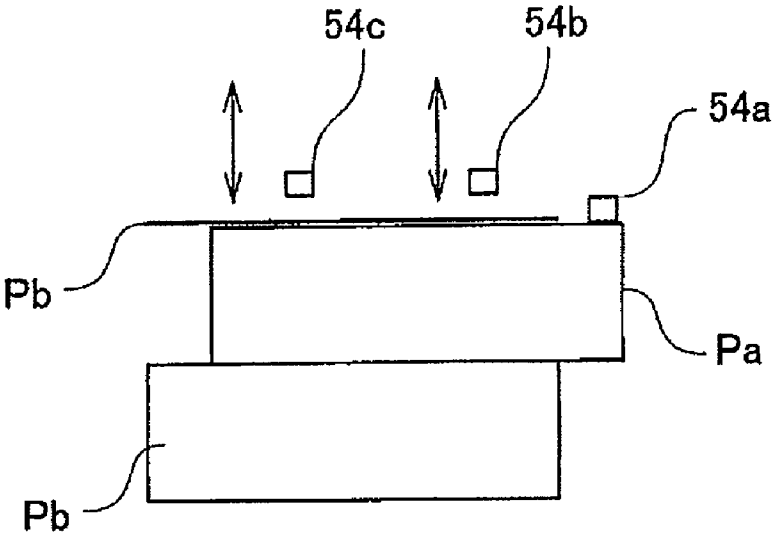
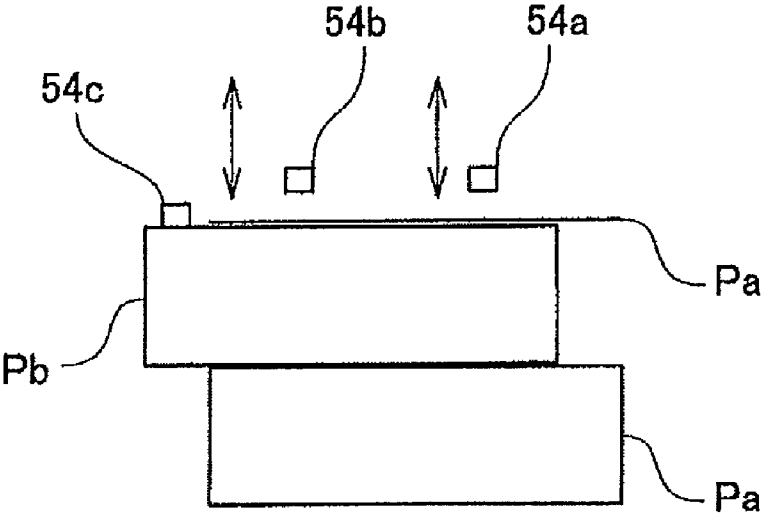


Fig. 12B



(b)

SHEET ATACKER AND FINISHER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. §119 to Japanese Patent Application No. P2011-136047, filed Jun. 20, 2011. The contents of this application are herein incorporated by reference in their entirety.

FIELD OF INVENTION

[0002] The present invention relates to a sheet stacker and a finisher, for example, provided as a printer accessory or the like.

DESCRIPTION OF RELATED ART

[0003] Conventionally, it is known that some image forming system includes a finisher for performing a variety of post-printing processes in addition to an image forming apparatus as an electrophotographic system. Also, this image forming system is provided with a sheet stacker in the final stage of the system (for example, in a finisher). The sheet stacker serves to stack sheets of paper which are output from a paper discharge unit. The sheet stacker is configured to move a catch tray up and down for stacking printed sheets in the stacking direction to make it possible to discharge a large amount of sheets. In addition to this, this sheet stacker is configured to sort printed sheets in different stacking positions by performing shift operations in a predetermined cycle. The shift operation is performed, for example, to move the sheet transporting position or the catch tray in the sheet width direction (the direction perpendicular to the sheet transportation direction) by a predetermined amount with a predetermined timing.

[0004] For example, Japanese Patent Application Laid-Open Publication No. 2009-23739 discloses a sheet stacker capable of performing the shift operation. According to this sheet stacker, each time a printed sheet is discharged, holding members are driven to hold the upper surface of the sheet downwards against a catch tray (or the previously uppermost sheet) near the tail end of the sheet as seen from the transportation direction of the sheet. This structure makes it possible to prevent a sheet from being displaced when the sheet falls on the catch tray, and thereby sheet alignment can be achieved to a desired level.

[0005] However, while the technique described in the publication is effective to inhibit sheet misalignment when a sheet falls on the catch tray, the shift operation is not taken into consideration.

SUMMARY OF THE INVENTION

[0006] To achieve at least one of the abovementioned objects, a sheet stacker reflecting one aspect of the present invention comprises a catch tray configured to stack a sheet discharged from a discharging unit; a holding unit including a first holding member and a second holding member which are arranged adjacent to each other in the sheet width direction that is perpendicular to the discharge direction of the sheet; a lateral motion drive unit configured to move said first holding member and said second holding member in the sheet width direction respectively; a holding drive unit configured to drive said first holding member and said second holding member to hold down the tail edge area of the sheet from the upper side of the sheet toward a sheet receiving surface; and a control unit configured to control said holding drive unit to perform a tail edge holding motion in synchronization with the discharge of the sheet, and control said lateral motion drive unit. Particularly, when the sheet is stacked by sorting between a first stacking position and a second stacking position which is offset from said first stacking position in the sheet width direction, said control unit determines a common area which is shared by said first stacking position and said second stacking position, and sets the positions of said first holding member and second holding member in order that said tail edge holding motion is performed in symmetric positions which are located within said common area and symmetrical about the center position of said common area.

[0007] Preferably, said holding unit comprises three holding members functioning as said first holding member, said second holding member and a third holding member which is arranged in said sheet width direction with said first holding member and said second holding member.

