

Printing apparatus, control method for a printing apparatus, and recording medium for recording a control program for a printing apparatus

BACKGROUND OF THE INVENTION

1. Field of the invention

The present invention relates to a printing apparatus for printing to a cut-sheet form, and relates to a printing apparatus capable of selecting an operation performed when a cut-sheet form is inserted, to a control method for such printing apparatus, and to a recording medium for storing said control method and related control program.

2. Description of related art

A printer 9 exemplary of the prior art for printing to cut-sheet forms (slip forms) is shown in Fig. 11. As shown in Fig. 11, this printer 9 comprises a horizontal paper path 11 for transporting a slip form 1 from the right side of the figure for printing. Arrayed in sequence from the right side along paper path 11, the printer 9 further comprises: BOF sensor 21 for detecting the presence of a slip form 1 in the paper path 11 and the trailing edge of a form during printing; paper feed roller 31 and paper presser roller 32 for transporting slip forms 1 along paper path 11; platen 36 and print head 37 for printing slip forms 1; TOF sensor 22 for detecting the presence of a slip form 1 in the paper path 11, and the leading edge of the paper; form stop 15 for positioning the paper by contacting the leading edge of slip form 1 inserted to the paper path 11; and a paper guide 14 for guiding the printed slip form 1 to the paper exit.

To print to a specific position on a slip form 1, the slip form 1 must be placed in a specific position and manner in the insertion area 12 of the paper path 11. A form stop 15 is therefore placed in this insertion area 12 such that the leading edge of the inserted slip form 1 contacts the form stop 15, and is thereby consistently loaded to the same position.

Depending upon the user or the type of slip form 1 used, however, the tactile response between the form stop 15 and the leading edge of the slip form 1 varies. If the slip form 1 is not sufficiently stiff and contact with the form stop 15 is therefore soft, for example, the user may not recognize that the slip form 1 has contacted the form stop 15, resulting in the slip form 1 being inserted further and buckling inside the paper path 11. If the slip form 1 is then held by the paper feed roller 31 and paper presser roller 32 and the form stop 15 is released, the leading edge of the slip form 1 tends to shift from the normal

position in the insertion area 12, and the slip form 1 is not printed to the correct position.

On the other hand, if the TOF sensor 22 and BOF sensor 21 detect the form before the leading edge thereof reaches the form stop 15, the slip form 1 will be held by the rollers 31 and 32 after a specific period of time has elapsed, and printing will be enabled. When printing starts in this condition, printing again does not occur to the correct position on the slip form 1.

To resolve this problem, a conventional printer comprised as described above indexes the slip form 1 to the correct position by transporting the slip form 1 in the forward or reverse direction while detecting the leading and trailing edges of the form with the TOF sensor 22 and BOF sensor 21, thereby controlling the leading edge position of the slip form 1 in the insertion area 12.

It should be further noted, however, that if the form is positioned by an indexing operation such as described above, the form stop is not necessarily required. Printers without such a form stop have therefore also been developed.

[Problem to be resolved by the invention]

As described above, a slip form indexing operation is automatically performed when a form is inserted to a conventional printer as a means of ensuring that the form is correctly positioned and is printed at a specific position.

However, there are cases in which it is desirable to position a specific part of a form to be printed to the position traversed by the print head, and then print with the form in said selected position. This is referred to below as "targeted printing." One exemplary application for targeted printing is check printing, or more specifically, printing the amount to a specific position on the check. In the conventional described above, however, a form is automatically indexed to a predetermined position in the paper path 11 when the form is inserted, and targeted printing to a specific desired position on the form is therefore not possible.

For the foregoing reasons, there is a need for a printing apparatus that can selectively apply the process performed when a form or paper to be printed is inserted according to the printing objective, and there is a further need for a recording medium for storing a control method and control program for said printing apparatus.

SUMMARY OF THE INVENTION

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The present invention is therefore directed to a printing apparatus whereby the process performed upon printing form insertion is selectively controlled according to a printing objective.

To achieve said printing apparatus, a printing apparatus according to the present invention comprises: a printing means for printing to a cut-sheet form according to print data or a print command received from a host device; a detection means for detecting the presence of a cut-sheet form; a transportation means for transporting a cut-sheet form; a control means for positioning the leading edge of a cut-sheet form to a specific position based on a detection result from said detection means by driving the transportation means; and a selection means for enabling or disabling control means operation according to a specific command received from a host device. By storing the value set by said selection means, it is only necessary to set the operating state of the control means once, and it is not necessary to change the setting until a change in said operating state is required.

