Embodiments described herein are to a printing apparatus includes a printing mechanism to print information on a plurality of paper sheets and further to sequentially convey the printed paper sheets along a first conveying path. The apparatus further includes a paper holding mechanism provided downstream from the printing mechanism in a paper feed direction, which includes a pair of conveying members configured to face each other via the first conveying path. The apparatus further includes a control unit configured to control the printing mechanism and the paper holding mechanism to convey sequentially the printed paper sheets through a gap between the pair of conveying members so that the printed paper sheets are sequentially accumulated in the paper holding mechanism, and further configured to collectively discharge the printed paper sheets outside of the apparatus by holding the printed paper sheets between the pair of conveying members.
PRINTING APPARATUS AND PAPER HOLDING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2010-198194, filed on Sep. 3, 2010, the entire contents of which are incorporated herein by reference.

FIELD

[0002] Embodiments described herein relate generally to a printing apparatus (e.g., installed in an ATM), and a paper holding device, for use in the printing apparatus, which temporarily holds a plurality of sheets of printed paper in an overlaid state.

BACKGROUND

[0003] An ATM (Automatic Teller Machine), for example, may include a printing apparatus which conveys a paper sheet (which is being discharged from a paper roll) along a conveying path and prints transaction information on the paper sheet using a printing unit. Thereafter, the printing apparatus cuts a printed portion of the paper sheet and ejects the cut printed paper to an outlet, so that a customer may take the ejected paper from the outlet (e.g., as a receipt).

[0004] Such a printing apparatus may successively print a plurality of paper sheets. In this case, the plurality of printed paper sheets are temporarily held in an overlaid state in a holding section and then ejected, so that the customer can easily take them out of the printing apparatus. The plurality of paper sheets are then collectively taken from the holding section and discharged through an outlet.

[0005] The plurality of printed paper sheets fall due to their own weight and are held in the holding section in a vertical state. This requires the holding section to have a vertical dimension corresponding to at least a length of the paper sheets, which also increases the vertical dimension of the printing apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a perspective view of a printing apparatus according to one illustrative embodiment.

[0007] FIG. 2 is a side elevational view showing an internal configuration of the printing apparatus shown in FIG. 1.

[0008] FIG. 3 is an enlarged side elevational view of the paper holding mechanism shown in FIG. 2.

[0009] FIG. 4 is a perspective view of a lower conveying block provided in the paper holding mechanism shown in FIG. 3.

[0010] FIG. 5 is a perspective view showing a state in which a stopper block shown in FIG. 4 is moved downstream in a paper feeding direction PD.

[0011] FIG. 6 is a perspective view showing a state in which a stopper shown in FIG. 5 is disposed horizontally.

[0012] FIG. 7 is a perspective view showing a state in which a stopper shown in FIG. 5 is disposed vertically.

[0013] FIG. 8 is a block diagram showing a drive control system of a printing apparatus according to one illustrative embodiment.

[0014] FIG. 9 is a side view showing a state in which a lower conveying belt is spaced downstream from an upper conveying belt to hold printed paper sheets.

[0015] FIG. 10 is a side view showing a state in which the lower conveying belt shown in FIG. 9 moves upward while holding the printed paper sheets.

[0016] FIG. 11 is a side view showing a state in which printed paper sheets being discharged by the configuration shown in FIG. 10 are collected into a collecting container.

[0017] FIG. 12 is a block diagram showing a printing device according to another illustrative embodiment.

DETAILED DESCRIPTION

[0018] According to one embodiment, a printing apparatus includes a printing mechanism configured to print information on a plurality of paper sheets and further configured to sequentially convey the plurality of printed paper sheets along a first conveying path. The printing apparatus further includes a paper holding mechanism provided downstream from the printing mechanism in a paper feed direction, the paper holding mechanism including a pair of conveying members configured to face each other via the first conveying path. The printing apparatus further includes a control unit configured to control the printing mechanism and the paper holding mechanism to convey sequentially the plurality of printed paper sheets through a gap between the pair of conveying members so that the plurality of printed paper sheets are sequentially accumulated in the paper holding mechanism, and further configured to collectively discharge the plurality of printed paper sheets outside of the apparatus by holding the plurality of printed paper sheets between the pair of conveying members.