[0008] When said stacking position is switched, said control unit performs a shift position holding motion by holding the side edge area of an uppermost sheet stacked in the stacking position before switching with said third holding member, in the side opposite the shift direction of said stacking position.

[0009] Preferably, said control unit assigns, of said three holding members constituting said holding unit, a pair of adjacent holding members to said first holding member and said second holding member for performing said tail edge holding motion and the remaining holding member to said third holding member for performing said shift position holding motion.

[0010] Preferably, when said stacking position is switched, said control unit changes assignment of said three holding members constituting said holding unit in correspondence with the stacking position after switching.

[0011] Furthermore, said control unit sets the positions of said three holding members in accordance with said assignment thereof as changed and the stacking position after switching.

[0012] Preferably, said control unit sets a holding pressure, with which said shift position holding motion is performed by said holding members, to be smaller than a holding pressure with which said tail edge holding motion is performed by said holding members.

[0013] Preferably, the sheet stacker of claim **1** further comprises: a pair of regulating members configured to align a sheet discharged from said discharging unit in the sheet width direction; and a regulating member drive unit configured to move said regulating members in the sheet width direction respectively.

[0014] Particularly, said control unit controls said regulating member drive unit to set the positions of said pair of regulating members in correspondence with a stacking position of the sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** is an explanatory view for schematically showing the overall configuration of an image forming system in accordance with an embodiment of the present invention.

[0016] FIG. **2** is an explanatory view for schematically showing the configuration of a sheet stacker of the image forming system.

[0017] FIG. **3** is an explanatory view for showing the operation of regulating members of the image forming system.

[0018] FIG. **4** is an explanatory view for showing the operation of holding members of the image forming system.

[0019] FIG. **5** is a block diagram for schematically showing the control architecture of holding members of the image forming system.

[0020] FIG. **6** is a view for explaining a scheme to determine the common area and the positions of the holding members for holding a tail edge of a sheet.

[0021] FIG. **7** is a flow chart for showing the stacking operation of the image forming system.

[0022] FIG. **8** is a timing chart showing the stacking operation of the image forming system.

[0023] FIG. **9** is an explanatory view for showing the positions of a pair of holding members for holding a tail edge, and the position of a holding member for holding a shift position.

[0024] FIG. **10** is an explanatory view for showing the situation where the tail edge holding motion is performed in a position outside the common area Rc.

[0025] FIG. **11** is an explanatory view for showing the sheet stacking state in which the holding member for holding a shift position is not used.

[0026] FIG. **12** is an explanatory view for showing the positions of a pair of the holding members for holding a tail edge and the position of the holding member for holding a shift position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0027] FIG. **1** is an explanatory view for schematically showing the overall configuration of the image forming system in accordance with the present embodiment. This image forming system includes an image forming apparatus **1** and a finisher **2**.

[0028] The image forming apparatus **1** is, for example, a copying machine, a printer, a facsimile machine, a multifunctional peripheral, or the like which is provided with an electrophotographic image forming apparatus for forming images on sheets P on the basis of image data. The image forming apparatus **1** includes an original document reading unit **5**, a photoreceptor unit **11**, a charging unit **12**, an image exposure unit **13**, a developing unit **14**, a transfer unit **15**A, a separation unit **15**B, a cleaning unit **16**, a fixing unit **18** and an image formation control unit **100** (refer to FIG. **5**).

[0029] The original document reading unit **5** is located on the top of the housing of the image forming apparatus **1**, and provided with an automatic document feeder for automatically feeding original documents to this feeder when scanning images thereof. This original document reading unit **5** reads an image from an original document and outputs a predetermined image signal. The output image signal is A/D converted into image data.

[0030] The original document reading unit **5** is provided with an image reading control unit **110** (refer to FIG. **5**) which processes the image signals by performing shading compensation, dithering, data compression and so on, and outputs the processed image signals to the image formation control unit **100** as final image data. Incidentally, the image formation control unit **100** may receive image data not only from the image reading control unit **110**, but also from another image forming apparatus, a personal computer or the like connected to the image forming apparatus **1**.

[0031] The surface of the photoreceptor unit **11** is uniformly charged with electricity by the charging unit **12**. The image exposure unit **13** scans and exposes the surface of the photoreceptor unit **11** with laser beams on the basis of the image data in correspondence with the output information which is output from the image formation control unit **100**. This process forms latent images on the photoreceptor unit **11** uniformly charged with electricity. The developing unit **14** performs reversal development of the latent image with toner to form a toner image on the surface of the photoreceptor unit **11**.

[0032] The sheet P stored in one of paper trays **17**A is fed to the transfer unit **15**A. The transfer unit **15**A transfers the toner image on the surface of the photoreceptor unit **11** to the sheet P, and then the separation unit **15**B separates the sheet P from the photoreceptor unit **11** with the toner images transferred to the sheet P. The cleaning unit **16** removes toner remaining on the surface of the photoreceptor unit **11** after the transfer unit **15**A transfers the toner images to the sheet

[0033] The intermediate conveyance unit **17**B transports the separated sheet P to the fixing unit **18**. The fixing unit **18** performs a fixing process by heating and pressing the sheet P. The discharging unit **17**C discharges (supplies) the sheet P after the fixing process to the finisher **2**.

[0034] On the other hand, when images are formed on both sides of the sheet P, a transportation route switch plate **17**D is driven to switch the transportation route of the sheet P from the direction toward the discharging unit **17**C to the downward direction (toward the sheet reversing conveyance unit **17**E) after performing the fixing process of the sheet P by the fixing unit **18**. The sheet reversing conveyance unit **17**E transports the sheet P to the transfer unit **15**A after reversing the front and back sides of the sheet P by a switchback operation. The transfer unit **15**A transfers a toner image to the back side of the sheet P, which is then passed through the fixing unit **18** and supplied from the discharging unit **17**C to the finisher **2**.