When an indexing operation for automatically setting a form inserted to the printing apparatus to a specific position is not required, the indexing operation can be disabled, thereby enabling the printing apparatus to be used according to the current printing objective. When the indexing operation is disabled, a form to be printed can be inserted with the desired printing position aligned to the printing position of the print head, thereby enabling printing to a selected position.

The printing apparatus of the invention further comprises a means for temporarily enabling operation regulated by the control means irrespective of the selection means setting if the detection result from the detection means indicates there is no paper after print data or a print command has been received from the host device when operation regulated by the control means has been disabled by the selection means.

This makes it possible to prevent paper jams and carriage misalignment when a printing form is inserted after print data or a print command has been received and the indexing operation has been disabled because the indexing operation is temporarily enabled and executed.

A printing apparatus according to the present invention further preferably comprises a first insertion opening for inserting a cut-sheet form parallel to the direction in which a cut-sheet form is transported by the transportation means, and a second insertion opening for inserting a cut-sheet form in a direction substantially perpendicular to said transportation direction.

By thus providing a second insertion opening, a form to be used for targeted printing can be inserted from the second insertion opening, thereby making insertion easier.

In this case, the printing apparatus further preferably comprises a housing for housing at least the printing means where the housing has a mark proximal to the printing means on the second insertion opening side.

This mark can then be used as an index for inserting a printing form for targeted printing, thereby helping to ensure the printing form is correctly positioned and printed.

The present invention is further directed to a method for controlling a printing apparatus comprising an interface for communicating with a host device, a detection means for detecting the presence of a cut-sheet form, a transportation means for transporting a cut-sheet form, and a printing means for printing to a cut-sheet form. A control method according to the present invention comprises: a receiving step for receiving print data or a print command from a host device; a detecting step for detecting the presence of a cut-sheet form; a positioning step for positioning the leading edge of an inserted cut-sheet form to a specific position by transporting and detecting the cut-sheet form; a printing step for printing to the cut-sheet form according to received print data or a received print command; and a skipping step for skipping the printing form positioning step according to a specific command from a host device. By further comprising a storing step for storing the setting controlling whether the printing form positioning step is skipped, it is only necessary to set the execution state of the position step once unless it is necessary to change the setting.

When the positioning step is set to skip and the form detecting step detects that a form is not present, the positioning step is executed.

The control method of a printing apparatus according to the present invention can be provided as a control program implementing the above-described control steps, and can be distributed by means of a recording medium for storing the control program.

The control program can also be provided by means of a computer network or communications network, including the Internet or other on-line communications system. In this case, the control program can be downloaded from such a network for storage to a local recording medium, from which it can then be used by a user's personal computer or printing apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and attainments together with a fuller understanding of the invention will become apparent and appreciated by referring to the following description and claims taken in conjunction with the accompanying drawings, in which like parts are designated by like reference numerals and in which:

Fig. 1 is a perspective view of the appearance of a printer according to a preferred embodiment of the present invention;

Fig. 2 is a typical block diagram of the configuration of the printer shown in Fig. 1;

Fig. 3 is a flow chart used to describe the process for selecting the operation performed when a cut-sheet form is inserted to the printer shown in Fig. 1;

Fig. 4 is a flow chart used to describe the operation controlling loading a form to the printer shown in Fig. 1;

Fig. 5 is a flow chart used to describe the operation controlling a first evaluation process for checking skewing of a form in the printer shown in Fig. 1;

Fig. 6 is a flow chart used to describe the operation controlling a second evaluation process for detecting the leading edge of a form in the printer shown in Fig. 1;

Fig. 7 is a flow chart used to describe the operation controlling a leading edge indexing operation in the printer shown in Fig. 1;

Fig. 8 is a typical plan view illustrating movement of a printing form during the skew detection process shown in Fig. 5;

Fig. 9 is a typical plan view illustrating movement of a printing form during the detection of skew in a different direction from that shown in Fig. 8;

Fig. 10 is a typical plan view illustrating movement of a printing form during a leading edge detection and indexing operation;

Fig. 11 is a typical view of a printer according to the prior art.