[0019] Embodiments will now be described in detail with reference to the drawings.

[0020] FIG. 1 is a perspective view of a printing apparatus (e.g., installed in an ATM) according to one illustrative embodiment. FIG. 2 is a side elevational view showing an internal configuration of the printing apparatus shown in FIG. 1.

[0021] In a printing apparatus A as shown in FIGS. 1 and 2, disposed in one side of a main body 1 is a paper loading unit 54 which loads a sheet material (e.g., a fan-fold thermal paper) 52 therein. The thermal paper 52 is discharged from the paper loading unit 54 to be conveyed to a printer engine 1a over a supply reel 55. The printer engine 1a (referred to as a “printing mechanism”) includes a thermal head 3 and a platen 2, which face each other via a main conveying path 56. The thermal head 3, which is urged against the platen 2 by a head spring 4, prints information on the thermal paper 52, which is being conveyed and interposed between the platen 2 and the thermal head 3.

[0022] A cutter 5 configured to cut a printed portion from the thermal paper 52 is disposed downstream from the thermal head 3 in a paper feeding direction PD.

[0023] A paper holding mechanism 58 configured to hold the cut printed paper sheet is disposed downstream from the cutter 5 in the paper feeding direction PD. As shown in FIG. 3, the paper holding mechanism 58 includes an upper conveying belt 9 and a lower conveying belt 12, which are provided in an approximately horizontal state and face each other via a conveying path 6. The conveying path 6 is connected to the main conveying path 56 as described above.

[0024] The upper conveying belt 9 is stretched between an upper drive pulley 7 and an upper idler pulley 8. The lower conveying belt 12 is stretched between a lower drive pulley 10 and an upper idler pulley 11. The upper conveying belt 9 and the lower conveying belt 12 are stretched and thereby held in a state in which a lower conveying belt is spaced downward from an upper conveying belt to hold printed paper sheets.
and a lower idler pulley 11. The upper drive pulley 7 and the lower drive pulley 10 are driven by a first driving unit (e.g., a first drive motor 13).

[0025] First and second pinch rollers 14 and 15 are disposed upstream from the upper conveying belt 9. A flapper 17 is disposed upstream from the first and second pinch rollers 14 and 15. The flapper 17 is configured to guide the printed paper sheet, which is being reversely conveyed along the conveying path 6 of the paper holding mechanism 56, to a paper collection path 16. The configuration where the printed paper sheet is reversely conveyed will be described later. The flapper 17 is configured so that the tip end thereof (facing toward the first pinch roller 14) is forced upward due to its own weight or by an elastic member such as a spring.

[0026] Disposed at the introduction side of the paper collection path 16 are a drive roller 19 with a one-way clutch, and a third pinch roller 21 configured to be urged against the drive roller 19 by a spring. A collecting container 22 configured to collect the printed paper sheets therein is disposed at the ejection side of the paper collection path 16.

[0027] As shown in FIG. 4, the lower drive pulley 10 and the lower idler pulley 11 as described above are pivotally supported by frames 23 and 24, respectively. These frames 23 and 24 are coupled to each other through a center stay 25, which constitutes a lower conveying block 26.

[0028] FIG. 6 is a perspective view showing a state in which a stopper is disposed horizontally. A paper stopper block 42 as shown in FIG. 6 is slidably mounted on the lower conveying block 26 along the paper feeding direction PD. The paper stopper block 42 includes a stopper frame 44 at which a third driving unit (e.g., a third drive motor 45) is mounted.

[0029] A worm 73 is mounted in the third drive motor 45. The worm 73 is in engagement with a worm wheel 74. A boss 74a of the worm wheel 74 is inserted into an elongated slot 68b which is formed in the middle of a turnable arm 68. The turnable arm 68 is turnably supported at a base end thereof by a support shaft 69.

[0030] One end of a link arm 70 is linked to the turnable arm 68. The other end of the link arm 70 is linked to a stopper shaft 71 through a link arm shaft 72.

