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(54) **PAPER JAM REMOVAL MECHANISM FOR SHEET FINISHING PROCESS DEVICE**

**Related U.S. Application Data**

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(52) **U.S. Cl.** ..... **271/3.15; 271/265.04**  
(57) **ABSTRACT**

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A sheet finishing process device includes: a housing unit which houses a sheet discharged from an image forming unit; a carrying unit which is driven in a first direction toward the housing unit from the image forming unit or in a second direction that is opposite to the first direction, and carries the sheet discharged from the image forming unit, and carries the sheet discharged from the image forming unit; a detection unit which detects a paper jam of the sheet in the carrying unit; and a control unit which controls the carrying unit to be driven in the second direction if the detection unit detects the paper jam of the sheet.

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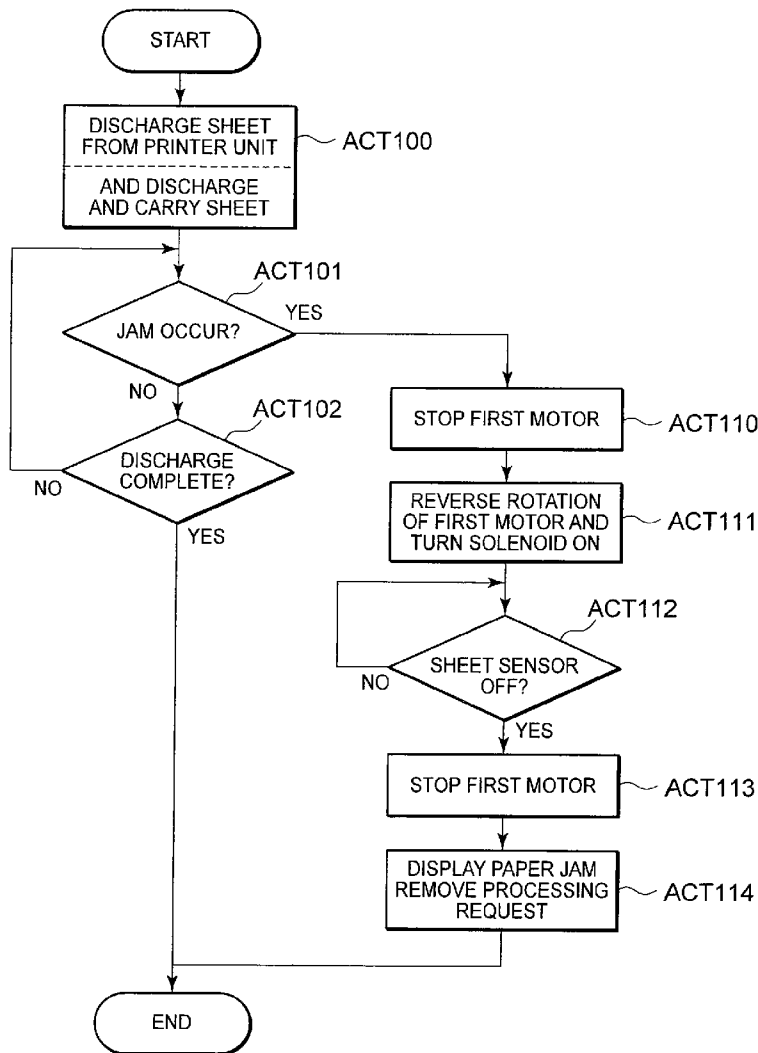


