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(54) **SHEET POST-PROCESSING APPARATUS**

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(57) **ABSTRACT**

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A sheet post-processing apparatus is provided with a first paper discharge tray that is formed to be able to move up and down and to stack thereon a sheet of paper discharged by way of a processing tray after post-processing, and a second paper discharge tray that is formed to be able to move up and down and to stack thereon the sheet of paper discharged by way of the processing tray after the post-processing, and is disposed at a lower stage of the first paper discharge tray and able to stack sheets of paper of a size larger than sheets of paper stacked on the first paper discharge tray.

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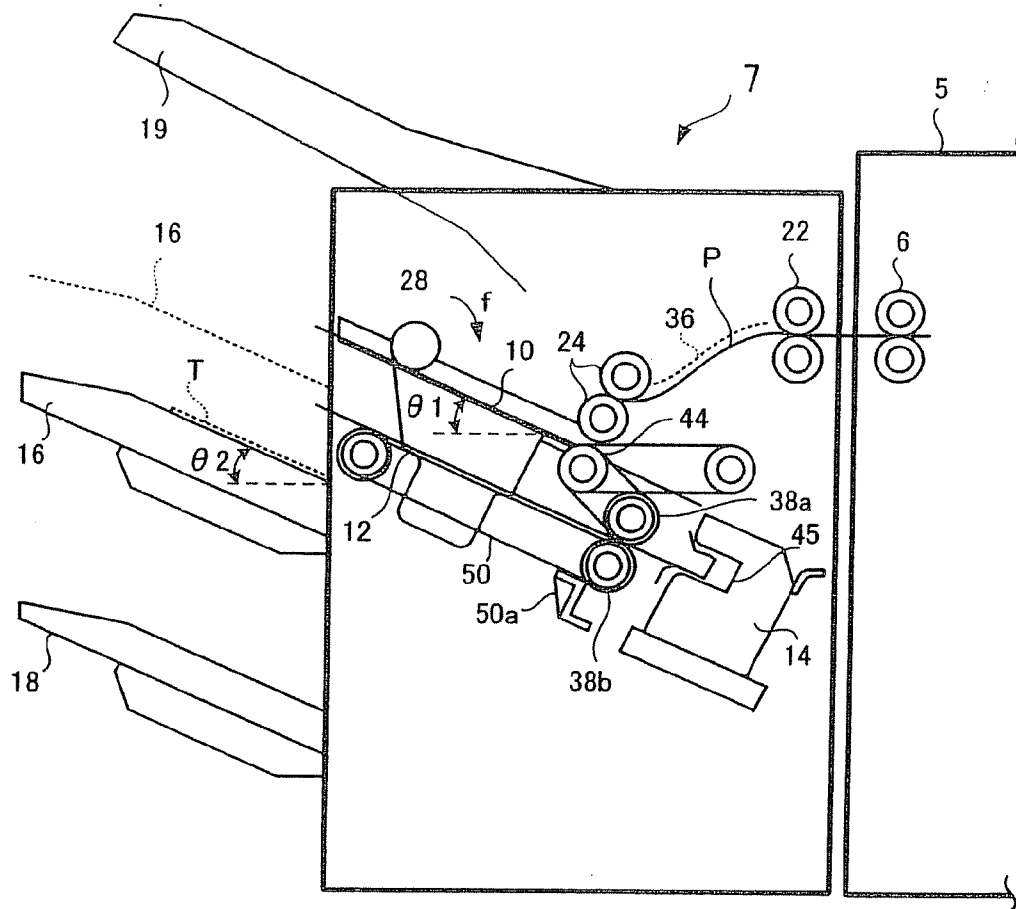