[0031] The stopper shaft 71 is fixed to a stopper shaft 46 by a fixing member (e.g., a screw). A pair of stoppers 47 is mounted at both distal ends of the stopper shaft 46, respectively. Thus, the turning force of the turnable arm 68 may be transferred to the pair of stoppers 47.

[0032] First and second stopper detection sensors 51a and 51b are configured to detect if the position of the stopper 47 is disposed along a rotation trajectory of the free end of the turnable arm 68. If the free end of the turnable arm 68 is detected by the first stopper position sensor 51a, this means that the stopper 47 is in an open position (e.g., in an approximately horizontal state). On the other hand, if the free end of the turnable arm 68 is detected by the second stopper position sensor 51b, this means that the stopper 47 is in a paper stop position (e.g., in an approximately vertical state).

[0033] A fixation screw 43 is mounted in the paper stopper block 42. Loosening the fixation screw 43 allows the paper stopper block 42 to be moved in the paper feeding direction PD depending on the length of paper to be used. After the movement of the paper stopper block 42, the fixation screw 43 may be fastened so that the paper stopper block 42 is fixed on the lower conveying block 26.

[0034] Referring back to FIG. 3, a lower cam mechanism 60 is mounted downstream from the lower conveying block 26, while an upper cam mechanism 61 is mounted upstream from the lower conveying block 26.

[0035] The lower cam mechanism 60 includes a front arm 30 and a front cam 31 configured to allow the front arm 30 to be turned up or down along a fulcrum shaft 29. The fulcrum shaft 29 is mounted between main frames 27 and 28 which are disposed at right and left sides of the paper holding mechanism 56 in relation to the paper feeding direction PD. The front cam 31 is rotationally driven by a front cam drive shaft 32. Further, the downstream end of the lower conveying block 26 is biased downward by a spring 33.

[0036] The upper cam mechanism 61 includes a rear cam 34 which is rotationally driven by a rear cam drive shaft 35. The front cam drive shaft 32 and the rear cam drive shaft 35 are driven by a second driving unit (e.g., a second drive motor 36).

[0037] A first paper guide 37, which is turnable up or down along a fulcrum shaft 53 that is located downstream from the lower conveying block 26, is disposed at the upper side of the lower conveying block 26.

[0038] Further, a second paper guide 38 is disposed at the lower side of the upper drive pulley 7. A third paper guide 39 is disposed at the upper side of the first and second pinch rollers 14 and 15. Further, a fourth paper guide 40 is disposed at the lower side of the upper idler pulley 8. A fifth paper guide 41 is disposed at the upper side of the lower drive pulley 10.

[0039] A first paper detection sensor 48 is disposed near a location where the second and third paper guides 38 and 39 are disposed. A second paper detection sensor 49 is disposed near a location where the fourth and fifth paper guides 40 and 41 are disposed.

[0040] A rear cam position detection sensor 50 configured to detect a rotation position of the rear cam 34 is disposed in the main frame 27.

[0041] FIG. 8 is a block diagram showing a drive control system of a printing apparatus according to one illustrative embodiment.

[0042] As shown in FIG. 8, a control unit 62 is connected to a host computer 67, the first and second paper detection sensors 48 and 49, the rear cam position detection sensor 50, and the first and second stopper position sensors 51a and 51b through a signaling circuit. The control unit 62 is further connected to the printer engine 1a, the first drive motor 13, the second drive motor 36, and the third drive motor 45 through a control circuit.

[0043] The following is a description of a paper holding operation of the printing apparatus A according to one illustrative embodiment with reference to FIGS. 3, 7 and 9 to 11.

[0044] When the printing apparatus A is in a standby state (i.e., in a non-printing state), as shown in FIG. 3, the position of the paper stopper block 42 is adjusted and fixed on the lower conveying block 26 by the fixation screw 43 according to a length of paper to be used. Further, the stopper 47 is disposed horizontally to be positioned at the open position. In addition, the lower conveying block 26 is initially positioned in an upper side.