Key to the figures

- 1 printing form (cut-sheet form or slip form)
- 2 base
- 3 table
- 4 top cover
- 5 document table
- 6, 7 paper guides
- 8a operating panel

10	printer
11	paper path
12	insertion area
13	targeted printing alignment mark
15	form stop
21	BOF sensor
22	TOF sensor
31	paper feed roller
33	transportation means drive motor
34	transportation means
35	printing area
36	platen
37	print head
40	platen drive mechanism
44	drive solenoid
50	control unit
51	first evaluation unit
52	second evaluation unit
53	indexing unit
54	bypass unit
58	status determination unit
59	flash memory
81	host
83	floppy disk
84	computer network
85	hard disk

DESCRIPTION OF EMBODIMENTS

The preferred embodiments of the present invention are described below with reference to the accompanying figures, of which Fig. 1 is an external perspective view of a printer 10 according to a preferred embodiment of the invention. An arrangement of the substantial components of the printer 10 of the invention are shown in Fig. 2 with particular attention to the components disposed along the paper path 11. As with the printer described above and shown in Fig. 11, the printer 10 of the present embodiment comprises, in order along the paper path 11 from the right side thereof as shown in Fig. 2, a BOF sensor 21, a paper feed roller 31 and paper presser roller 32 of a transportation means 34, a printing area 35 comprising a platen 36 and print head 37, a TOF

sensor 22, and a form stop 15. A paper guide 14 for conducting the printed form 1 to a paper exit is further disposed on a downstream side, shown at the left in the figure.

The printer 10 further comprises a platen drive mechanism 40 for moving platen 36 up and down in a direction perpendicular to paper path 11, and a paper transport mechanism 34 that can be set to an operating or non-operating state in conjunction with platen closing and opening.

The platen drive mechanism 40 comprises a platen frame 42, which functions to raise platen 36 by means of a spring 41; a platen opening/closing shaft 43 for controlling the up and down movement of the platen frame 42 by means of contact with an incline 42a of the platen frame 42; and a drive solenoid 44 for moving the position of the platen opening/closing shaft 43. When the platen opening/closing shaft 43 is moved right and left as seen in the figure by the drive solenoid 44, the platen frame 42 moves up and down, thereby moving the platen 36 into or out of the paper path 11. Movement of platen frame 42 also causes a paper feed roller 31 that is part of the transportation means (paper feed mechanism) 34 to move concomitantly with the platen 36, thereby holding a slip form 1 inserted to an insertion area 12 between the paper presser roller 32 and paper feed roller 31. Movement of the slip form 1 can thus be controlled by the transportation means 34. The transportation means (paper feed mechanism) in a printer 10 according to the present invention is thus set to a non-operating or operating state in conjunction with platen opening and closing.

The platen opening/closing shaft 43 also contacts an incline 16a of paper stop frame 16, which supports the form stop 15 in a pivotable manner. Note that the incline 16a of the paper stop frame 16 slopes in the opposite direction from the incline 42a of the platen frame. As a result, when the platen 36 moves into the paper path 11 as a result of the platen opening/closing shaft 43 moving, the form stop 15 separates from paper path 11. A print form can thus be transported by paper feed roller 31, the print head 37 moved in a direction perpendicular to the paper transport direction by a drive means not shown in the figure, and content can be printed to a desired position on the slip form 1.

As shown in Fig. 1, the printer 10 according to the present embodiment comprises a substantially rectangular base 2 of which the top functions as a table 3 used for paper path 11. At approximately the middle of the base 2 is attached a top cover 4 in which are housed the print head 37 and appurtenant components such as an ink ribbon and carriage mechanism, also not shown in the figure.

A document table 5 is disposed on the slip form 1 insertion side (the front or right side as shown in the figure) of the table 3 as an extension of the table 3, thereby forming a flat paper path 11 continuous to the below the top cover 4. A fixed paper guide 6 extending to a point proximal to the BOF sensor 21 is provided on one side of the document table 5; this fixed paper guide 6 thus forms one edge (the right edge as seen in the figure) 11a of the paper path 11. A short, movable paper guide 7 for adjusting the width of the paper path 11 to the width of the printing form is provided on the side of the paper path 11 opposite the fixed paper guide 6.

It is therefore possible to insert a printing form to the insertion area 12 of the paper path 11 in a printer 10 according to the present embodiment without skewing the form alignment by inserting the slip form 1 with one edge 1c thereof following the fixed paper guide 6.

With a table 3 thus configured, a slip form 1 can be inserted in the X direction shown in Fig. 1 along the paper path 11 using the paper guides 6 and 7, or perpendicularly to the paper path 11 for targeted printing to a specific position 1a on slip form 1 as indicated by arrow Y in Fig. 1. To facilitate printing form alignment in this case, a mark 13 indicating the position of print head 37 travel, and therefore indicative of the printing area 35 of paper path 11, is provided the side 4a of top cover 4 from which the printing form is inserted, that is, the left side as seen in Fig. 1. It is therefore possible to align a form 1 for targeted printing with this mark 13 to facilitate correct positioning.