FIG. 1

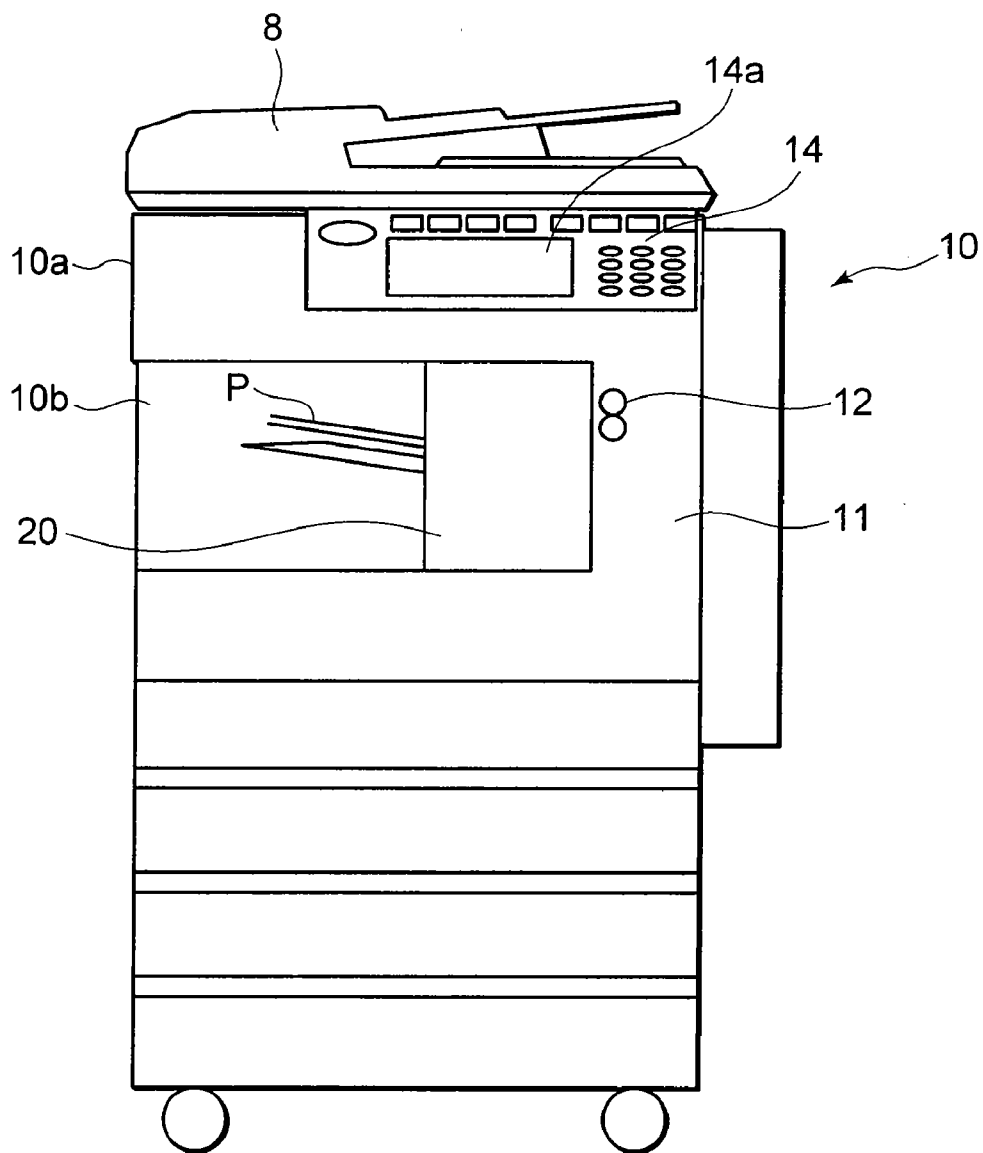


FIG. 2

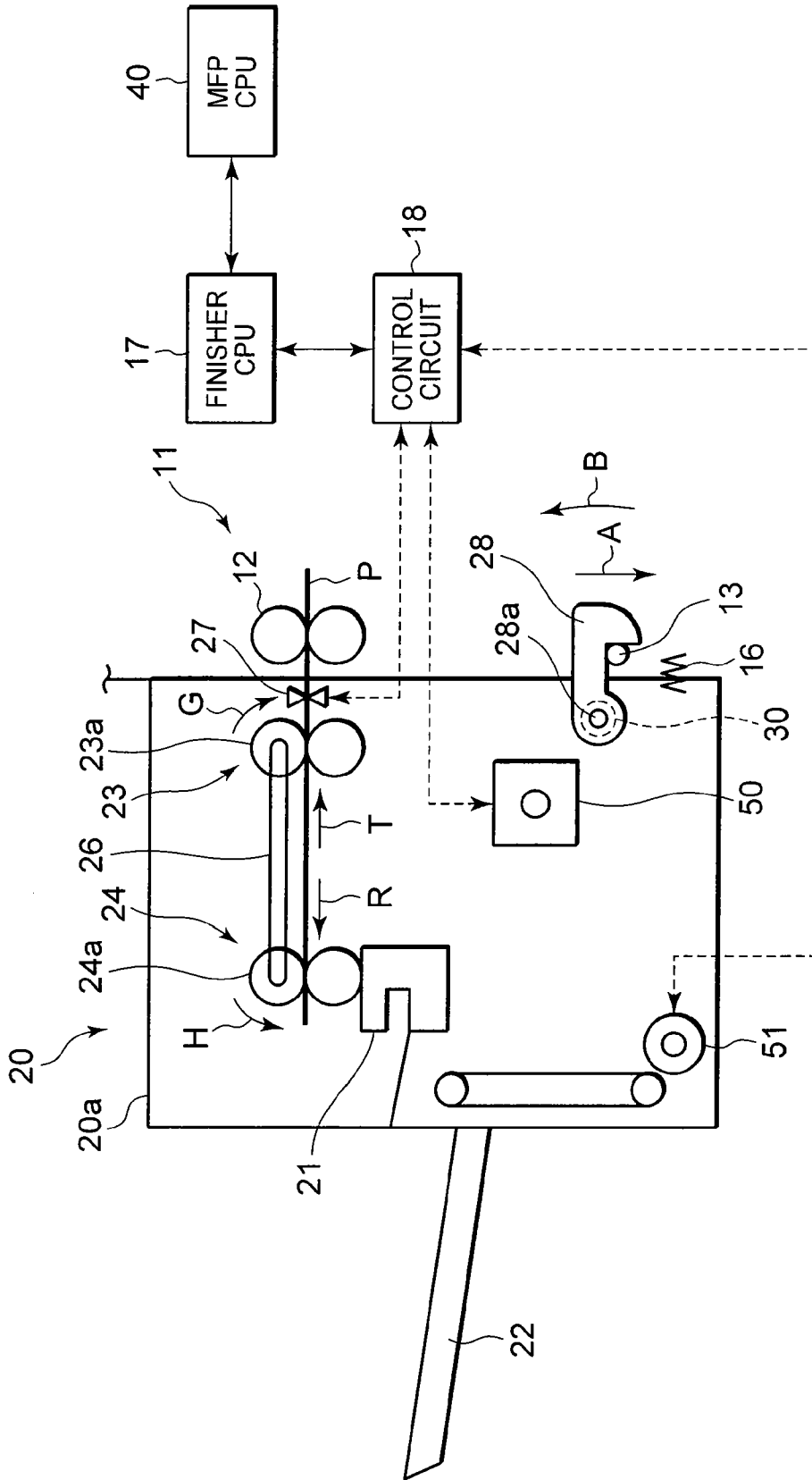


FIG. 3

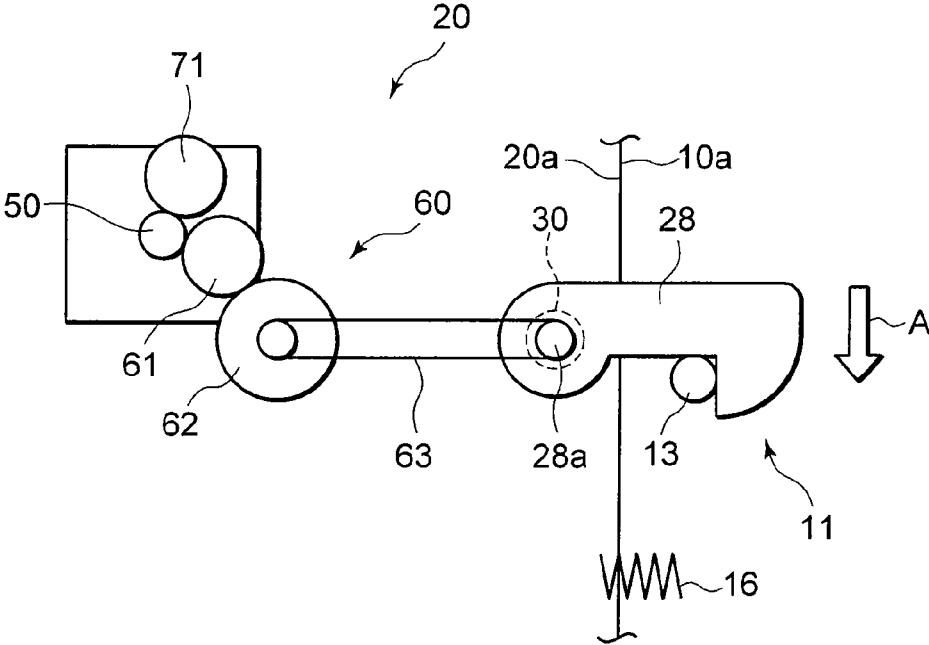


FIG. 4

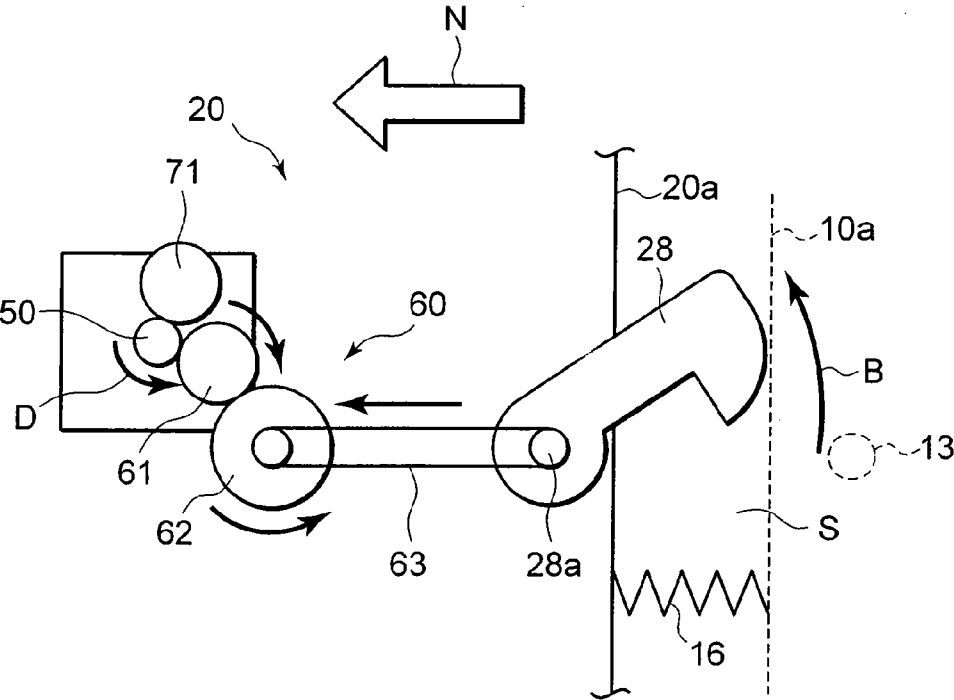


FIG. 5

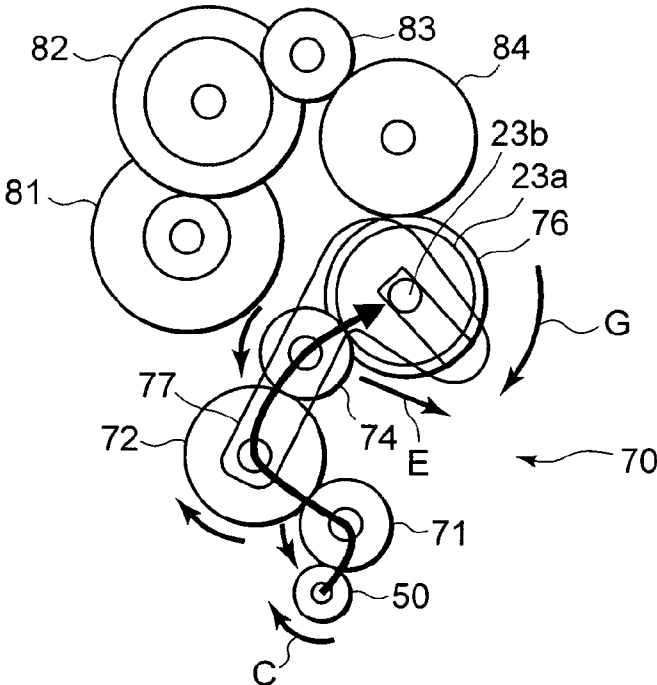


FIG. 6

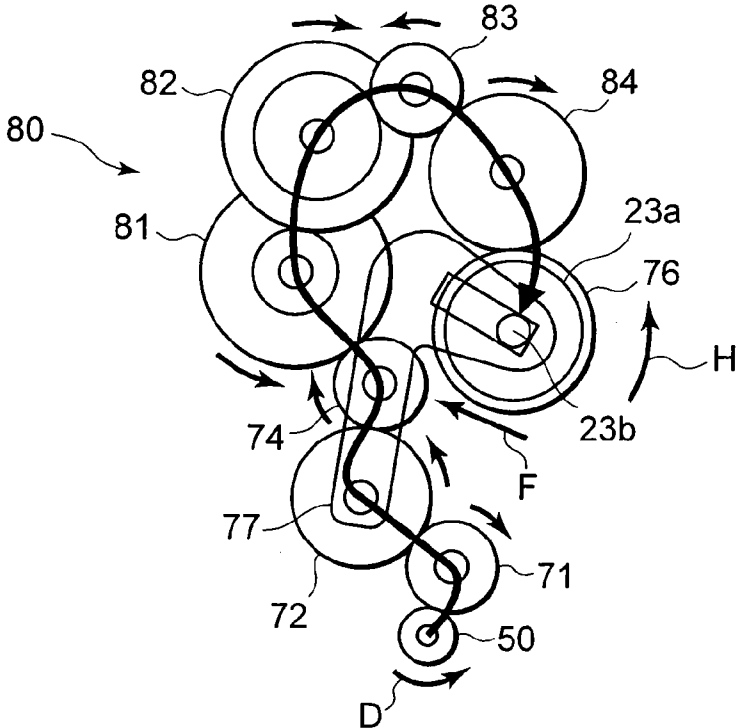