FIG. 1

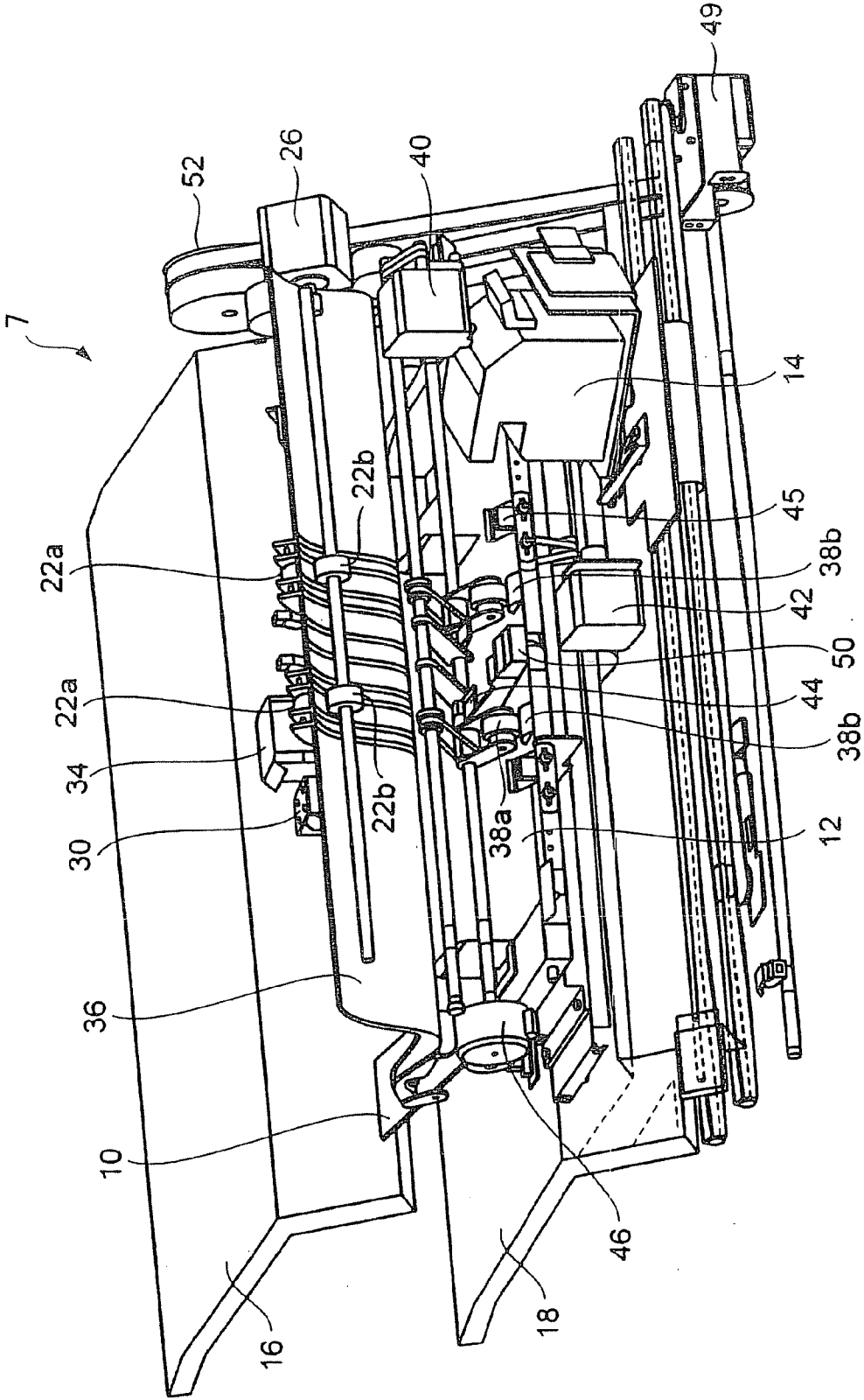


FIG. 2

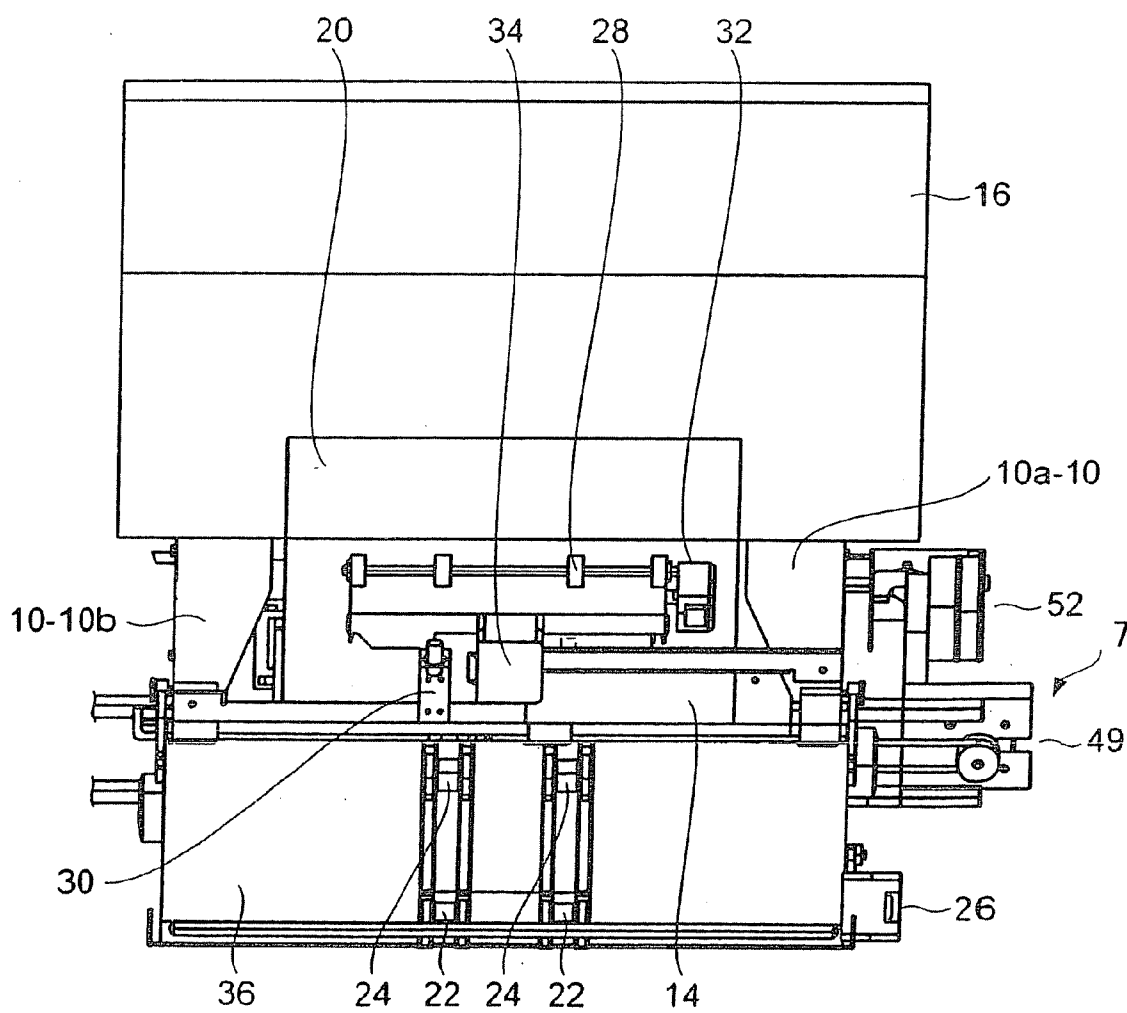


FIG. 3

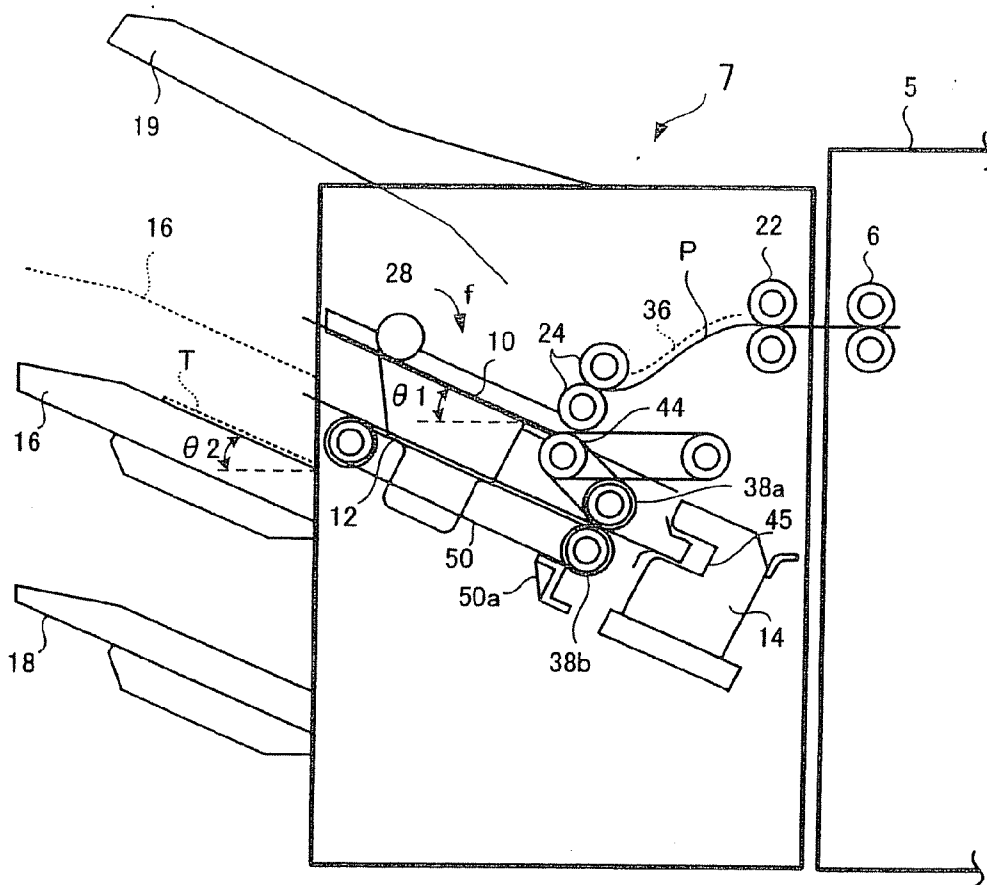


FIG. 4

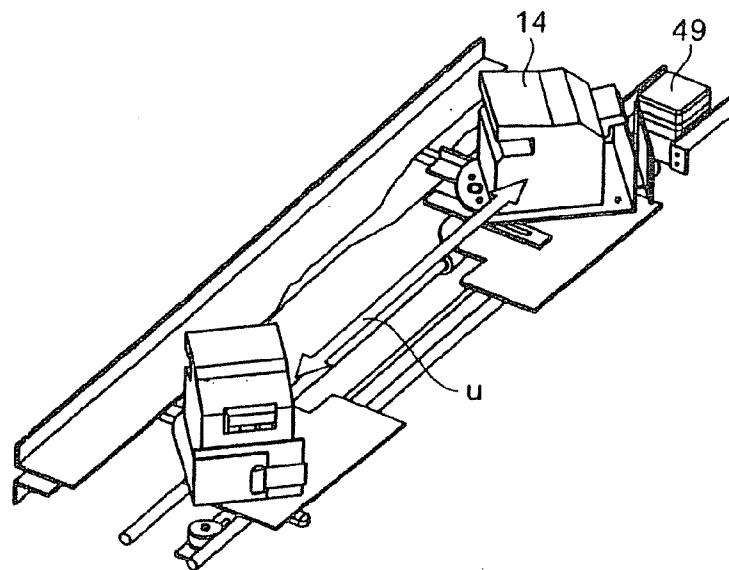


FIG. 5

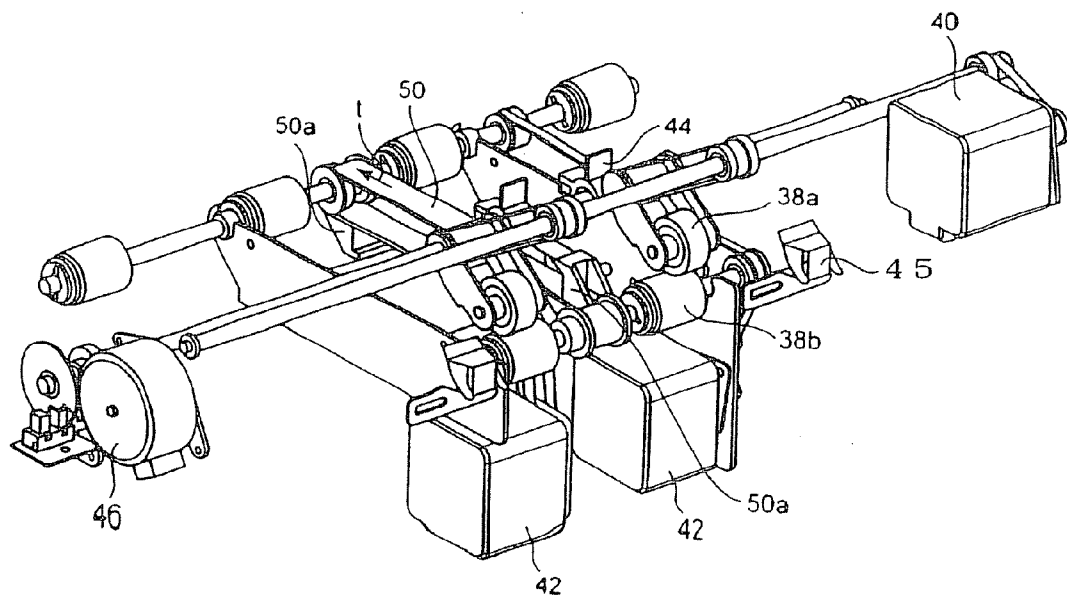


FIG. 6

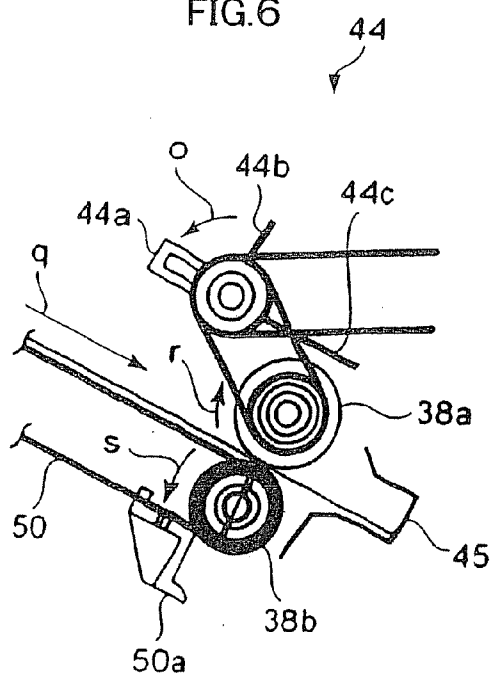


FIG. 7

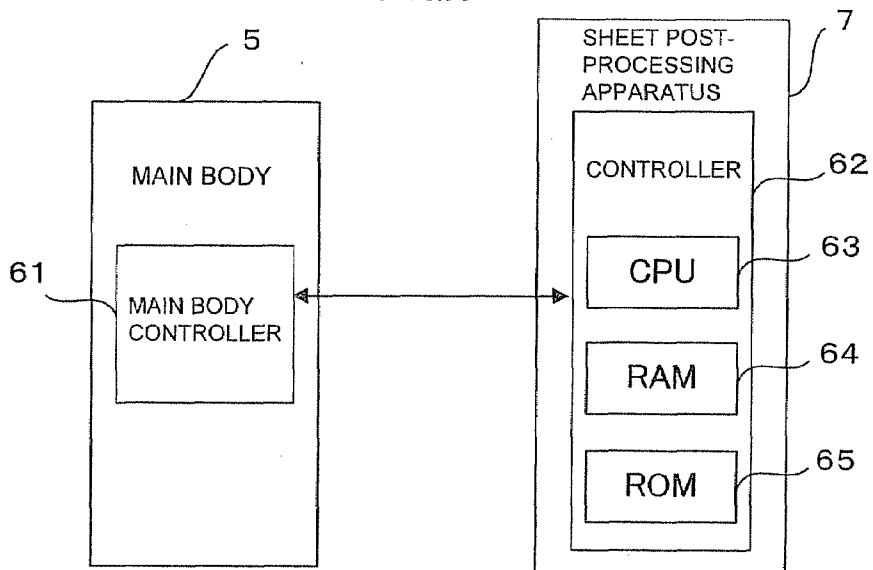
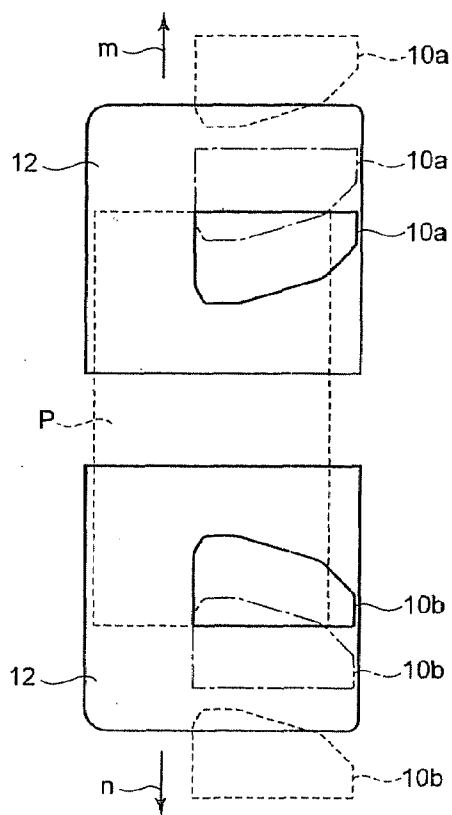


FIG. 8



SHEET POST-PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an image forming apparatus, such as a copying machine, a printer, and a multi function peripherals, and more particularly, to a sheet post-processing apparatus that applies post processing on sheets of paper discharged after image formation.

[0003] 2. Description of the Related Art

[0004] There is a sheet post-processing apparatus configured to selectively apply staple processing and punching processing by accepting sheets of paper on which are formed image inside the apparatus (for example, JP-A-2002-226118).

[0005] Sheets of paper done with the post-processing are discharged from the sheet post-processing apparatus, and the apparatus is equipped with an upper tray and a lower tray capable of stacking thereon a large number of discharged sheets of paper.