[0045] With this arrangement, when the printing apparatus A receives a printing instruction from the host computer 67, the printer engine 1a performs a printing job on the thermal paper 52 that is being conveyed along the main conveying path 56 in response to the printing instruction. To perform the printing job, the first drive motor 13 is driven to rotate the
upper drive pulley 7 and the lower drive pulley 10. This rotation enables the rotation of the upper conveying belt 9 and the lower conveying belt 12.

[0046] The leading end of the printed thermal paper 52, which is being conveyed from the printer engine 1a, is inserted into the gap between the second paper guide 38 and the flapper 17, and is subsequently conveyed along the conveying path 6 of the paper holding mechanism 58, with the printed thermal paper 52 interposed between the upper conveying belt 9 and the first and second pinch rollers 14 and 15.

[0047] When the leading end of the printed thermal paper 52 is detected by the first paper detection sensor 48, the second drive motor 36 is driven to rotate each of the front cam 31 and the rear cam 34 by 180 degrees. Then, as shown in FIGS. 7 and 9, the lower conveying block 26 moves downward, and simultaneously the third drive motor 45 of the paper stopper block 42 is operated to allow the stopper 47 to be disposed in an approximate vertical state (i.e., in the paper stop position).

[0048] Upon completion of the printing job, the conveyance of the printed thermal paper 52 made by the printer engine 1a and the first drive motor 13 is stopped, and the printed thermal paper 52 is cut by the cutter 5 to obtain a first printed paper sheet. The first printed paper sheet is again conveyed in the paper feeding direction PD by the first drive motor 13. Then, the leading end of the first printed paper sheet abuts against the stopper 47, and at this time, the rear end thereof falls off the third paper guide 39 to be held on the first paper guide 37. Thus, the conveying of the first printed paper sheet is stopped.

[0049] In this arrangement, while both the upper conveying belt 9 and the lower conveying belt 12 are rotating, the upper conveying belt 9 is not in contact with the first printed paper sheet because the first printed paper sheet has already been held on the first paper guide 37. Meanwhile, when the lower conveying block 26 is positioned at an upper side, the lower conveying belt 12 has a convex shape upward compared to the first paper guide 37. On the other hand, as shown in FIG. 9, when the lower conveying block 26 moves downward, the lower conveying belt 12 has a concave shape downward compared to the first paper guide 37. Thus, the lower conveying belt 12 is not in contact with the first printed paper sheet.

[0050] Subsequently, a subsequent printing job is performed to obtain a second printed paper sheet and so on. In a similar manner to that described above, the second printed paper sheet is also conveyed and held on the first paper guide 37. Thus, the second printed paper sheet is stacked on the first printed paper sheet previously placed on the first paper guide 37, by which the position of the lower conveying block 26 is slightly lowered. In this way, an n-th subsequent printing job is performed to obtain an n-th printed paper sheet, which is stacked on an (n−1)-th printed paper sheet. Thereafter, the second drive motor 36 is operated. With the operation of the second drive motor 36, the front cam 31 and the rear cam 34 turn by 180 degrees again, which allows the lower conveying block 26 to move upward, as shown in FIG. 10. Thus, a paper bundle 52a, which is formed by sequentially accumulating the first to the n-th printed paper sheets, is sandwiched between the upper conveying belt 9 and the lower conveying belt 12. At this time, the third drive motor 45 of the paper stopper block 42 is operated so that the stopper 47 as shown in FIG. 7, is disposed horizontally, to thereby be positioned in the open position as described above.

[0051] With the stopper 47 in the open position, the first drive motor 13 is operated to rotate the upper drive pulley 7 and the lower drive pulley 10, which allows the upper conveying belt 9 and the lower conveying belt 12 to be rotated. Thus, the paper bundle 52a, interposed between the upper conveying belt 9 and the lower conveying belt 12, is conveyed downstream in relation to the paper feeding direction PD.

[0052] When the leading end of the paper bundle 52a is detected by the second paper detection sensor 49, as shown in FIG. 10, the paper bundle 52a passes through the gap between the fourth paper guide 40 and the fifth paper guide 41 and is popped out of an outlet by a predetermined length. Thereafter, the first drive motor 13 is stopped to stop further conveyance of the paper bundle 52a.