FIG. 7

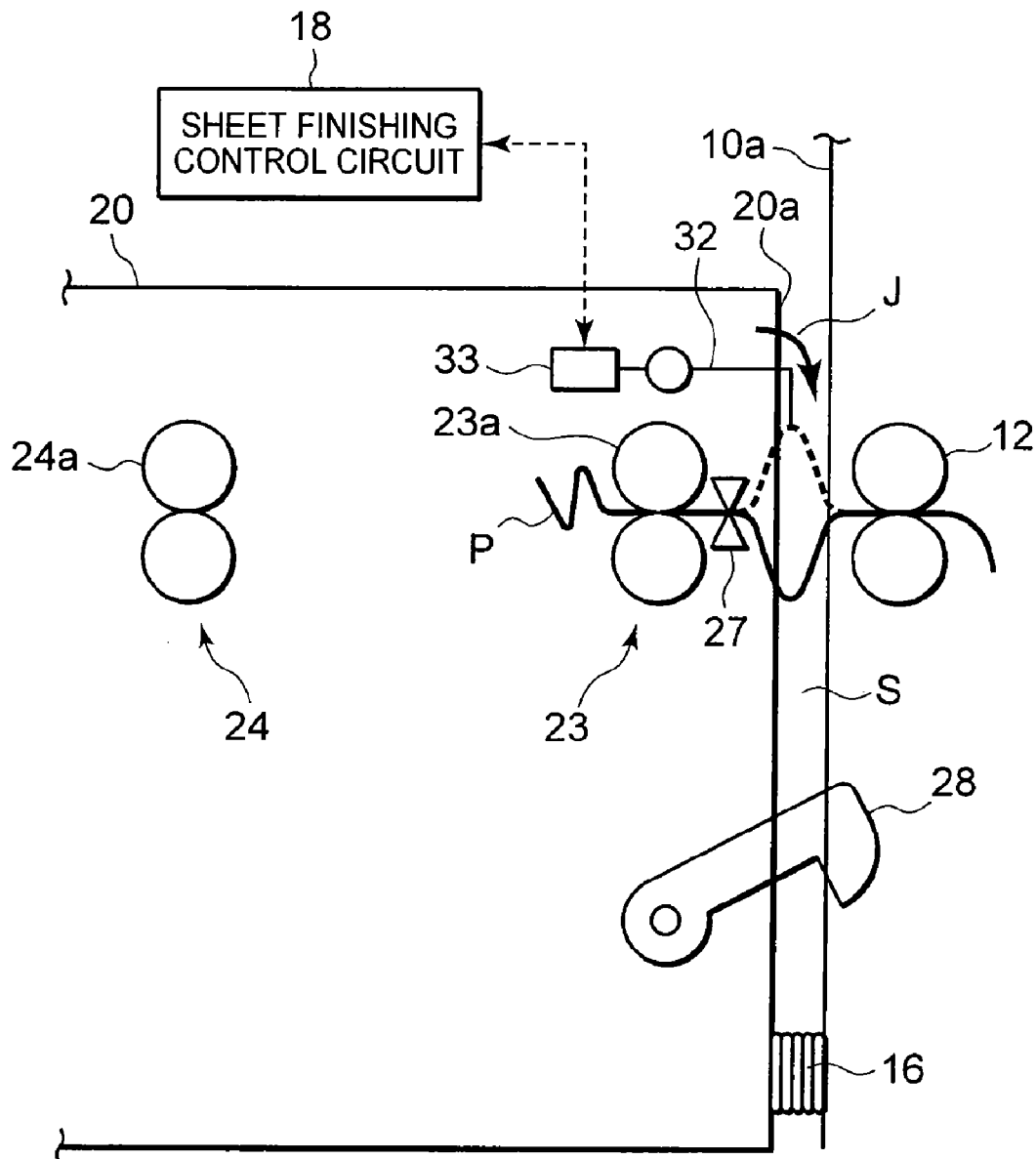


FIG. 8

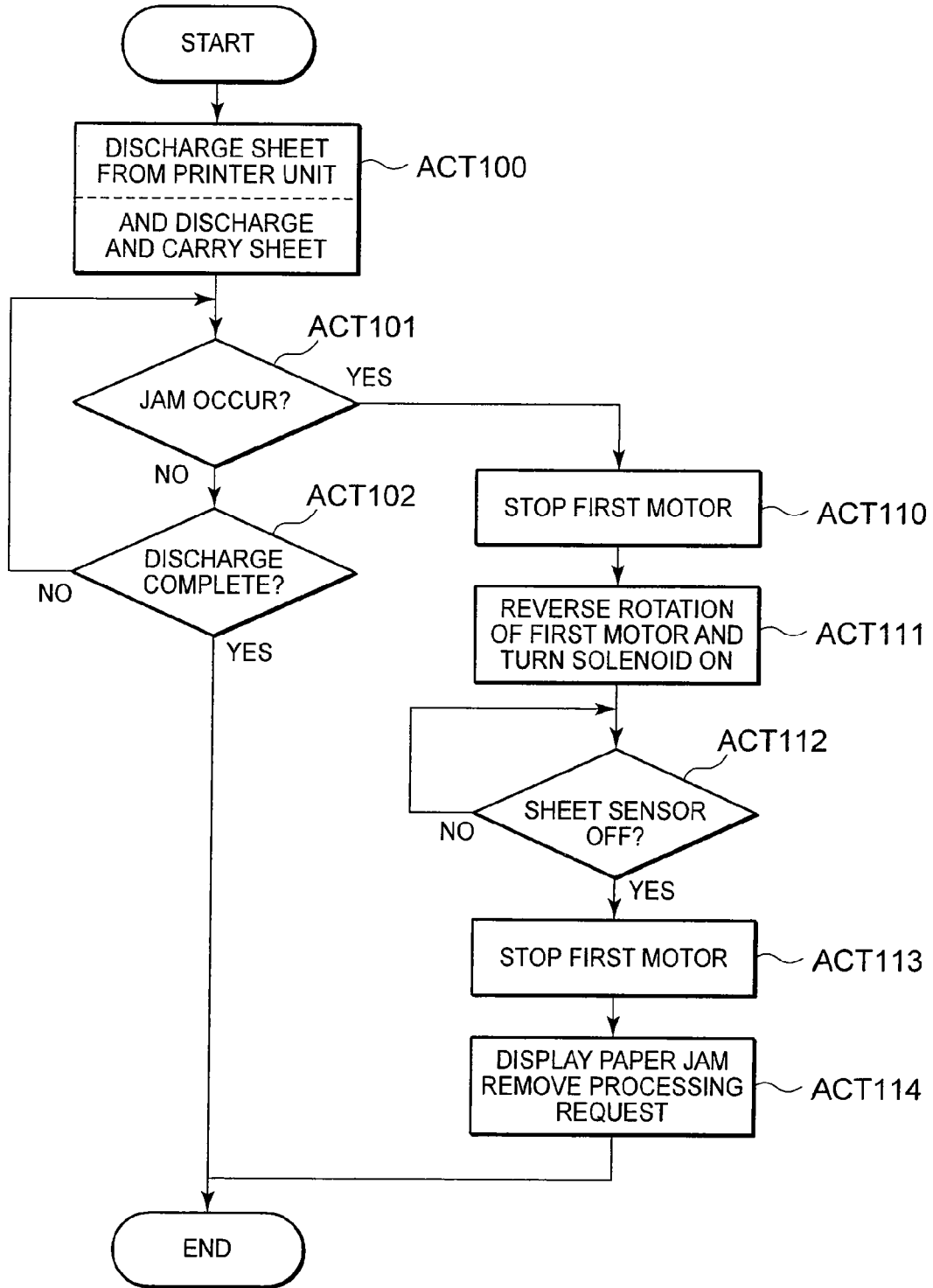


FIG. 9

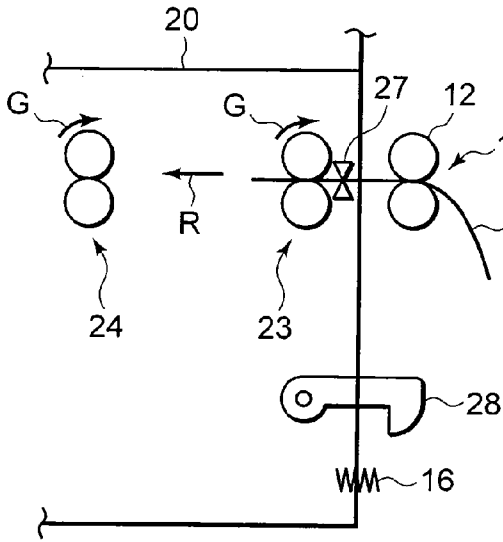


FIG. 10

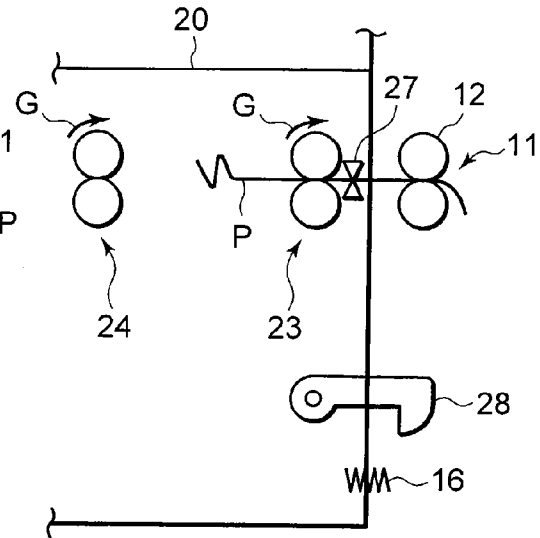


FIG. 11

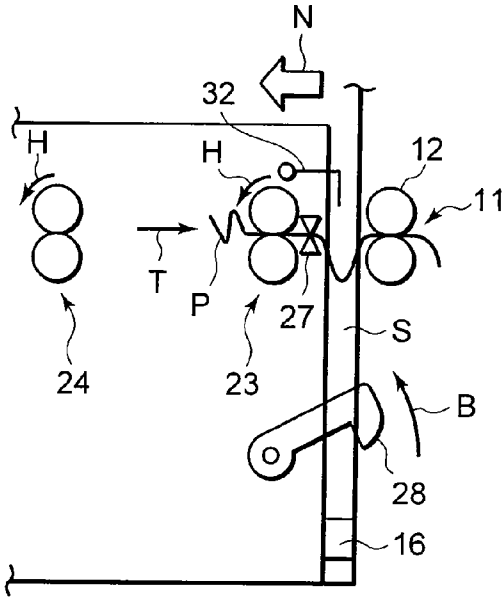


FIG. 12