[0006] In addition, the upper tray and the lower tray are disposed to incline at specific angles, so that discharged sheets of paper are aligned at the end faces on the sheet post-processing apparatus side.

[0007] Each of the upper tray and the lower tray is able to move in a top-bottom direction, and they are used properly depending on the content of a job the user uses, for example, a copy, a network printer, and a facsimile. Hence, even the upper tray is able to stack thereon sheets of paper of a long size.

[0008] However, in a case where sheets of paper of a long size are stacked on the upper tray, the sheets of paper of the long size on the upper tray get in the way when the user picks up the sheets of paper on the lower tray, and there arises a problem that the sheets of paper on the lower tray are not picked up easily.

[0009] In addition, in a case where a large volume of sheets of paper of a long size are stacked on the upper tray, the center of gravity becomes higher due to the weight of the stacked sheets of paper, which causes an inconvenience that the sheet post-processing apparatus becomes easy to fall.

BRIEF SUMMARY OF THE INVENTION

[0010] It is an object of the present invention to provide a sheet post-processing apparatus equipped with plural paper discharge trays capable of moving up and down.

[0011] In an aspect of the present invention, a sheet post-processing apparatus includes: a processing tray that receives a sheet of paper on which is formed an image from an image forming apparatus; a processing mechanism that applies post-processing on the sheet of paper stacked on the processing tray; a first paper discharge tray that is formed to be able to move up and down and to stack thereon the sheet of paper discharged by way of the processing tray after the post-processing; and a second paper discharge tray that is formed to be able to move up and down and to stack thereon the sheet of paper discharged by way of the processing tray after the post-processing, and is disposed at a lower stage of the first

paper discharge tray and able to stack sheets of paper of a size larger than sheets of paper stacked on the first paper discharge tray.

DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a perspective view showing a major portion of a sheet post-processing apparatus according to one embodiment of the invention;

[0013] FIG. 2 is a plan view showing the major portion of the sheet post-processing apparatus according to the embodiment of the invention;

[0014] FIG. 3 is a view schematically showing the configuration of the sheet post-processing apparatus according to the embodiment of the invention;

[0015] FIG. 4 is a perspective view showing a stapler of the sheet post-processing apparatus according to the embodiment of the invention;

[0016] FIG. 5 is a view used to describe a portrait alignment roller according to the embodiment of the invention;

[0017] FIG. 6 is a perspective view showing a paddle according to the embodiment of the invention;

[0018] FIG. 7 is a functional block diagram showing the relation of a control system according to the embodiment of the invention and a control system of an image forming apparatus main body; and

[0019] FIG. 8 is a view used to describe a movement of a stand-by tray according to one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Throughout this description, the embodiments and examples shown should be considered as exemplars, rather than limitations on the apparatus and methods of the present invention.

[0021] Hereinafter, one embodiment of the invention will be described with reference to the drawings.

[0022] FIG. 1 is a perspective view showing a major portion of a sheet post-processing apparatus according to one embodiment of the invention. FIG. 2 is a plan view of the major portion of the sheet post-processing apparatus.

[0023] FIG. 3 schematically shows the configuration of the sheet post-processing apparatus disposed adjacently to an image forming apparatus.

[0024] A sheet post-processing apparatus 7 has a pair of inlet rollers 22 that takes a sheet of paper P, on which an image is formed in an image forming apparatus 5 and which is discharged from a pair of paper discharge rollers 6, inside the sheet post-processing apparatus 7. The inlet rollers 22 are driven by an inlet roller motor 26. A paper path ceiling 36 that introduces a sheet of paper P to a pair of paper feeding rollers 24 is provided from the inlet rollers 22 to a stand-by tray 10. A processing tray 12 on which is stacked a sheet of paper P supplied by falling from the stand-by tray 10 is disposed below the stand-by tray 10.

[0025] The processing tray 12 supports and aligns sheets of paper stacked thereon while the sheets of paper P are subjected to staple processing by a stapler 14, which is a processing mechanism that performs post-processing.

[0026] As is shown in FIG. 4, the stapler 14 is allowed to move by sliding in the direction indicated by an arrow u by a staple driving unit 49 and is positioned by being rotationally moved in a staple direction, so that the staple processing is controlled. In order to align plural sheets of paper P supplied by falling from the stand-by tray 10 in a portrait direction,

which is the carrying direction, the processing tray 12 has a pair of an upper portrait alignment roller 38a and a lower portrait alignment roller 38b, respectively, at top and bottom as shown in FIG. 5. The upper and lower portrait alignment rollers 38a and 38b also serve as bundle carrying rollers that nip and take out a bundle of sheets, T (shown in FIG. 3), from the stapler 14 after the staple processing ends. The upper portrait alignment roller 38a is driven by a portrait alignment upper roller motor 40, and the lower portrait alignment roller 38b is driven by a portrait alignment lower roller motor 42.

[0027] Also, at a position at which the rear end of a sheet of paper P falls when the sheet of paper P (shown in FIG. 3) is supplied to the processing tray 12 by falling, a paddle 44 is disposed, which is capable of rotating to align the uppermost sheet of paper P stacked on the processing tray 12 in the portrait direction. As is shown in FIG. 6, the paddle 44 has a reception unit 44a of a sheet of paper P supplied to the processing tray 12 by falling, a flip unit 44b that flips down a sheet of paper P onto the processing tray 12, and a sending unit 44c that aligns sheets of paper P on the processing tray 12, and it is driven by a paddle motor 46. The paddle 44 is made of a rubber material and therefore has elasticity.