An operating panel 8a used for local control of a printer 10 according to the present embodiment is provided on the right side of table 3 as seen in Fig. 1. A power switch 8b is provided on the base 2. A control unit 50 for controlling various components of the printer 10 according to a control program and commands indicated using the operating panel 8a is also provided in the printer 10. This control unit 50 comprises flash memory 59 or other storage for storing such information as the control program and settings.

The printer 10 is connected to a host 81 by means of an interface cable 82 or communications interface such as an infrared transceiver, thereby enabling print data, control data, and other information to be exchanged between the printer 10 and host 81.

The printer 10 can be controlled from an application program running on the host 81, or a control program can be received from the host 81 via the interface and written to flash memory 59. The host 81 also has the ability to read and/or write such portable recording media as floppy disks 83 and ROM cards, which can be used to supply a control program to the printer 10.

The host 81 may further have telecommunications functionality enabling communication via the Internet or other computer network 84. When thus comprised, a control program can be received via the network, stored to an internal hard disk 85 or other storage media, and then supplied therefrom to the printer 10.

It will also be obvious that the printer 10 could comprise a LAN driver enabling direct connection to the network such that a control program, print data, or other information can be supplied directly to the printer 10 via the network.

The configuration of control unit 50 comprising a function for controlling the operation for loading (setting) a printing form to the paper path 11 of a printer 10 according to the present embodiment is described in further detail below with reference to Fig. 2. As shown in Fig. 2, control unit 50 comprises a paper detection unit 55, a mechanical control unit 56, a status determination unit 58, a bypass unit 54, flash memory 59, and an interface 57.

The paper detection unit 55 determines whether a form is present using BOF sensor 21 and TOF sensor 22. The mechanical control unit 56 controls, for example, platen 36, transportation means 34, and print head 37. The status determination unit 58 evaluates the printing form loading status based on the detection result output from the paper detection unit 55 when the transportation means 34 is driven in the forward or reverse direction after the transportation means 34 is determined to be operable as a result of slip form 1 detection by the paper detection unit 55.

The status determination unit 58 comprises first and second evaluation units 51 and 52, and an indexing unit 53. The first evaluation unit 51 drives the transportation means 34 in a forward direction, detects printing form presence using BOF sensor 21, and checks for form skewing. The second evaluation unit 52 drives the transportation means 34 in the opposite direction, detects printing form presence using TOF sensor 22, and detects the leading edge of the slip form 1. The indexing unit 53 drives the transportation means 34 a specific distance in the forward direction and detects printing form presence using the TOF sensor 22 to index the form to a specific position. This status determination unit 58 can therefore be used for an auto-loading operation whereby the form 1 is consistently and automatically loaded to the same position.

The bypass unit 54 enables printing to be started without evaluating the form loading status by bypassing the status determination unit 58. The bypass unit 54 therefore enables a form 1 to be inserted with the desired printing

position 1a thereon aligned with the print head (referred to as "positioned insertion" below) for targeted printing directly to a desired position 1a on the printing form 1.

The functional units described above are achieved in a control program stored to flash memory 59, and the instructions of the control program for implementing various processes under appropriate conditions and timings are loaded into a CPU or other processor used as the control unit 50 but not shown in the figure. The control program and other data can be alternatively supplied to the flash memory 59 from the interface 57, thereby enabling the control programs stored in flash memory 59 to be updated and maintained. In addition to being automatically controlled by a control program, the mechanical control unit 56 can also be manually controlled using control panel 8a.

The determination of whether the bypass unit 54 bypasses the status determination unit 58 is controlled by a form insertion selection command from the host 81 for selecting the operation to be executed when a form is inserted. This form insertion selection command has the form "ESC x n " where n is an integer from 1 to 2. In hexadecimal form, this command has the exemplary form "1Bh 78h n ," which, it will be obvious, can be appropriately changed. More specifically, the command ESC x is a predefined command for selecting the process to be implemented when a cut-sheet form is inserted, and parameter n is the argument specifying which process to implement.

In an exemplary embodiment of the invention, a value $n = 1$ does not bypass the status determination unit 58 and enables the auto-loading operation. A value $n = 2$ bypasses the status determination unit 58 and enables the above-noted positioned insertion operation.

Use of this form insertion selection command is described in further detail below with reference to the flow chart in Fig. 3.

The procedure starts when command data or print data sent from a host is received (step ST 101). It is then determined whether the received data is a form insertion selection command (ST 102).

If the received data is not a form insertion selection command, a process appropriate to the receive command data or other data is performed (ST 103).

If the received data is a form insertion selection command, the value of parameter n is determined (ST 104). If n is 1, auto-loading is enabled (ST 105); if n is 2, positioned insertion is enabled (ST 106).