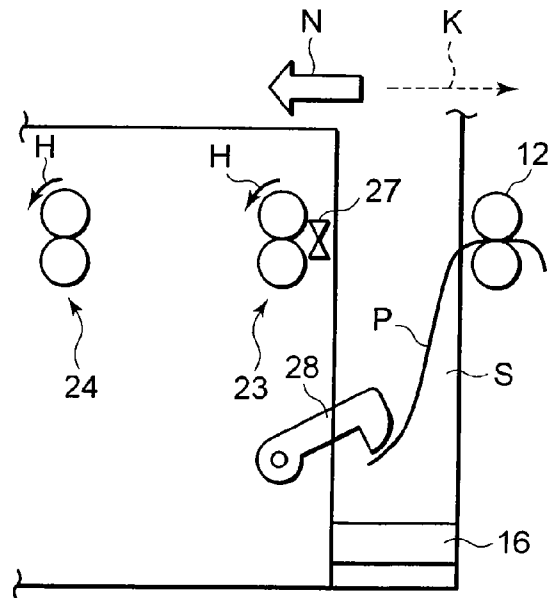




FIG. 13

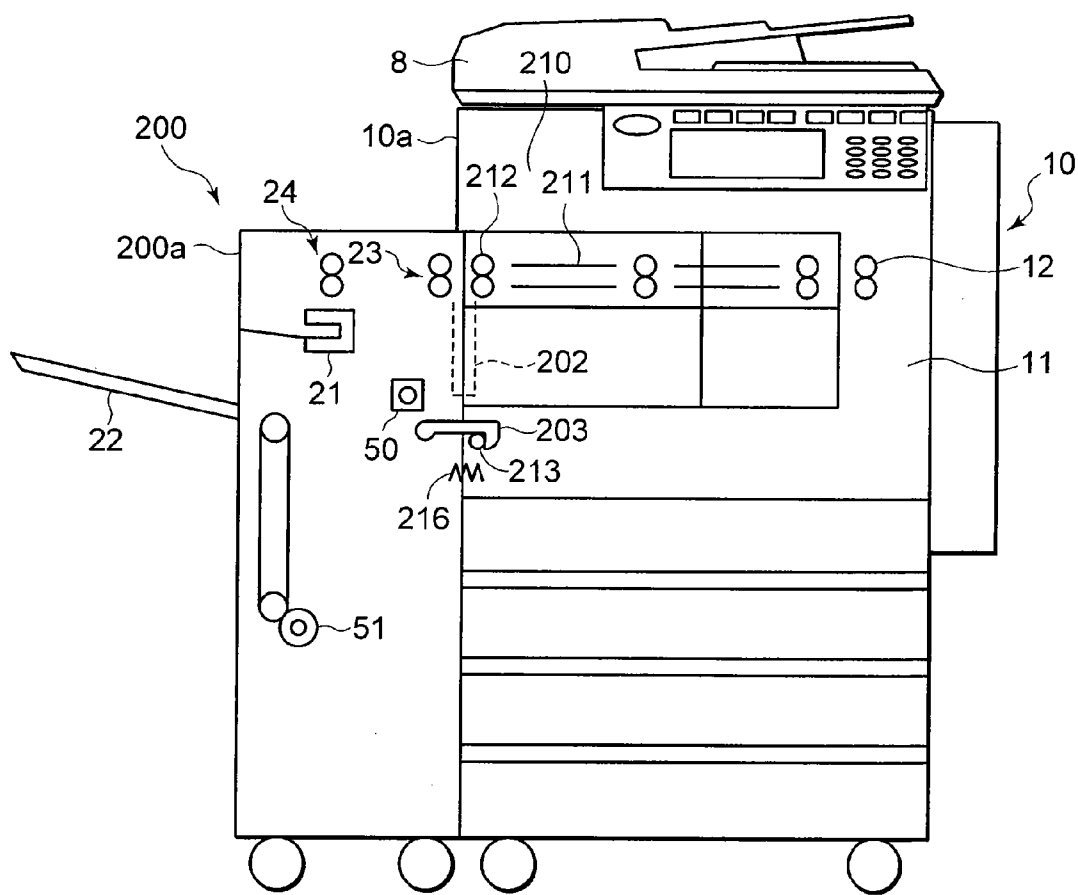


FIG. 14

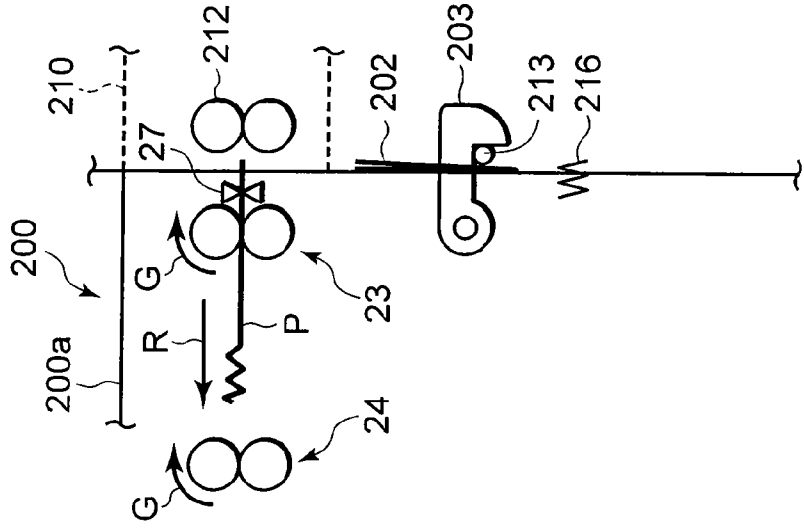


FIG. 15

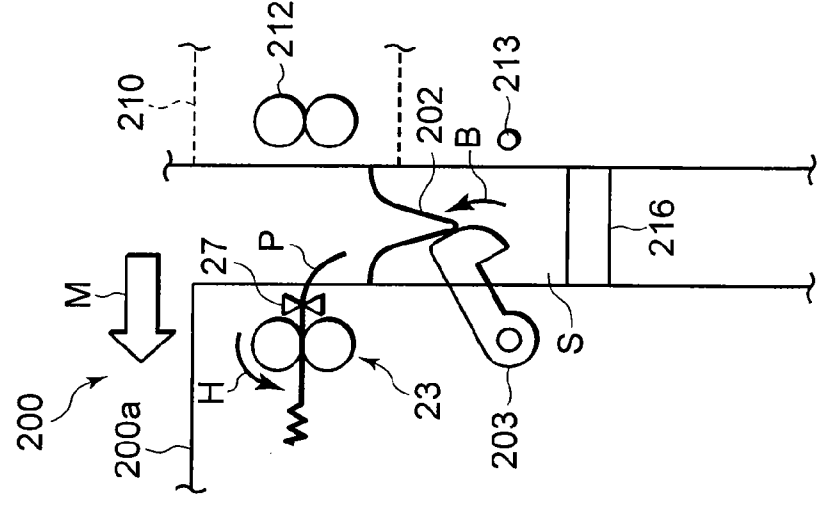
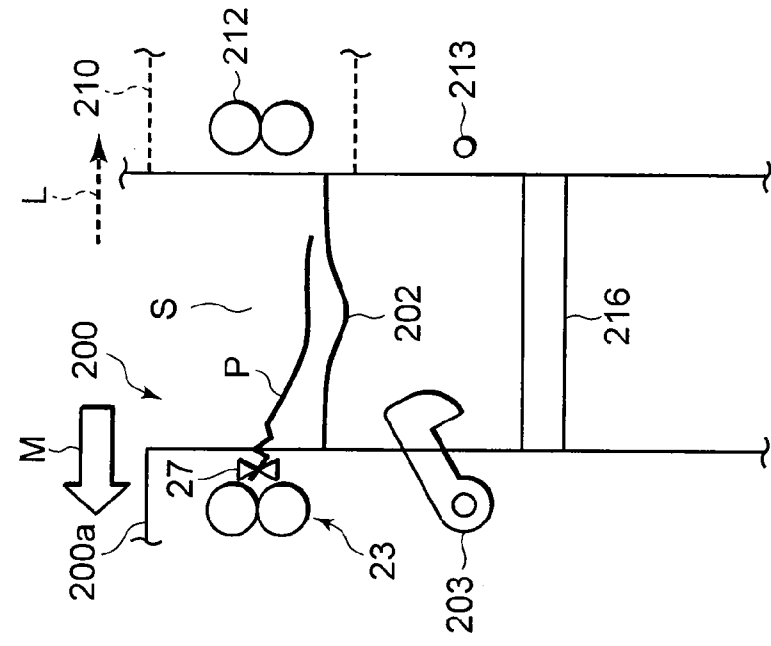


FIG. 16



**PAPER JAM REMOVAL MECHANISM FOR SHEET FINISHING PROCESS DEVICE**

**CROSS-REFERENCE TO RELATED APPLICATION**

[0001] This application is based upon and claims the benefit of priority from Provisional U.S. Applications 61/150,266 filed on Feb. 5, 2009 and 61/178,385 filed on May 14, 2009, the entire contents of which are incorporated herein by reference.