[0028] A stopper 45 that limits the rear end position by abutting on the rear end of the sheets of paper P is provided to the processing tray 12 at the end portion on the stapler 14 side. At almost the center of the processing tray 12, a carrying belt 50 is provided, which is a carrying mechanism that carries a bundle of sheets, T, done with the staple processing and taken out from the stapler 14 by the upper and lower portrait alignment rollers 38a and 38b to a first or second paper discharge tray 16 or 18, and it comes into contact with the lowermost sheet of paper P on the processing tray 12. The carrying belt 50 is an endless belt that moves in the direction indicated by an arrow t, and a sending claw 50a to hook up the rear end of a bundle of sheets, T, is attached to the carrying belt 50.

[0029] The stand-by tray 10 is able to supply sheets of paper P by letting them fall onto the processing tray 12, while it is able to carry the sheets of paper P in the direction of the first (upper) or second (lower) paper discharge tray 16 or 18. The sheets of paper P are carried in the direction of the paper discharge tray 16 or 18 by bringing a stand-by tray roller 28 that aligns the sheets of paper P into contact with the sheets of paper P on the stand-by tray 10. The stand-by tray roller 28 is controlled to move in the top-bottom direction by a stand-by tray roller driving source 30, and driven to rotate by a stand-by tray roller motor 32.

[0030] The stand-by tray 10 is disposed with an inclination such that make the tip end of the sheets of paper P higher than the rear end. The first or second paper discharge tray 16 or 18 is moved up or down by a paper discharge tray driving unit 52, and either of them is selected. The first or second paper discharge tray 16 or 18 moves up or down to the level almost as high as the stand-by tray 10 or the processing tray 12 while the sheets of paper P are stacked thereon, so that the sheets of paper P to be discharged can be aligned better.

[0031] The first or second paper discharge tray 16 or 18 is moved up or down by driving means in the top-bottom direction while being guided by an unillustrated guiding rail. The paper discharge tray 16 stacks thereon sheets of paper of a size smaller than those on the paper discharge tray 18, such as those of A-4 size or a letter size or smaller. Meanwhile, the paper discharge tray 18 stacks thereon sheets of paper larger than those of A-4 size, such as those of B-4 size or A-3 size or those of a long size. It goes without saying that the first paper

discharge tray 16 can be smaller than the second paper discharge tray 18 in the size of an outer shape.

[0032] In terms of shapes, the first or second paper discharge tray 16 or 18 is disposed with an inclination such that makes the tip end of the sheets of paper P higher than the rear end.

[0033] FIG. 7 is a functional block diagram showing a relation of the control system of the sheet post-processing apparatus 7 and the control system of the image forming apparatus main body. Referring to FIG. 7, a main body controller 61 of an image forming apparatus main body 5 is connected to a controller 62 of the sheet post-processing apparatus 7. More specifically, by operations by the user or the like, the main body controller 61 of the image forming apparatus 5 acquires information about the paper size of a print output together with document data to be printed when it receives a print job. The main body controller 61 of the image forming apparatus main body 5 transmits the paper size information to the controller 62 of the sheet post-processing apparatus 7 together with information about the reception of the print job.

[0034] The controller 62 of the sheet post-processing apparatus 7 has a CPU 63 that controls the sheet post-processing apparatus 7, a ROM 64 having stored a program or the like to control the sheet post-processing apparatus 7, and a RAM 65 that is used as a working area of the program and temporarily stores data necessary for the control on the sheet post-processing apparatus 7.

[0035] Functions of the sheet post-processing apparatus 7 configured as described above will now be described.

[0036] As the prerequisite, it is necessary for each of the paper discharge trays 16 and 18 in the sheet post-processing apparatus 7 to stack sheets of paper of various sizes discharged from the image forming apparatus main body without letting any sheet of paper fall down. More specifically, whether the paper size is the size of the largest A-3 size or a long size, or the A-4 size or the letter size that are assumed to account for about 80% of sheets of paper actually used, or a further smaller B-5 size, each of the paper discharge trays 16 and 18 should be able to stack sheets of paper in a reliable manner.

[0037] Moreover, it is also important that sheets of paper stacked on each of the paper discharge trays 16 and 18 can be readily picked up, or even in a state where sheets of papers are stacked on each of the paper discharge trays 16 and 18, the sheet post-processing apparatus 7 will no readily fall by losing a balance.

[0038] In order to satisfy these requirements, the sheet post-processing apparatus 7 operates in response to respective modes.

[0039] To be more specific, when images are formed in the image forming apparatus 5 and sheets of paper P are supplied from the paper discharge rollers 6, the sheet post-processing apparatus 7 operates differently depending on a case where to post-processing the sheets of paper P is performed or is not performed or in a case where a preceding sheet of paper P is being subjected to the post-processing or done with the post-processing.

(A) A Case Where Post-Processing is not Performed

[0040] The paper size information has been previously transmitted to the controller 62 of the sheet post-processing apparatus 7 from the controller 61 of the image forming apparatus main body 5 by the settings of the print job made by

the operator. The controller 62 of the sheet post-processing apparatus 7 controls the position of each of the paper discharge trays 16 and 18 according to the paper size information thus transmitted.

[0041] To be more specific, in a case where sheets of paper are of a paper size as large as an A-4 size or a letter size or smaller, the upper paper discharge tray 16 moves by sliding to the position indicated by a dotted line of FIG. 3. Meanwhile, in a case where sheets of paper are of a B-4 size or an A-3 size or a long size larger than the A-4 size, the lower paper discharge tray 18 moves by sliding to the position indicated by a dotted line of FIG. 3.

[0042] In this state, in a case where the post-processing is not performed, the sheets of paper P carried to the paper feeding rollers 24 via the paper path ceiling 36 from the inlet rollers 22 are fed to the stand-by tray 10 from the paper feeding rollers 24. Subsequently, the sheets of paper P are carried by the stand-by tray roller 28 that is moved down onto the stand-by tray 10 and rotated in the direction indicated by an arrow f, and discharged to either the upper paper discharge tray 16 or the lower paper discharge tray 18 depending on the paper size.