[0035] The finisher **2** is located in the subsequent stage of the image forming apparatus **1**, and performs post-printing processes of the sheet P discharged from the image forming apparatus **1**. The finisher **2** of the present embodiment includes a post-printing unit for performing a post-printing process, for example, a staple process, i.e., the process of stapling a plurality of printed sheets P together. The finisher **2** is comprised mainly of a sheet receiving unit **20**, an intermediate stacker **40**, a staple unit **43**, a sheet stacker **50** and a finisher control unit **200** (refer to FIG. **5**).

[0036] The sheet receiving unit **20** is provided to receive and introduce the sheet P, which is output from the image forming apparatus **1**, into the finisher **2**. The position of this sheet receiving unit **20** is determined to be aligned with the discharging unit **17**C of the image forming apparatus **1**.

[0037] Next, the transportation route of the sheet P introduced from the sheet receiving unit **20** is explained. The transportation route in the downstream of the sheet receiving unit **20** branches into three routes, i.e., a first transportation route R**1**, a second transportation route R**2** and a third transportation route R**3**. The sheet P transported through the sheet receiving unit **20** is supplied to one of the transportation routes R**1** to R**3** in accordance with the position of a switch gate (not shown in the figure). When the sheet P is discharged to an outside tray without a stapling operation, the switch gate is set to the position to lead to the first transportation route R**1** or the second transportation route. On the other hand, when a stapling operation is performed, the switch gate is set to the

position to lead to the third transportation route R3. Incidentally, even when the sheet P is discharged to an outside tray without a stapling operation, if a shift operation to be described below is to be performed, the switch gate is set to the position to lead to the third transportation route R3.

[0038] The transportation routes R1 to R3 are made up of a number of conveyance rollers and guide members. The first transportation route R1 is a route for transporting the sheet P from the sheet receiving unit **20** to a subordinate catch tray **60**. This subordinate catch tray **60** is arranged outward in an upper location of the finisher **2**. The subordinate catch tray **60** has a small capacity, and therefore is used for discharging a small number of unusual sheets, for example, sheets of cardboard.

[0039] The second transportation route R2 is a route for transporting the sheet P from the sheet receiving unit **20** to a catch tray **51** of the sheet stacker **50**. The second transportation route R2 terminates in a first discharging roller **25** serving as a discharging unit. The first discharging roller **25** discharges the sheet P, which is transported along the second transportation route R2, to the catch tray **51**.

[0040] The third transportation route R3 is a route for transporting the sheet P from the sheet receiving unit **20** to the intermediate stacker **40**. The third transportation route R3 terminates in a second discharging roller **26** serving as a discharging unit. This second discharging roller **26** is located above the intermediate stacker **40** (specifically speaking, located in the upper side of sheets stacked on the intermediate stacker **40**), and driven to discharge the sheet P, which is transported along the second transportation route R3, to the intermediate stacker **40**. The sheet (or stack of sheets) on the intermediate stacker **40** is transported by a paper feed unit **42**, and thereafter discharged to the catch tray **51** by the discharging roller **25** which is part of the second transportation route R2.

[0041] Incidentally, the finisher **2** is also provided with a paper supplier unit **30** in order to enable the finisher **2** to receive sheets from a different route than the sheet P is discharged from the image forming apparatus **1**. This paper supplier unit **30** is comprised of a paper supply tray and a paper feeding mechanism. The sheet P stacked on the paper supply tray is taken by the paper feeding mechanism, and thereafter transported through a predetermined transportation route to the transportation route in the downstream side of the sheet receiving unit **20**.

[0042] The intermediate stacker **40** is responsible for successively accumulating the sheet P discharged from the second discharging roller **26** to supply the accumulate sheets to the staple unit **43** for performing an staple operation. Also, when a shift operation to be described below is to be performed, this intermediate stacker **40** is responsible for temporarily saving the sheet P to offset the transportation position of the sheet P in the sheet width direction (the direction perpendicular to the sheet transportation direction) corresponding to the stacking position of the sheet P.

[0043] The intermediate stacker **40** is obliquely arranged to in order that the sheet P stacked on this intermediate stacker **40** is oriented upward with its leading edge being located upper than its tail end. The sheet P discharged from the second discharging roller **26** falls on the intermediate stacker **40** or the uppermost sheet stacked thereon. The fallen sheet P slides down the inclined surface of the intermediate stacker **40** or the upper surface of the uppermost sheet, and stops when the tail end of the sheet P abuts a lower guide plate (not shown in the figure).

[0044] Around the intermediate stacker **40**, a sheet aligning member **41** is arranged together with the paper feed unit **42**. The sheet aligning member **41** aligns the position of the side edges of the sheet P successively accumulated on the intermediate stacker **40** (the edges of the sheet P oriented in parallel with the sheet transportation direction) for performing a staple operation.

[0045] The sheet aligning member **41** is made up of, for example, a pair of movable plates which move back and forward in the sheet width direction. The sheet aligning member **41** is driven each time the second discharging roller **26** discharges the sheet P, and aligning the side edges of the discharged sheet P with the side edges of the uppermost sheet P stacked on the intermediate stacker **40** by abutting the side edges of the discharged sheet P respectively.

[0046] Also, when a shift operation is to be performed, this sheet aligning member **41** is driven each time the second discharging roller **26** discharges the sheet **2**, and sets the transportation position of the sheet P in the sheet width direction. Specifically speaking, either one of the movable plates of the sheet aligning member **41** moves in the sheet width direction, and abut the side edge of the discharged sheet P for moving the sheet P. The transportation position of the sheet P is therefore moved in the sheet width direction. Then, when the sheet P is completely moved, the paper feed unit **42** transports this sheet P to the first conveyance roller **25**. When determining the transportation position of each sheet P, the motion amount and the motion direction in the sheet width direction are determined in accordance with the stacking position of the sheet P in the catch tray **51**.