[0053] Then, a user may take out the paper bundle 52a popped out of the outlet. In this case, the entire receipt issuing process is completed.

[0054] Occasionally, a user may not take out the paper bundle 52a even after a specified time period has lapsed from the time when the paper bundle 52a is popped out of the outlet. In this case, the first drive motor 13 may be reversely operated to allow the upper drive pulley 7 and the lower drive pulley 10 to rotate in a reverse direction. With the reverse-rotation, the upper conveying belt 9 and the lower conveying belt 12 travel from downstream to upstream (i.e., in the opposite direction of the paper feeding direction PD). In this way, the paper bundle 52a, interposed between the upper conveying belt 9 and the lower conveying belt 12, is conveyed upstream. Subsequently, when the rear end of the paper bundle 52a is detected by the first paper detection sensor 48 and is inserted into the gap between the flapper 17 and the third paper guide 39, as shown in FIG. 11, the paper bundle 52a, interposed between the drive roller 19 and the third pinch roller 21, is directed to the collecting container 22, where the paper bundle 52a is stored.

[0055] After the rear end of the paper bundle 52a is detected by the first paper detection sensor 48, the first drive motor 13 rotates in a reverse direction by a predetermined degree, which is required to completely store the paper bundle 52a in the collecting container 22, and stops the rotation.

[0056] In one embodiment, if a length of paper to be printed is changed, the location of the paper stopper block 42 may be adjusted according to the length of the paper.

[0057] For example, an operator may loosen the fixation screw 43 to displace the paper stopper block 42 to a new position, and then may tighten the fixation screw 43 to fix the paper stopper block 42 at the new position. After that, the third drive motor 45 of the paper stopper block 42 may be operated to allow the stopper 47 to be disposed in an approximately vertical state, as shown in FIG. 9. Thus, the printed paper sheet, which is being conveyed in the paper feeding direction PD, abuts against the stopper 47 and remains at the new position, so that the printed paper sheet is held in the paper holding mechanism 58.

[0058] In accordance with the above embodiment, the paper holding mechanism 58 includes the upper conveying belt 9 and the lower conveying belt 12, which face each other via the conveying path 6 in an approximately horizontal direction. This configuration reduces the vertical dimension of the paper holding mechanism, resulting in a compact size of a paper discharge mechanism.

[0059] Further, since a position where the paper stopper block is disposed may be adjusted in the paper feeding direc-
tion according to a length of paper sheet to be printed, paper sheets of various lengths can be held in the paper holding mechanism.

[0060] Furthermore, in accordance with the above embodiment, the collecting container 22 is provided under the paper holding mechanism 58, which makes effective use of space inside the printer apparatus.

[0061] Moreover, even if the paper bundle (e.g., including a plurality of printed paper sheets accumulated on the first paper guide) causes a paper jam, it is possible to remove a jammed paper bundle from the gap between the upper conveying belt 9 and the lower conveying belt 12.

[0062] In the embodiment explained above, the position of the paper stopper block 42 has been explained to be manually adjusted, but the present disclosure is not limited thereto. In an alternate embodiment, the position of the paper stopper block 42 may be automatically adjusted.

[0063] For example, as shown in FIG. 12, a printing apparatus according to another illustrative embodiment further includes a drive mechanism 66 configured to automatically move the paper stopper block 42. The printing apparatus (e.g., mounted in an ATM) may further include a display 64 configured to allow a user to input size information associated with a length of paper. In response to the size information input by the user, a CPU 65 of the printing apparatus controls the drive mechanism 66 so that the paper stopper block 42 is automatically displaced to a certain position (e.g., a position where a printed paper sheet is properly held). This embodiment has the same effect as the embodiments as described above.