**TECHNICAL FIELD**

[0002] The present invention relates to a mechanism to remove a paper jam in a sheet finisher that finishes a sheet having an image formed thereon by an image forming apparatus such as a copier or MFP (multi-functional peripheral).

**BACKGROUND**

[0003] There is a sheet finisher which performs finishing such as stapling and sorting of a sheet discharged from an image forming apparatus. In the sheet finisher, a sheet discharged from the image forming apparatus may cause a paper jam while the sheet is carried to a finishing unit or a paper discharge tray. Depending on a location where the paper jam occurs, the paper jam may be hard to remove and it may take a long time to remove the jam.

[0004] Thus, it is desired that a paper jam removal mechanism for a sheet finisher that reduces the operation at the time of removing a paper jam and improves maintenance performance should be developed.

**SUMMARY**

[0005] According to an embodiment, a sheet finishing process device includes: a housing unit which houses a sheet discharged from an image forming unit; a carrying unit which is driven in a first direction toward the housing unit from the image forming unit or in a second direction that is opposite to the first direction, and carries the sheet discharged from the image forming unit; a detection unit which detects a paper jam of the sheet in the carrying unit; and a control unit which controls the carrying unit to be driven in the second direction if the detection unit detects the paper jam of the sheet.

**DESCRIPTION OF THE DRAWINGS**

[0006] FIG. 1 is a schematic explanatory view showing a sheet finisher connected to an MFP according to a first embodiment;

[0007] FIG. 2 is a schematic view of configuration showing the sheet finisher according to the first embodiment;

[0008] FIG. 3 is a schematic explanatory view showing the state at the time of connecting a connection lever according to the first embodiment;

[0009] FIG. 4 is a schematic explanatory view showing the state at the time of releasing the connection lever according to the first embodiment;

[0010] FIG. 5 is a schematic view of configuration showing a first gear array according to the first embodiment;

[0011] FIG. 6 is a schematic view of configuration showing a second gear array according to the first embodiment;

[0012] FIG. 7 is a schematic explanatory view showing a sheet striking lever according to the first embodiment;

[0013] FIG. 8 is a flowchart showing a sheet removing process according to the first embodiment;

[0014] FIG. 9 is a schematic explanatory view showing discharge and carrying of a sheet according to the first embodiment;

[0015] FIG. 10 is a schematic explanatory view showing the state at the time of detecting a paper jam according to the first embodiment;

[0016] FIG. 11 is a schematic explanatory view showing the state at the time of starting paper jam removal according to the first embodiment;

[0017] FIG. 12 is a schematic explanatory view showing the state at the time of ending removal and carrying of a sheet according to the first embodiment;

[0018] FIG. 13 is a schematic explanatory view showing a sheet finisher connected to an MFP according to a second embodiment;

[0019] FIG. 14 is a schematic explanatory view showing the state at the time of detecting a paper jam according to the second embodiment;

[0020] FIG. 15 is a schematic explanatory view showing the state at the time of starting paper jam removal according to the second embodiment; and

[0021] FIG. 16 is a schematic explanatory view showing the state at the time of ending removal and carrying of a sheet according to the second embodiment.

**DETAILED DESCRIPTION**

[0022] Hereinafter, a first embodiment will be described. FIG. 1 is a schematic explanatory view showing the arrangement of a finisher 20 as a sheet finishing process device connected to an MFP 10 as an image forming unit according to the first embodiment. The finisher 20 is situated in a hollow body part 10b as a body part which is hollowed provided in a main frame 10a of the MFP 10 having a scanner 8. In the MFP 10, a printer unit 11 forms an image on a sheet P and the sheet P is discharged from paper discharge rollers 12 to the finisher 20. The MFP 10 has a control panel 14 having a display panel 14a, above the printer unit 11.

[0023] The finisher 20 has, for example, a stapler 21 which staples sheets as finishing, as shown in FIG. 2. The finisher 20 has, for example, two carrying roller pairs 23 and 24 as a carrying unit which discharges and carries make the sheet P discharged from the paper discharge rollers 12, in the direction of arrow R as a third direction, which is the direction toward the stapler 21 or a paper discharge tray 22. The finisher 20 has a sheet sensor 27 as a detection unit which detects a paper jam at the carrying roller pairs 23 and 24. After being turned on by the arrival of the sheet P, when the sheet sensor 27 is not turned off because the rear end of the sheet P does not leave even with the lapse of a predetermined time, the sheet sensor 27 detects that a paper jam is occurred.

[0024] In the finisher 20, a connection lever 28 is hung on a boss 13 formed on the printer unit 11, and a frame 20a is connected and fixed to the main frame 10a. The connection lever 28 which is attached to the frame 20a is energized in the direction of arrow A by a spring 30 provided on a shaft 28a.

[0025] In the finisher 20, the carrying roller pairs 23 and 24 and the connection lever 28 are driven by a first motor 50. In the finisher 20, the paper discharge tray 22 is slid by a second motor 51. A control circuit 18 as a control unit is controlled by a finisher CPU 17 that controls the finisher 20. The finisher CPU 17 is connected to an MFP-CPU 40 that controls the MFP 10. The control circuit 18 controls the first motor 50 and

the second motor 51. The control circuit 18 controls the direction of rotation of the first motor 50 in accordance with the result of detection by the sheet sensor 27.

[0026] At the time of carrying the sheet P, the first motor 50 rotates forward and rotates an upper roller 23a of the carrying roller pair 23 forward at a print speed as a first speed to a first direction, that is, the direction of arrow G. For example, a timing belt 26 is laid between the upper roller 23a of the carrying roller 23 and an upper roller 24a of the carrying roller pair 24, and the upper rollers 23a and 24a are rotated forward in the same timing. The carrying roller pairs 23 and 24 rotate forward and discharge and carry the sheet P in the direction of arrow R. At the time of removing a paper jam, the first motor 50 rotates backward and rotates the upper rollers 23a and 24a backward at a removal speed as a second speed that is lower than the print speed to a second direction, that is, the direction of arrow H. At the time of paper jam removal, the carrying roller pairs 23 and 24 rotate backward and remove and carry the sheet P in the direction of arrow T as a fourth direction.

[0027] At the time of backward rotation, the first motor 50 rotates the connection lever 28 in the direction of arrow B. The first motor 50 releases the connection lever 28 by using a release mechanism 60 as a release unit shown in FIG. 3 and FIG. 4. The release mechanism 60 has a release gear 61, an electromagnetic clutch 62 which transmits the rotation of the release gear 61, and a belt laid over the electromagnetic clutch 62 and the connection lever 28. When the first motor 50 rotates forward in the direction of arrow C, the electromagnetic clutch 62 is off and the driving of the first motor 50 is not transmitted to the connection lever 28. The connection lever 28 is hung on the boss 13 by the energizing force of the spring 30 and thus connects the finisher 20 with the MFP 10.

[0028] The control circuit 18 rotates the first motor 50 backward and turns on the electromagnetic clutch 62. As the electromagnetic clutch 62 is turned on, the backward rotation of the first motor 50 in the direction of arrow D is transmitted to the release gear 61, the electromagnetic clutch 62 and the belt 63 and thus rotates the connection lever 28 in the direction of arrow B. When the connection lever 28 is rotated in the direction of arrow B and the connection with the boss 13 is released, a separation spring 16 that stands between the frame 20a and the main frame 10a causes the frame 20a to slide in the direction of arrow N away from the main frame 10a. As the frame 20a slides, a space S is formed between the frame 20a and the main frame 10a.