[0047] The paper feed unit **42** transports the sheet P stacked on the intermediate stacker **40** (or a plurality of sheets P stapled together) from this intermediate stacker **40** to the first discharging roller **25**. The paper feed unit **42** is comprised of, for example, a pair of conveyer units located adjacent to each other in the sheet width direction. Each conveyer unit is comprised of a drive pulley, a driven pulley and a timing belt that is wound around these pulleys. The paper feed unit **42** transports the sheet P stacked on the intermediate stacker **40** to the first discharging roller **25** by driving the drive pulley to rotate the timing belt.

[0048] The staple unit **43** is comprised of a stapler which strikes staple legs through the sheets P and a clincher which bends the staple legs along the sheets P. This staple unit **43** performs a staple operation with a plurality of sheets P stacked on the intermediate stacker **40** in accordance with a predetermined position and a predetermined direction. For example, the staple unit **43** is used to perform side stitching by stapling the rear edges of a sheet stack.

[0049] The sheet stacker **50** is a device for stacking the sheet P discharged from the first discharging roller **25**, and includes the catch tray **51** and an elevator mechanism **52**. The catch tray **51** is used to successively stack the sheet P discharged from the first discharging roller **25**, and designed to move up and down along the sheet stacking direction W1 by the elevator mechanism **52**.

[0050] FIG. **2** is an explanatory view for schematically showing the configuration of the sheet stacker **50**. Particularly, this explanatory view schematically shows the sheet stacker **50** with the catch tray **51** as viewed from above. The sheet stacker **50** of the present embodiment is further pro-

vided with a pair of regulating members **53***a* and **53***b*, and a holding unit which includes three holding members **54***a*, **54***b* and **54***c* to perform a shift operation without misalignment. In this description, the shift operation is an operation of sorting and stacking the sheet P discharged from the first discharging roller **25** on a first stacking position or a second stacking position which is offset from the first stacking position in the sheet width direction W**2** by a predetermined amount (shift amount). In the present embodiment, the shift operation is implemented as the transportation of the sheet P through the intermediate stacker **40**. In other words, the sheet aligning member **41** enables the shift operation by determining in advance the transportation position of the sheet P in the sheet width direction according to the stacking position. Meanwhile, in this description, reference symbol "Pa" is used to specify the sheet P that is to be stacked in the first stacking position, and reference symbol "Pb" is used to specify the sheet P that is to be stacked in the second stacking position.

[0051] The pair of regulating members **53***a* and **53***b* are provided for aligning the sheet P discharged from the first discharging roller **25** in the sheet width direction W**2**. These regulating members **53***a* and **53***b* are arranged adjacent to each other in the sheet width direction W**2**. Also, each of the regulating members **53***a* and **53***b* is configured to move in the sheet width direction W**2**. It is thereby possible to adjust the distance between the pair of the regulating members **53***a* and **53***b* corresponding to the size of the sheet P in the sheet width direction W**2**, and adjust the positions of the regulating members **53***a* and **53***b* respectively corresponding to the stacking position of the sheet P.

[0052] Specifically speaking, when the sheet Pb is stacked in the second stacking position, one type of single-sided alignment is performed by fixing one regulating member **53***a* and moving the other regulating member **53***b* in the sheet width direction W**2** in order that the sheet Pb abuts the one regulating member **53***a*. Also, when the sheet Pa is stacked in the first stacking position, the other type of single-sided alignment is performed by fixing the other regulating member **53***b* and moving the one regulating member **53***a* in the sheet width direction W**2** in order that the sheet Pa abuts the other regulating member **53***b*.

[0053] Referring to FIG. **2** and FIGS. **3**A and **3**B, the single-sided alignment will be explained in a scenario that the first stacking position is switched to the second stacking position in which the sheet Pb is stacked. When stacking the sheet Pb in the second stacking position, the pair of regulating members **53***a* and **53***b* move from the positions as shown with broken lines in FIG. **2** to the positions as shown with solid lines corresponding to the second stacking position.

[0054] Then, while the regulating member **53***a* as one of the pair is placed on the surface of the sheet Pa (the uppermost sheet Pa in the first stacking position) on the catch tray **51** as shown in FIG. **3**A, the regulating member **53***b* as the other of the pair is located in the position to push the side edge of the sheet Pb in the sheet width direction as shown in FIG. **3**B. Incidentally, the pair of regulating members **53***a* and **53***b* are pivotally supported around a predetermined shaft, and their heads are held in predetermined lower limit positions by a stopper (not shown in the figure).

[0055] When the sheet Pb is discharged on the catch tray **51** as the first sheet to be stacked in the second stacking position, this sheet Pb is placed on the uppermost sheet Pa stacked in the first stacking position. Then, the other regulating member **53***b* moves back and forward in the sheet width direction W**2** to push the sheet Pb to abut the one regulating member **53***a*. This motion of the other regulating member **53***b* is performed each time the sheet P is discharged so that the single-sided alignment of the sheet Pb is performed during stacking the sheet Pb in the second stacking position.

[0056] Referring to FIG. **2** again, the three holding members **54***a* through **54***c* are arranged adjacent to each other in the sheet width direction W**2**. Each of the holding members **54***a* through **54***c* is constructed to move in the sheet width direction W**2**, and it is therefore possible to adjust the positions of the holding members **54***a* through **54***c* in accordance with the stacking position of the sheet P.

[0057] Specifically, of the three holding members **54***a* through **54***c*, the adjacent pair of the holding members **54***a* and **54***b* (or **54***b* and **54***c*) function as the holding members responsible for holding a tail edge as described below. The remaining holding member **54***c* (or **54***a*) functions as the holding member responsible for holding a shift position as described below. When the stacking position of the sheet P is switched, the functional assignment to the holding members **54***a* through **54***c* is switched in correspondence with the stacking position after switching.