[0064] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. A printing apparatus comprising:
   a printing mechanism configured to print information on a plurality of paper sheets and further configured to sequentially convey the plurality of printed paper sheets along a first conveying path;
   a paper holding mechanism provided downstream from the printing mechanism in a paper feed direction, the paper holding mechanism including a pair of conveying members configured to face each other via the first conveying path; and
   a control unit configured to control the printing mechanism and the paper holding mechanism to convey sequentially the plurality of printed paper sheets through a gap between the pair of conveying members so that the plurality of printed paper sheets are sequentially accumulated in the paper holding mechanism, and further configured to collectively discharge the plurality of printed paper sheets outside of the apparatus by holding the plurality of printed paper sheets between the pair of conveying members.

2. The apparatus of claim 1, wherein the paper holding mechanism further comprises a paper stopper provided between the pair of conveying members and configured to allow each of the plurality of printed paper sheets, which is sequentially conveyed through the gap between the pair of conveying members, to be abutted against the paper stopper.

3. The apparatus of claim 2, wherein the paper stopper is slidably mounted in the paper holding mechanism along the paper feeding direction.

4. The apparatus of claim 3, wherein the paper holding mechanism further comprises a fixing member configured to fix the stopping device to a position in the paper holding mechanism according to a length of the paper sheet.

5. The apparatus of claim 3, wherein the paper holding mechanism further comprises a driving member configured to automatically adjust the position of the stopping device in the paper holding mechanism according to a length of the paper sheet.

6. The apparatus of claim 1, further comprising: a collecting container provided under the paper holding mechanism, wherein a flap provided in the second conveying path and configured to guide the plurality of printed paper sheets passing through the second conveying path into the collecting container.

7. The apparatus of claim 1, wherein each of the pair of conveying members comprises one belt stretched between two pulleys.

8. A paper holding device for use in a printing apparatus, comprising:
   a first assembly comprising a first belt provided to extend between two pulleys;
   a second assembly provided to face the first assembly, the second assembly comprising a second belt provided to extend between two pulleys; and
   a paper stopper disposed between the two pulleys of the second assembly and configured to temporarily hold a plurality of printed paper sheets provided sequentially from a printing mechanism through a gap between the first and second assemblies, and further configured to collectively discharge the plurality of printed paper sheets to the outside of the printing apparatus.

9. A paper holding mechanism comprised in the printing apparatus, comprising:
   a driving unit;
   a turnable arm configured to be turned by the driving unit;
   first and second sensors disposed proximate to a free end of the turnable arm, and configured to detect at least two positions of a pair of stoppers; and
   a link arm connected to the turnable arm and configured to transfer the turning force of the turnable arm to the pair of stoppers, wherein the pair of stoppers change position to be in a direction perpendicular or parallel to the paper discharge direction according to the turning of the turnable arm.

10. The device of claim 10, wherein the paper stopper is slidably mounted in the second assembly.
12. The device of claim 10, wherein the paper stopper further includes a fixing member to fix the paper stopper to a position in the second assembly according to a length of the paper sheet.

13. The device of claim 9, wherein the respective two pulleys of the first and second assemblies are driven by different driving units.

14. A printing apparatus, comprising:
   a printing mechanism configured to print information on a plurality of paper sheets;
   a paper holding mechanism provided downstream from the printing mechanism in a paper feed direction and configured to temporarily hold the plurality of printed paper sheets provided sequentially from the printing mechanism along a first conveying path; and
   a control unit configured to control the paper holding mechanism to collectively discharge the plurality of printed paper sheets outside of the apparatus.

15. The apparatus of claim 14, further comprising: a display unit connected to the control unit and configured to allow a user to input size information of the paper sheet, wherein the control unit adjusts the position of the paper holding mechanism based on the size information.

16. The apparatus of claim 14, further comprising: a paper stopper provided in the paper holding mechanism and configured to allow each of the plurality of printed paper sheets to be abutted against the paper stopper.

17. The apparatus of claim 14, further comprising: a collecting container provided under the paper holding mechanism, wherein after a lapse of a specified time period from the time when the plurality of printed paper sheets are discharged outside of the apparatus, the control unit is configured to control the paper holding mechanism to convey the plurality of printed paper sheets in the opposite direction of the paper feeding direction so that the plurality of printed paper sheets is collected in the collecting container along a second conveying path disposed upstream the first conveying path in the paper feeding direction.