[0043] As has been described, sheets of paper are successively stacked on each of the paper discharge trays 16 and 18. In this instance, because each of the paper discharge trays 16 and 18 is disposed with an inclination such that makes the tip end side of the sheets of paper P higher than the rear end side, there will be no event that sheets of paper P stacked earlier on each of the paper discharge trays 16 and 18 are pushed out by the contact with the tip end of the following sheet of paper P. In other words, the order of the discharged sheets of paper P remains intact, and sheets of papers P are stacked sequentially on each of the paper discharge trays 16 and 18. In addition, even when the preceding sheets of paper P undergo positional displacement slightly by being pushed by the following sheet of paper P, the sheets of paper P fall with their own weights owing to the angle of inclination. Consequently, the sheets of paper P are stacked while they are aligned with the rear end being aligned on each of the paper discharge trays 16 and 18, whereupon the paper discharge processing of the sheets of paper P is completed.

[0044] In this case, even when the sheets of papers are stacked on the paper discharge tray 16 or 18, sheets of paper of a size as large as the A-4 size or the letter size or smaller are stacked on the upper paper discharge tray 16 while sheets of paper of the B-4 size or the A-3 size or the long size larger than the A-4 size are stacked on the lower paper discharge tray 18. Accordingly, it is possible to pick up the sheets of paper easily whether they are sheets of paper stacked on the upper paper discharge tray 16 or sheets of paper stacked on the lower paper discharge tray 18 without being interrupted by the sheets of paper stacked on the other tray.

[0045] Regarding the stacking on the same paper discharge tray 16 or 18, while sheets of paper of a short size are stacked under the sheets of paper of a long size, it has been quite difficult to pick up the sheets of paper of a short size. However, in this embodiment, because the sizes are assigned to the trays, the difficulty of picking up sheets of paper can be eliminated.

[0046] By stacking print matter having different sizes on the lower paper discharge tray 18 as a rule, it is possible to prevent a problematic event that print matter is stacked separately. Moreover, because the upper paper discharge tray 16 is small, it is easy to pick up sheets of paper from the lower paper

discharge tray 18 as the sheets of paper of a long size mixed and stacked thereon serve as a partition.

[0047] In addition, the weight of the sheets of paper stacked on the lower paper discharge tray 18 is greater than the weight of sheets of paper stacked on the upper paper discharge tray 16, even when sheets of paper are stacked on the both paper discharge trays, the center of gravity of the sheet post-processing apparatus 7 stays at a lower position. The sheet post-processing apparatus thus becomes difficult to fall and is stabilized.

(B) When Post-Processing is Performed

[0048] As an example of the post-processing, a case will be described, in which the staple processing is performed when there is no preceding sheet of paper P on the processing tray 12 that is being subjected to the staple processing.

[0049] In this case, too, the paper size information has been previously transmitted from the controller 61 of the image forming apparatus main body 5 to the controller 62 of the sheet post-processing apparatus 7 by the settings of the print job made by the user. The controller 62 of the sheet post-processing apparatus 7 controls the position of each of the paper discharge trays 16 and 18 according to the paper size information thus transmitted.

[0050] More specifically, in a case where the sheets of paper are sheets of paper of a size as large as the A-4 size or the letter size or smaller, the upper paper discharge tray 16 moves by sliding to the position indicated by the dotted line of FIG. 3. Meanwhile, in a case where the sheets of paper are of the B-4 size or the A-3 size or the long size larger than the A-4 size, the lower paper discharge tray 18 moves by sliding to the position indicated by the dotted line of FIG. 3.

[0051] As is shown in FIG. 8, in this state, the stand-by tray 10 opens a fall supply path of sheets of paper P by moving tray members 10a and 10b by sliding to positions indicated by dotted lines of FIG. 8 in the directions indicated by an arrow m and an arrow n, respectively. Also, in order to align sheets of paper P falling from the paper feeding rollers 24 in the landscape direction, landscape alignment plates 47a and 47b are disposed in such a manner that a distance between the landscape alignment plates 47a and 47b becomes almost the same as the width of the sheets of paper P. Accordingly, sheets of paper P fed by the paper feeding rollers 24 are supplied directly by falling onto the processing tray 12 without being interrupted by the stand-by tray 10 while being carried.

[0052] During the supply by falling, the upper portrait alignment roller 38a evacuates to an upper position, and the reception unit 44a of the paddle 44 receives the rear end of the sheets of paper P. The sheets of paper P fall while the both ends are coming into contact with the landscape alignment plates 47a and 47b so as to be aligned in the landscape direction. Subsequently, the paddle 44 rotates in the direction indicated by an arrow o to let the rear end of the sheets of paper P fall from the reception unit 44a and flips them down onto the processing tray 12 by means of the flipping unit 44b. Further, the paddle 44 feeds the sheets of paper P in the direction indicated by an arrow q by means of the sending unit 44c to let the rear end of the sheets of paper P abut on the stopper 45, whereupon the alignment of sheets of paper P in the portrait direction is completed. In this manner, when the sheets of paper P supplied to the processing tray 12 are aligned in reference to the stopper 45, the rear end 50c of the carrying belt 50 on the sheets of paper P side become lower than the supporting plane of the processing tray 12 for the

sheets of paper P. Hence, the contact friction of the carrying belt 50 to the rear end of the lowermost sheet of paper P is so small that the alignment of the sheets of paper P will not be disturbed, which makes it possible to align the sheets of paper P in a reliable manner. Sheets of paper P may be aligned in the portrait direction on the processing tray 12 by the upper portrait alignment roller 38a instead of the paddle 44 by moving the upper portrait alignment roller 38a vertically for each alignment.