[0058] As shown in FIGS. **4**A and **4**B, two of the holding members **54***a* to **54***c* assigned for holding a tail edge are driven to hold down the tail edge area of the sheet P from its upper side toward the sheet receiving surface (as a tail edge holding motion). In this description, the sheet receiving surface is the surface on which the discharged sheet P is placed. When no sheet has been placed on the catch tray **51**, the catch tray **51** serves to provide the sheet receiving surface. When there is one or more sheet on the catch tray **51**, the uppermost sheet P serves to provide the sheet receiving surface.

[0059] On the other hand, when switching the stacking position of the sheet P, one of the holding members **54***a* to **54***c* assigned for holding a shift position is driven to hold the side edge area of the uppermost sheet P, which is stacked in the stacking position before switching, in the side opposite the shift direction of the stacking position (as a shift position holding motion).

[0060] Referring to FIG. **2**, it is assumed that the first stacking position is switched to the second stacking position in which the sheet Pb is stacked. In this scenario, of the rightmost and leftmost holding members **54***a* and **54***c*, the holding member **54***a* which is located in the first stacking position side is used as the holding members for holding a shift position. Then, as shown with broken lines in FIG. **2**, this holding member **54***a* moves in the sheet width direction W**2** by a predetermined amount from the position as shown with solid lines in FIG. **2** to the position as shown with broken lines. The holding member **54***a* then holds the side edge area of the uppermost sheet Pa, which is stacked in the stacking position before switching, i.e., the offset area of the first and second stacking positions.

[0061] FIG. **5** is a block diagram for showing the control system of the image forming system in accordance with the present embodiment. The control system of this image forming system is comprised of an image formation control unit **100** and a finisher control unit **200**. These control units **100** and **200** are designed to communicate with each other.

[0062] The image formation control unit **100** is responsible for integrally controlling the entire image forming system by controlling the image forming apparatus **1** as well as the finisher control unit **200**. The image formation control unit

100 can be implemented with a microcomputer mainly including a CPU, a ROM, a RAM and an I/O interface.

[0063] The image formation control unit **100** acquires image data which is input from the image reading control unit **110** or the like. Also, the image formation control unit **100** controls these units of the image forming apparatus **1** on the basis of the input image data to form an image on the sheet P in correspondence with the input image data. Specifically speaking, the image formation control unit **100** controls an image forming unit **120**, a paper feed unit **130** for feeding the sheet P from any one of the paper trays **17**A, and a conveyance unit **140** respectively. In this case, the image forming unit **120** collectively represents the functional elements responsible for performing the image formation process, i.e., the photoreceptor unit **11**, the charging unit **12**, the image exposure unit **13**, the charging/developing device **14**, the transfer unit **15**A, the separation unit **15**B, the fixing unit **18** and so on.

[0064] The manipulation unit **150** outputs several parameters, which are selected by users, to the image formation control unit **100**. The manipulation unit **150** is implemented, for example, with a touch panel through which a user can perform input operations with reference to information displayed on a screen. Through the manipulation unit **150**, a user can enter printing conditions, for example, by selecting whether to perform a shift operation, setting or selecting the shift amount during the shift operation, selecting the type of the sheet P (for example, basis weight), selecting the density and reduce/enlarge ratio of images, setting whether to perform a post-printing process (staple operation), and so forth. Also, the image formation control unit **100** displays a variety of messages to the user through the manipulation unit **150** by controlling this manipulation unit **150**.

[0065] The communication unit **160** serves as an input/output unit for establishing communication with the finisher **2** which is connected to own image forming system. The image formation control unit **100** can therefore communicate with the finisher control unit **200** of the finisher **2** through the communication unit **160**.

[0066] The finisher control unit **200** is responsible for controlling the finisher **2**. The finisher control unit **200** can be implemented with a microcomputer mainly including a CPU, a ROM, a RAM and an I/O interface.

[0067] The finisher control unit **200** controls a conveyance unit **210** for transporting the sheet P, a sheet alignment drive unit **220** for driving the sheet aligning member **41**, a stapling drive unit **230** for driving the stapler and clincher of the staple unit **54**, and the like. Also, the finisher control unit **200** controls an elevator drive unit **240** for driving up and down the catch tray **51** which is part of the elevator mechanism **52**. The finisher control unit **200** thereby moves up and down the catch tray **51** in accordance with the stacking amount of the sheets P in order to maintain the height of the surface of the uppermost sheet P stacked on the catch tray **51**. Furthermore, the finisher control unit **200** controls a regulating member drive unit **250** to move the pair of regulating members **53***a* and **53***b* in the sheet width direction W**2**.

[0068] The finisher control unit **200** also controls a holding member drive unit **260** to perform the tail edge holding motion and the shift position holding motion. In addition to this, the finisher control unit **200** is capable of controlling this holding member drive unit **260** to move the three holding members **54***a* through **54***c* in the sheet width direction W**2** respectively. As described, the holding member drive unit **260** of the present embodiment serves as a holding drive unit for driving the holding members **54***a* to **54***c* respectively to perform the tail edge holding motion or the shift position holding motion, and as a lateral motion drive unit for moving the holding members **54***a* through **54***c* respectively in the sheet width direction.

[0069] In the case of the present embodiment, when the sheet P is sorted between the first stacking position and the second stacking position, the finisher control unit **200** determines the common area which is shared by the first stacking position and the second stacking position. The finisher control unit **200** then sets the positions of two of the holding members **54***a* to **54***c* for holding a tail edge in order that the tail edge holding motion is performed within the common area.

[0070] FIG. **6** is a view for explaining a scheme to determine the common area Rc and the positions of two of the holding members **54***a* to **54***c* for holding a tail edge. Specifically, the finisher control unit **200** determines the holding positions of two of the holding members **54***a* to **54***c* for holding a tail edge to positions F**1** and F**2** which are symmetrical about the center position Rcc of the common area Rc.