[0029] When the first motor 50 rotates forward in the direction of arrow C, the first motor 50 rotates the upper carrying roller pair 23a and 24a forward in the direction of arrow G via a first gear array 70 as a first link unit shown in FIG. 5. The first gear array 70 has carrying gears 71 and 72, a planetary gear 74, and a driving gear 76. The driving gear 76 is coaxial with a driving shaft 23b of the upper carrying roller 23a. The upper carrying roller 23a rotates coaxially with the driving gear 76. The upper carrying roller 24a is rotated forward by the timing belt 26 in the same timing as the upper carrying roller 23a.

[0030] When the first motor 50 rotates backward in the direction of arrow D, the first motor 50 drives the upper carrying roller pair 23a and 24a in the direction of arrow H via a second gear array 80 as a second link unit shown in FIG. 6. The second gear array 80 has the carrying gears 71 and 72, the planetary gear 74, removal gears 81, 82, 83 and 84, and the driving gear 76.

[0031] When the first motor 50 rotates forward, the planetary gear 74 attached to a planetary lever 77 energized in the direction of arrow E by the carrying gear 72 meshes with the driving gear 76. Therefore, the first motor 50, by its forward rotation, rotates the driving gear 76 and the upper carrying rollers 23a and 24a forward in the direction of arrow G. When the first motor 50 rotates backward, the planetary gear 74 energized in the direction of arrow F via the planetary gear 77 meshes with the removal gear 81. Therefore, the first motor 50, by its backward rotation, rotates the driving gear 76 and the upper carrying rollers 23a and 24a backward in the direction of arrow H via the removal gears 81 to 84.

[0032] As the backward rotation of the first motor 50 is transmitted via the removal gears 81 to 84, the backward rotation is significantly decelerated with respect to the rotation speed of the first motor 50 and then transmitted to the driving gear 76. Therefore, the backward rotation of the driving gear 76 and the upper carrying rollers 23a and 24a in the direction of arrow H is at a lower speed than the forward rotation in the direction of arrow G. As the upper carrying rollers 23a and 24a are rotated backward at a low speed, the upper carrying rollers 23a and 24a can provide a high torque. Thus, even if there are some creases on the sheet P at the time of paper jam removal, the upper carrying rollers 23a and 24a can securely carry the sheet P in the direction of removal.

[0033] As shown in FIG. 7, the finisher 20 has a striking lever 32 as a regulating part above the carrying roller pair 23. At the time of paper jam removal, the striking lever 32 strikes a part of the sheet P removed and carried toward the space S between the frame 20a and the main frame 10a and changes the flexure direction of the sheet downward. The striking lever 32 returns to a housing position indicated by a dotted line after the striking lever 32 is rotated in the direction of arrow J by a solenoid 33 that is on- and off-controlled by the control circuit 18. The control circuit 18 turns on the solenoid 33 at the same time when turning on the electromagnetic clutch 62 to release the connection lever 28.

[0034] Next, the process of removing the sheet P when a paper jam is occurred will be described with reference to the flowchart of FIG. 8. The finisher 20 starts sheet finishing, rotates the first motor 50 forward in the direction of arrow C, rotates the carrying roller pairs 23 and 24 forward in the direction of arrow G as shown in FIG. 9, and discharges and carries the sheet P discharged from the paper discharge rollers 12 of the printer unit 11, in the direction of arrow R (ACT 100). When there is no paper jam (No in ACT 101) while the sheet P is discharged and carried, the finisher 20 waits for the completion of paper discharge from the paper discharge rollers 12 (Yes in ACT 102) and then finishes the process of removing the sheet P.

[0035] When a paper jam of the sheet P occurs and the sheet sensor 27 detects the paper jam (Yes in ACT 101) as shown in FIG. 10 while the sheet is discharged and carried in the direction of arrow R, the control circuit 18 stops the first motor 50 (ACT 110), then rotates the first motor 50 backward in the direction of arrow D and turns on the solenoid 33 (ACT 111). When the sheet sensor 27 detects the paper jam, the MFP-CPU 40 suspends printing in the printer unit 11.

[0036] As shown in FIG. 11, the first motor 50 rotates the carrying roller pairs 23 and 24 backward in the direction of arrow H and rotates the connection lever 28 in the direction of arrow B. The carrying roller pairs 23 and 24 remove and carry the sheet P in the direction of arrow T and the connection lever 28 release the connection between the frame 20a and the main

frame 10a. The frame 20a slides in the direction of arrow N and thus forms the space S from the main frame 10a.

[0037] The solenoid 33 rotates the striking lever 32 in the direction of arrow J, changes the flexure of the sheet P in the space S downward, and then returns the striking lever 32 to the housing position. The sheet P flexes on a relatively broad side below the carrying roller pair 23 in the space S. As the sheet P flexes on the upper side in the space S, the sheet P may hit the top side of the hollow body part 10b be torn and make it difficult to remove the paper jam. As the striking lever 32 changes the flexure downward, it becomes easier to remove the paper jam.

[0038] When the sheet P is removed and carried in the direction of arrow T by the carrying roller pairs 23 and 24 and the sheet P exits the carrying roller pair 23 as shown in FIG. 12, the sheet sensor 27 turns off (Yes in ACT 112) and detects that the paper jam is removed. After exiting the carrying roller pair 23, the sheet P with its part nipped by the paper discharge rollers 12 hangs down in the space S between the frame 20a and the main frame 10a. The control circuit 18 stops the first motor 50 that is rotating backward (ACT 113). The MFP-CPU 40 displays a message requesting for a removed processing of the paper jam in the space S, for example, on the display panel 14a (ACT 114) and then finishes the process of removing the sheet P.

[0039] The operator removes the sheet P hanging down in the space S in accordance with the message on the display panel 14a. After removing the paper jam, the operator slides the frame 20a in the direction of arrow K, hangs the connection lever 28 on the boss 13 and thus connects the frame 20a to the main frame 10a. When it is detected that the frame 20a is connected to the main frame 10a, the MFP-CPU 40 detects the restoration of the finisher 20 and resumes printing.

[0040] According to the first embodiment, when a paper jam occurs, the finisher 20 rotates the first motor 50 backward, thus automatically removes and carries the sheet P existing in the carrying roller pairs 23 and 24 to the space S between the frame 20 and the main frame 10a, and then discharges the sheet P outside of the finisher 20. The operator can remove the paper jam simply by removing the sheet P that is automatically discharged outside of the finisher 20, without carrying out any operation to remove the sheet P existing within the finisher 20. The operation by the operator at the time of occurrence of a paper jam can be significantly reduced and maintenance performance can be improved.

[0041] Next, a second embodiment will be described. In the second embodiment, the sheet finisher of the first embodiment is arranged on the lateral side of the MFP and thus connected to the MFP. In the second embodiment, the same components of the configuration as those described in the first embodiment are denoted by the same reference numerals and will not be described further in detail.

[0042] FIG. 13 shows a finisher 200 connected to a lateral side of the MFP 10. In the hollow body part 10b of the printer unit 11, a relay unit 210 which relays the sheet P discharged from the paper discharge rollers 12 to the finisher 200 is optionally arranged. The relay unit 210 has a relay guide 211 and relay rollers 212 that are controlled by the MFP-CPU 40. The finisher 200 hangs a connection lever 203 on a boss 213 formed on a lateral side of the printer unit 11 and connects and fixes a frame 200a to the main frame 10a. When the connection lever 203 is released, the frame 200a is slid in the direction of arrow M by a separation spring 216 and the space S is formed between the frame 200a and the main frame 10a.