[0053] As has been described, sheets of paper P on which are formed images are directly stacked on the processing tray 12 from the paper feeding rollers 24 while being aligned successively in the landscape direction and the portrait direction. When a predetermined number of sheets of paper P are stacked, the stapler 14 bundles the sheets of paper P on the processing tray 12 by stapling them at the desired position and makes a bundle of sheets, T. Thereafter, the upper portrait alignment roller 38a is moved down above the bundle of sheets, T, between the upper portrait alignment roller 38a rotating in the direction indicated by an arrow r and the lower portrait alignment roller 38b rotating in the direction indicated by an arrow s for the bundle to be carried in the direction of the first paper discharge tray 16.

[0054] When the rear end of the bundle of sheets, T, passes by the upper and lower portrait alignment rollers 38a and 38b, it is hooked by the sending claw 50a of the carrying belt 50 rotating in the direction indicated by an arrow t and discharged onto the first paper discharge tray 16 in the form of a bundle. While the bundle is discharged by the carrying belt 50, the carrying belt 50 inclines so as to protrude from the supporting plane of the processing tray 12 for sheets of paper P towards the tip end 50b on the sheets of paper P side. Hence, the contact friction by the carrying belt 50 becomes gradually larger toward the tip end of the lowermost sheet of paper P, and a carrying force of the sheet of paper P in the paper discharging direction by the carrying belt 50 is increased toward the first paper discharge tray 16. The bundle of sheets, T, is thus carried onto the paper discharge tray 16 or 18 set according to the paper size in the form of a bundle by the carrying force of the sending claw 50a and the carrying belt 50 in a reliable manner without being disturbed.

[0055] Because the respective paper discharge trays 16 and 18 are disposed with inclinations such that makes the tip end of the sheets of paper P higher than the rear end, there will be no event that sheets of paper P discharged onto the first paper discharge tray 16 earlier in the form of a bundle are pushed out by the contact with the tip end of a following bundle of sheets, T. Also, even when the preceding bundle of sheets, T, undergoes displacement by the following sheet of paper P, the bundle of sheets, T, falls by its own weight owing to the angle of inclination and is stacked on the paper discharge tray 16 or 18 with the rear end being aligned for the staple processing on the sheets of paper P to be completed.

[0056] In this case, too, even when sheets of paper are stacked on the paper discharge trays 16 and 18, sheets of paper of the A-4 size or the letter size or smaller are stacked on the upper paper discharge tray 16 while sheets of paper of the B-4 size, the A-3 size or the long size larger than the A-4 size are stacked on the lower paper discharge tray 18. Hence, it is possible to pick up the sheets of paper whether they are sheets of paper stacked on the upper paper discharge tray 16 or sheets of paper stacked on the lower paper discharge tray 18 without being interrupted by the sheets of paper stacked on the other tray.

[0057] Regarding the stacking on the same paper discharge tray 16 or 18, while sheets of paper of a short size are stacked

under the sheets of paper of a long size, it has been quite difficult to pick up the sheets of paper of a short size. However, in this embodiment, because the sizes are assigned to the trays, the difficulty of picking up sheets of paper can be eliminated.

[0058] By stacking print matter having different sizes on the lower paper discharge tray 18 as a rule, it is possible to prevent a problematic event that print matter is stacked separately. Moreover, because the upper paper discharge tray 16 is small, it is easy to pick up sheets of paper from the lower paper discharge tray 18 as the sheets of paper of a long size mixed and stacked thereon serve as a partition.

[0059] In addition, the weight of the sheets of paper stacked on the lower paper discharge tray 18 is greater than the weight of sheets of paper stacked on the upper paper discharge tray 16, even when sheets of paper are stacked on the both paper discharge trays, the center of gravity of the sheet post-processing apparatus 7 stays at a lower position. The sheet post-processing apparatus thus becomes difficult to fall and is stabilized.

[0060] Although exemplary embodiments of the present invention have been shown and described, it will be apparent to those having ordinary skill in the art that a number of changes, modifications, or alterations to the invention as described herein may be made, none of which depart from the spirit of the present invention. All such changes, modifications, and alterations should therefore be seen as within the scope of the present invention.

What is claimed is:

- 1. A sheet post-processing apparatus, comprising:
 - a processing tray that receives a sheet of paper on which is formed an image from an image forming apparatus;
 - a processing mechanism that applies post-processing on the sheet of paper stacked on the processing tray;
 - a first paper discharge tray that is formed to be able to move up and down and to stack thereon the sheet of paper discharged by way of the processing tray after the post-processing; and
 - a second paper discharge tray that is formed to be able to move up and down and to stack thereon the sheet of paper discharged by way of the processing tray after the post-processing, and is disposed at a lower stage of the first paper discharge tray and able to stack sheets of paper of a size larger than sheets of paper stacked on the first paper discharge tray.
- 2. The sheet post-processing apparatus according to claim 1, wherein:
 - on the first paper discharge tray are preferentially stacked sheets of paper of a short size and sheets of paper of other sizes are preferentially stacked on the second paper discharge tray.
- 3. The sheet post-processing apparatus according to claim 1, wherein:
 - on the first paper discharge tray are stacked sheets of paper of an A-4 size or a letter size and sheets of paper of a B-4, a A-3, or a long size are stacked on the second paper discharge tray.
- 4. The sheet post-processing apparatus according to claim 1, wherein:
 - for a bundle of sheets of different sizes, the sheets of paper are stacked on the second paper discharge tray in a mixed fashion.

* * * * *