[0071] Particularly, in the present embodiment, the symmetrical positions F**1** and F**2** is determined to be center between the center position Rcc of the common area Rc and the edge positions of the common area Rc respectively. In this case, the symmetrical positions F**1** and F**2** are given by the following equations as distances Sa and Sb from the edges of the sheet P stacked on the second stacking position respectively.

$$Sa=((W+L)/2)+((W-L)/4) \quad \text{Equation 1}$$

$$Sb=((W+L)/2)-((W-L)/4) \quad \text{Equation 2}$$

[0072] In the above Equations, "W" is the extent of the sheet P in the sheet width direction W**2**, i.e., the width itself, and "L" is the amount of shift between the first stacking position and the second stacking position.

[0073] The finisher control unit **200** also receives a detection signal from a sheet detection unit **270**. This sheet detection unit **270** is located, for example, in the vicinity of the first discharging roller **25**, and capable of detecting the timing with which the sheet P is discharged from the first discharging roller **25**.

[0074] A communication unit **280** is provided for establishing communication with the image forming apparatus **1** which is connected to the finisher **2**. The finisher control unit **200** can thereby communication with the image formation control unit **100** of the image forming apparatus **1** through the communication unit **280**.

[0075] FIG. **7** is a flowchart for showing the stacking operation of the present embodiment. Also, FIG. **8** is a timing chart which shows an example of the shift operation for switching the stacking position each time two sheets are stacked. The process shown in this flowchart is performed by the finisher control unit **200** in response to a print start command given by a user as a trigger (timing t**0**).

[0076] Incidentally, in the flowchart shown in FIG. **7**, while focusing the description to the operations of the holding members **54***a* to **54***c*, other operations are omitted from the explanation. However, the finisher control unit **200** drives and moves a pair of the regulating members **53***a* and **53***b* in synchronization with the discharge of a sheet and switching of the stacking position, and moves the catch tray **51** downwards in accordance with the amount of the stacked sheets P.

[0077] First, in step **10**(S**10**), the finisher control unit **200** determines whether or not the shift operation is selected as a printing condition which is requested by a user. If the determination is affirmative in step **10**, i.e., if the shift operation is selected, the process proceeds to step **11**(S**11**). Contrary to this, if the determination is negative in step **10**, i.e., if the shift operation is not selected, the process proceeds to step **14**(S**14**).

[0078] In step **11**, the finisher control unit **200** determines whether or not there is a sheet P in the catch tray **51**. If the determination is affirmative in step **11**, i.e., if there is a sheet P in the catch tray **51**, the process proceeds to step **17**(S**17**). Contrary to this, if the determination is negative in step **11**, i.e., if there is no sheet P in the catch tray **51**, the process proceeds to step **12**(S**12**).

[0079] In step **12**, the finisher control unit **200** performs functional assignment of the holding members **54***a* to **54***c*. For example, when the first stacking position is used first as an initial setting, as shown in FIG. **2**, the finisher control unit **200** assigns the adjacent pair of the three holding members **54***a* through **54***c* arranged in the first stacking position side, i.e., the holding members **54***a* and **54***b* as the holding members responsible for holding a tail edge.

[0080] In step **13**(S**13**), the finisher control unit **200** determines the common area Rc which is shared by the first stacking position and the second stacking position on the basis of the size of the sheet P and the amount of shift. The finisher control unit **200** then moves the holding members **54***a* and **54***b* for holding a tail edge to the positions F**1** and F**2** as described above (timing t**1**: refer to FIG. **8**).

[0081] In step **14**(S**14**), the finisher control unit **200** determines whether or not the sheet P is discharged from the first discharging roller **25**. If the determination is affirmative in step **14**, i.e., if the sheet P is discharged from the first discharging roller **25**, the process proceeds to step **15**(S**15**). Contrary to this, if the determination is negative in step **14**, i.e., if the sheet P is not discharged from the first discharging roller **25**, the operation in step **14** is repeated.

[0082] In step **15**, the finisher control unit **200** performs the tail edge holding motion with the sheet P discharged from the first discharging roller **25** (timing t**2**). The sheet P discharged from the first discharging roller **25** is thereby held down against the sheet receiving surface by two of the holding members **54***a* to **54***c* for holding a tail edge, after falling to the sheet receiving surface.

[0083] In step **16**(S**16**), the finisher control unit **200** determines whether or not the sheet P just discharged is the last sheet of the print job. If the determination is affirmative in step **16**, i.e., if the sheet P just discharged is the last sheet, the process ends. Contrary to this, if the determination is negative in step **16**, i.e., if the sheet P just discharged is not the last sheet, the process is returned to step **10**.

[0084] On the other hand, if there is a sheet P in the catch tray **51** in step **11** as described above, the finisher control unit **200** determines in step **17** whether to performs the shift operation, i.e., whether or not the sheet P to be discharged next is stacked in the stacking position to which the current stacking position is switched. If the determination is affirmative in step **17**, i.e., if the shift operation is performed next, the process proceeds to step **18**(S**18**). Contrary to this, if the determination is negative in step **17**, i.e., if the shift operation is not performed next, the process proceeds to step **14** in which the tail edge holding motion is performed (for example, timing t**3**) on the condition that the sheet P is discharged from the first discharging roller **25**.

[0085] In step **18**, the finisher control unit **200** changes the functional assignment of the holding members **54***a* to **54***c*. For example, when the first stacking position is switched to the second stacking position, as shown in FIG. **2**, the finisher control unit **200** assigns the adjacent pair of the three holding members **54***a* through **54***c* arranged in the second stacking position side, i.e., the holding members **54***b* and **54***c* as the holding members responsible for holding a tail edge. The finisher control unit **200** also assigns the remaining one of the three holding members **54***a* through **54***c*, i.e., the holding member **54***a* arranged in the first stacking position side, which was selected before switching, as the holding member responsible for holding a shift position.

[0086] In step **19**(S**19**), the finisher control unit **200** moves the three holding members **54***a* through **54***c*, and adjusts the positions of these holding members **54***a* through **54***c* in accordance with the assignment change (timing t**4**).