[0043] The finisher 200 has a fall prevention sheet 202 as a supporting unit which connects the finisher 200 and the printer unit 11 and which prevents the sheet P removed and carried from the finisher 200 from falling and thus supports the sheet P. One side of the fall prevention sheet 202 is attached to the frame 200a of the finisher 200 and the other side is attached to the relay unit 210. At the time of attaching the fall prevention sheet 202 to the frame 200a and the relay unit 210, the fall prevention sheet 202 is arranged in a manner that its front side is lowered.

[0044] When the finisher 200 is connected to the printer unit 11, the fall prevention sheet 202 is folded and housed between the frame 200a and the main frame 10a. When the connection between the finisher 200 and the printer unit 11 is released and the finisher 200 is separated from the printer unit 11, the fall prevention sheet 202 is spread and receives the sheet P removed and carried outward from the finisher 200.

[0045] As shown in FIG. 14, when the sheet sensor 27 detects a paper jam while the carrying roller pairs 23 and 24 are rotated forward in the direction of arrow G to discharge and carry the sheet P in the direction of arrow R, the control circuit 18 stops the first motor 50 and then rotates the first motor 50 backward. The MFP-CPU 40 suspends printing in the printer unit 11. As shown in FIG. 15, the first motor 50 rotates the carrying roller pairs 23 and 24 backward in the direction of arrow H and rotates the connection lever 203 in the direction of arrow B. When the connection lever 203 is rotated and the connection between the frame 200a and the main frame 10a is released, the frame 200a slides in the direction of arrow M and forms the space S from the main frame 10a. As the frame 200a slides in the direction of arrow M, the fall prevention sheet 202 is gradually spread with its front side lowered.

[0046] Therefore, even if the rear end of the sheet P exits the relay rollers 212 of the relay unit 210 and the sheet P is free when the removal and carrying by the carrying roller pairs 23 and 24 is finished, the sheet P removed and carried toward the space S between the frame 200a and the main frame 10a is loaded on the fall prevention sheet 202, as shown in FIG. 16. The fall prevention sheet 202 prevents the free sheet P from falling onto the floor. Even if the sheet P falls down onto the floor, there is no risk that the sheet P falls behind the MFP 10 because the fall prevention sheet 202 is lowered on the front side.

[0047] As the sheet sensor 27 detects the end of the paper jam removal and the MFP-CPU 40 displays a message requesting for a removed processing of a paper jam on the display panel 14a, the operator removes the sheet P on the fall prevention sheet 202. After removing the sheet P from the fall prevention sheet 202, as the operator slides the finisher 200 in the direction of arrow L and connects the finisher 200 to the main frame 10a, the MFP-CPU 40 detects the restoration of the finisher 200 and resumes printing.

[0048] According to the second embodiment, the finisher 200 automatically removes and carries the sheet P causing a paper jam, onto the fall prevention sheet 202 in the space S between the finisher 200 and the main frame 10a. Therefore, the operator can easily remove the paper jam simply by removing the sheet P on the fall prevention sheet 202. The operation by the operator at the time of occurrence of a paper jam can be significantly reduced and maintenance performance can be improved. Also, since the fall prevention sheet 202 supports the sheet P, the sheet P can be prevented from falling onto the floor.

**[0049]** The invention is not limited to the above embodiments and various changes and modifications can be made without departing from the scope of the invention. For example, the finishing carried out by the sheet finishing process device is not limited to stapling. The finishing can include punching, Z-folding and so on. The structure of the link unit or the release unit that drives the carrying unit is not limited, either. The second speed of the carrying unit in the fourth direction with respect to the first speed in the third direction is arbitrary. When the second speed is made lower than the first speed, the torque of the carrying unit when carrying the sheet in the second direction can be increased and the sheet can be removed and carried more securely irrespective of certain deformation. Also, the image forming unit may be arbitrary, such as a color image forming apparatus or a monochrome image forming apparatus.

What is claimed is:

1. A sheet finishing process device comprising:
  - a housing unit which houses a sheet discharged from an image forming unit;
  - a carrying unit which is driven in a first direction or in a second direction that is opposite to the first direction, and carries the sheet discharged from the image forming unit;
  - a detection unit which detects a paper jam of the sheet in the carrying unit; and
  - a control unit which controls the carrying unit to be driven in the second direction if the detection unit detects the paper jam of the sheet.
2. The device of claim 1, wherein the carrying unit is driven in the first direction at a first speed and is driven in the second direction at a second speed that is lower than the first speed.
3. The device of claim 1, further comprising a first link unit which transmits driving of a driving motor to the carrying unit and drives the carrying unit in the first direction, and a second link unit which transmits driving of the driving motor to the carrying unit and drives the carrying unit in the second direction,
  - wherein the first link unit drives the carrying unit at a first speed, and the second link unit drives the carrying unit at a second speed that is lower than the first speed.
4. The device according to claim 3, wherein a torque of the carrying unit that is driven at the second speed is higher than a torque of the carrying unit that is driven at the first speed.
5. The device of claim 1, further comprising a release unit which releases connection between a frame having the carrying unit and the image forming unit.
6. The device of claim 5, wherein the release movement by the release unit is interlocked with the driving of the carrying unit in the second direction.
7. The device according to claim 5, wherein the carrying unit that is driven in the second direction carries the sheet to a space between the image forming unit and the frame.
8. The device of claim 7, further comprising a regulation unit which regulates flexure of the sheet that is carried to the space between the image forming unit and the frame.
9. The device of claim 7, further comprising a supporting unit which supports the sheet that is carried to the space between the image forming unit and the frame.

10. The device of claim 9, wherein the supporting unit is housed between the image forming unit and the frame in a state where the frame is connected to the image forming unit.

11. The device of claim 9, wherein the supporting unit supports the sheet, inclined to be lower toward a front side of the image forming unit.

12. The device of claim 1, further comprising a communication unit which notifies the image forming unit of a paper jam of the sheet when a predetermined time passes after the driving of the carrying unit in the second direction is started.

13. The device of claim 1, wherein a frame having the carrying unit is situated in a body part which is hollowed provided in a main frame of the image forming unit and is connected to the main frame.

14. The device of claim 13, further comprising:

- a release unit which releases the connection between the frame and the main frame, interlocked with the driving of the carrying unit in the second direction; and
- a slide unit which slides the frame, in the body part, in a direction away from a paper discharge unit of the image forming unit when the connection is released by the release unit.

15. A paper jam removing method for a sheet finishing process device comprising:

- carrying a sheet discharged from an image forming unit, in a third direction within a frame connected to the image forming unit;
- carrying the sheet in a fourth direction that is opposite to the third direction when a paper jam of the sheet occurs while the sheet is carried in the third direction;
- releasing the connection between the image forming unit and the frame when a paper jam of the sheet occurs while the sheet is carried in the third direction; and
- carrying the sheet carried in the fourth direction, to a space between the image forming unit and the frame.

16. The method of claim 15, wherein the sheet is carried in the third direction at a first speed and is carried in the fourth direction at a second speed that is lower than the first speed.

17. The method of claim 15, wherein a release movement of the connection between the image forming unit and the frame is interlocked with the carrying of the sheet in the fourth direction.

18. The method of claim 15, wherein flexure of the sheet carried to the space between the image forming unit and the frame is regulated into a predetermined direction.

19. The method of claim 15, wherein the image forming unit is notified of a paper jam of the sheet when a predetermined time passes after the carrying of the sheet in the fourth direction is started.

20. The method of claim 15, wherein the frame is connected to the image forming unit in a body part which is hollowed provided in a main frame of the image forming unit, and by a release movement of the connection between the image forming unit and the frame, the frame is slid in the body part in a direction away from a paper discharge unit of the image forming unit.

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