[0087] In step **20**(S**20**), the finisher control unit **200** performs the shift position holding motion (timing t**5**) against the sheet P which is located in the uppermost position in the stacking position before switching, i.e., the sheet P which is currently located in the uppermost position. The sheet P stacked on the uppermost surface is therefore held down in the edge area by the holding member **54***a* (or **54***c*) for holding a shift position in the sheet stacking direction W**1**.

[0088] The process then proceeds to step **14** in which the tail edge holding motion is performed (for example, timing t**6**) on the condition that the sheet P is discharged from the first discharging roller **25**. The above process is repeatedly performed until the last sheet is processed.

[0089] In accordance with the present embodiment as described above, when the sheet P is stacked after sorting between the first stacking position and the second stacking position, the finisher control unit **200** determines the common area Rc which is shared by the first stacking position and the second stacking position. The finisher control unit **200** then sets the positions of the pair of holding members (**54***b* and **54***c*) for holding a tail edge, as shown in FIGS. **9**A and **9**B in order to perform the tail edge holding motion in the positions F**1** and F**2** respectively which are located within the common area Rc and symmetrical about the center position Rcc of the common area Rc.

[0090] FIG. **10** is an explanatory view for showing the situation where the tail edge holding motion is performed in a position outside the common area Rc. When the stacking position is switched by the shift operation, as shown in the same figure, even if a pair of the holding members is located on the uppermost sheet Pb, there is the possibility that one of the holding members holds in a position outside the stacking position before switching. In this case, there is concern that one of the holding members may displace the uppermost sheet Pb, and/or fold the sheet Pb to impair the sheet alignment.

[0091] On the other hand, the other holding member is located in the common area, and thereby the tail edge holding motion can be performed within the common area. However, in this case, the sheet P is held down only in a single position, and thereby when some external force is exerted on the sheet P by one holding member or some other cause, the sheet P may be rotated around the single position so that it is difficult to effectively inhibit the sheet misalignment.

[0092] On the other hand, from the view point of improving the productivity, the shorter the discharging interval of the sheet P, the faster it is required to perform the tail edge holding motion. In this case, two of the holding members **54***a* to **54***c* for holding a tail edge are driven by a high power, and thereby the tail edge area of the sheet P is held down by a relatively large force. Because of this, unless the sheet P is held down in an appropriate manner, some displacement of the sheet P may occur by the relatively large force of the holding members **54***a* to **54***c*.

[0093] In this regard, however, the pair of holding members for holding a tail edge according to the present embodiment are set in the positions located within the common area Rc and symmetrical about the center position Rcc of the common area Rc, so that the above shortcomings can be resolved. Namely, any holding member does not hold outside the stacking position before switching, and thereby it is possible to avoid the undesired situation that the sheet alignment level is lowered by displacing or folding of the uppermost sheet. Furthermore, the tail edge area of the sheet P is held down to keep a proper balance at two points, and thereby it is possible to effectively inhibit sheet misalignment.

[0094] Particularly, in accordance with the present embodiment, the symmetric positions F**1** and F**2** are determined at the middle positions between the center position Rcc of the common area Rc and the edge positions of the common area Rc respectively, and thereby it is possible to hold down the tail edge area of the sheet P with a proper balance. This effectively inhibits the sheet P from being displaced.

[0095] In addition to this, when switching the stacking position, the finisher control unit **200** of the present embodiment drives one of the holding members **54***a* to **54***c* assigned for holding a shift position to hold the edge area of the uppermost sheet P, which is stacked in the stacking position before switching, in the side opposite the shift direction of the stacking position (as the shift position holding motion).

[0096] FIG. **11** is an explanatory view for showing the sheet stacking state in which the holding member for holding a shift position is not used. As shown in the same figure, when switching the stacking position, the sheet Pa stacked in the stacking position before switching may be displaced by the sheet Pb discharged in the stacking position after switching. However, in accordance with the present embodiment, such displacement of the sheet P can be avoided in advance by performing the shift position holding motion.

[0097] Also, the finisher control unit **200** of the present embodiment assigns the holding members **54***a* and **54***b* (or **54***b* and **54***c*), which is an adjacent pair of the three holding members **54***a* through **54***c*, to the holding member for holding a tail edge, and assigns the remaining holding member **54***c* (or **54***a*) to the holding member for holding a shift position. Then, when switching the stacking position of the sheet P, the finisher control unit **200** changes the functional assignment of the three holding members **54***a* to **54***c* in correspondence with the stacking position after switching, and sets the positions of the holding members **54***a* to **54***c* in correspondence with the assignment change of the three holding members **54***a* to **54***c* and the stacking position after switching respectively.

[0098] This scheme dynamically changes assignment of the functions, i.e., the function to hold a tail edge and the function to hold a shift position, to the holding members **54***a* to **54***c* respectively in accordance with the stacking position, as shown in FIG. **12**, rather than statically assigns the functions to all the holding members **54***a* to **54***c* respectively. By this scheme, even if there are a small number of the holding members **54***a* to **54***c*, the above holding operations can be effectively performed without compromising functional performance thereof, and thereby preventing the configuration of the system from being complicated and growing in size.

[0099] Furthermore, the finisher control unit **200** of the present embodiment sets the positions of the pair of regulating members **53***a* and **53***b* in correspondence with the stacking position of the sheet P.

[0100] The alignment of the sheets P in the stacking positions can be improved by providing the regulating members **53***a* and **53***b* controlled as has been discussed above. Particularly, the more the number of sheets stacked in the same stacking position, the more reliably the regulating members **53***a* and **53***b* are engaged with the discharged sheet P to attain a high alignment level. However, even with these regulating members **53***a* and **53***b*, since either of the regulating members **53***a* and **53***b* is in contact with or close to the sheet P stacked in the stacking position before switching, just after switching the stacking position, there may be a clearance between the sheet P stacked in the stacking position before switching and the regulating members **53***a* and **53***b* so that displacement of the sheet P may occur.

[0101] In this regard, according to the present embodiment, the above shortcomings can be appropriately inhibited by concurrently performing the tail edge holding motion. On the other hand, while the regulating members **53***a* and **53***b* move in synchronization with switching of the stacking position and thereby is not effective to control the sheet P before switching, the shift position holding motion is concurrently performed to inhibit sheet misalignment in a more effective manner.

[0102] Meanwhile, in accordance with the present embodiment, the finisher control unit **200** may set a holding pressure, with which the shift position holding motion is performed by the holding members **54***a* to **54***c*, to be smaller than the holding pressure with which the tail edge holding motion is performed by the holding members **54***a* to **54***c*.

[0103] This scheme makes it possible to gently hold down the sheet P, and thereby inhibit the shortcomings that, when the shift position holding motion is performed, the sheet P is displaced by this operation of holding down the sheet P with the holding members **54***a* to **54***c*.

[0104] Meanwhile, in the case of the embodiment as described above, the shift operation is performed by offsetting the transportation position of the sheet P. However, the present invention is not limited to this. For example, the catch tray may be moved in the sheet width direction in synchronization with switching of the stacking position. Alternatively, in synchronization with switching of the stacking position, the sheet P may be moved in the sheet width direction by the pair of the regulating members **53***a* and **53***b*.

[0105] The foregoing description has been presented on the basis of the embodiments. However, it is not intended to limit the present invention to the precise form described, and obviously many modifications and variations are possible within the scope of the invention. While the sheet stacker is controlled by the control unit of the finisher in accordance with the embodiment as described above, the sheet stacker itself may be provided with own control unit, or may be controlled by the control unit of the image forming apparatus. Furthermore, while the sheet stacker is implemented in the finisher in

accordance with the embodiment as described above, it is possible to implement the sheet stacker in the image forming apparatus or the like.

1. A sheet stacker comprising:

a catch tray configured to stack a sheet discharged from a discharging unit;

a holding unit including a first holding member and a second holding member which are arranged adjacent to each other in the sheet width direction that is perpendicular to the discharge direction of the sheet;

a lateral motion drive unit configured to move said first holding member and said second holding member in the sheet width direction respectively;

a holding drive unit configured to drive said first holding member and said second holding member to hold down the tail edge area of the sheet from the upper side of the sheet toward a sheet receiving surface; and

a control unit configured to control said holding drive unit to perform a tail edge holding motion in synchronization with the discharge of the sheet, and control said lateral motion drive unit,

wherein, when the sheet is stacked by sorting between a first stacking position and a second stacking position which is offset from said first stacking position in the sheet width direction, said control unit determines a common area which is shared by said first stacking position and said second stacking position, and sets the positions of said first holding member and second holding member in order that said tail edge holding motion is performed in symmetric positions which are located within said common area and symmetrical about the center position of said common area.

2. The sheet stacker of claim **1**

wherein said holding unit comprises three holding members functioning as said first holding member, said second holding member and a third holding member which is arranged in said sheet width direction with said first holding member and said second holding member, and

wherein, when said stacking position is switched, said control unit performs a shift position holding motion by holding the side edge area of an uppermost sheet stacked in the stacking position before switching with said third holding member, in the side opposite the shift direction of said stacking position.

3. The sheet stacker of claim **2**

wherein said control unit assigns, of said three holding members constituting said holding unit, a pair of adjacent holding members to said first holding member and said second holding member for performing said tail edge holding motion and the remaining holding member to said third holding member for performing said shift position holding motion.

4. The sheet stacker of claim **3**

wherein, when said stacking position is switched, said control unit changes assignment of said three holding members constituting said holding unit in correspondence with the stacking position after switching, and

wherein said control unit sets the positions of said three holding members in accordance with said assignment thereof as changed and the stacking position after switching.

5. The sheet stacker of claim **2**

wherein said control unit sets a holding pressure, with which said shift position holding motion is performed by said holding members, to be smaller than a holding pressure with which said tail edge holding motion is performed by said holding members.

6. The sheet stacker of claim **1** further comprising:

a pair of regulating members configured to align a sheet discharged from said discharging unit in the sheet width direction; and

a regulating member drive unit configured to move said regulating members in the sheet width direction respectively,

wherein said control unit controls said regulating member drive unit to set the positions of said pair of regulating members in correspondence with a stacking position of the sheet.

7. A finisher comprising:

a sheet stacker;

a sheet receiving unit configured to receive a sheet on which an image is formed from an image forming apparatus;

a post-printing unit configured to perform a predetermined post-printing process with the sheet received through said sheet receiving unit; and

a discharging unit configured to discharge the sheet from said post-printing unit or from said sheet receiving unit to said sheet stacker,

wherein said sheet stacker comprises:

a catch tray configured to receive the sheet discharged from said discharging unit for stacking the sheet thereon;

a holding unit including a first holding member and a second holding member which are arranged adjacent to each other in the sheet width direction that is perpendicular to the discharge direction of the sheet;

a lateral motion drive unit configured to move said first holding member and said second holding member in the sheet width direction respectively;

a holding drive unit configured to drive said first holding member and said second holding member to hold down the tail edge area of the sheet from the upper side of the sheet toward a sheet receiving surface; and

a control unit configured to control said holding drive unit to perform a tail edge holding motion in synchronization with the discharge of the sheet, and control said lateral motion drive unit,

wherein, when the sheet is stacked by sorting between a first stacking position and a second stacking position which is offset from said first stacking position in the sheet width direction, said control unit determines a common area which is shared by said first stacking position and said second stacking position, and sets the positions of said first holding member and second holding member in order that said tail edge holding motion is performed in symmetric positions which are located within said common area and symmetrical about the center position of said common area.

* * * * *