Note that by storing the insertion mode information detected by this process to RAM or other storage device, it can be referenced in subsequent processes to determine what process to execute at form insertion.

The operation of the component units of control unit 50 is described in further detail below with reference to the flow charts shown in Fig. 4 to Fig. 7.

Fig. 4 shows a series of steps for setting printing form 1 in printer 10 of the present embodiment.

When a printing instruction or printing data is supplied from the host 81 in step ST1, bypass unit 54 determines whether targeted printing (positioned insertion) is enabled. If targeted printing is enabled, the presence of paper is detected using TOF sensor 22 and BOF sensor 21 in step ST2. If printing form 1 has been set in insertion area 12 of paper path 11 and if both TOF sensor 22 and BOF sensor 21 indicate the presence of paper, platen 36 is closed in step ST3 and paper transport mechanism 34 is made operable.

The process then shifts to step ST12 and printing begins.

On the other hand, if targeted printing is not enabled in step ST1, the process shifts to step ST4 and printer 10 waits for printing form 1 to be set in insertion area 12 of paper path 11. If printing form 1 is not set in insertion area 12 in step ST2 even though an instruction for targeted printing was received, targeted printing is canceled, the process shifts to step ST4, and printer 10 waits for printing form 1 to be set in insertion area 12.

Targeted printing is disabled at this time to prevent form buckling or bending, interference with traverse movement of the print head 37 and the resulting misalignment or desynchronization of the carriage, or paper jams as a result of the user inserting a form from the X direction (Fig. 2) rather than the Y direction and keep pushing a form. The procedure therefore shifts to step ST4 to prevent this by temporarily enabling the auto-loading operation. Note that an inserted form will not become buckled or bent in a printer in which there is no form stop. In this case, therefore, it is possible to wait in step ST2 until a form is inserted without shifting to step ST4.

When printing form 1 is set in insertion area 12 and both TOF sensor 22 and BOF sensor 21 indicate the presence of paper in step ST4, platen 36 is closed in step ST5 and paper transport mechanism 34 is made operable in conjunction therewith.

As described above, printer 10 of the present embodiment checks the loading status of printing form 1 before beginning printing when printing form 1 is set in insertion area 12 of paper path 11 and paper transport mechanism 34 becomes operable. For this reason, the loading status of the printing form is checked in steps ST6, ST8, and ST10. To accomplish this, first evaluation unit 51 performs a first evaluation process whereby transportation means 34 is

driven in the forward direction (printing form 1 insertion direction) to check for skew step ST6.

This first evaluation process (step ST6) is described in detail below with reference to the flow chart in Fig. 5. A typical plan view of printing form 1 when skewed in paper path 11 is shown in Fig. 8.

At step ST21 in Fig. 5, transportation means 34 is driven an appropriate distance P1 in forward direction V as shown in Fig. 8, and a first form detection operation is then performed in step ST22 after waiting for the output of BOF sensor 21 to stabilize. If as a result of this detection BOF sensor 21 determines in step ST23 that a form is not present, printing form 1 is skewed to paper path 11 as shown in Fig. 8. An error flag is therefore set in step ST24.

However, if BOF sensor 21 determines that paper is present in step ST23, printing form 1 is not skewed to paper path 11, the error flag is cleared (step ST25), and the transportation means 34 is driven in the direction opposite from that in step ST21 by distance P1 (step ST26), returning printing form 1 to its original position.

As shown in Fig. 8, BOF sensor 21 is a paper sensor provided in paper path 11 for detecting the presence of slip forms 1 and the end of the paper being printed, and is positioned near fixed paper guide 6 outside (before) insertion area 12. As a result, BOF sensor 21 senses right edge 1c of printing form 1, which contacts paper guide 6. Consequently, if printing form 1 has not been inserted along paper guide 6 and only partially contacts paper guide 6, BOF sensor 21 will not detect printing form 1 as it moves along paper path 11, and skew can be detected.

In printer 10 of the present embodiment, paper guide 6 is relatively long and BOF sensor 21 is installed relatively close to the inside end (the insertion direction side) of paper guide 6, which guides right edge 1c of printing form 1. Consequently, if the paper is skewed to the left relative to the forward direction (insertion direction) V, there is little possibility that BOF sensor 21 will sense the paper in step ST4, and thus platen 36 will not close. However, printing form 1 can also become skewed to the right relative to paper path 11. The slip form 1 is therefore advanced in step ST21 to detect skewing on the right side as seen in the figure. While distance P1 in the forward direction can be set to an appropriate value based on the width of paper path 11 and the size of paper guide 6, a range from several millimeters to several centimeters is sufficient.

If paper guide 6 is relatively small or if BOF sensor 21 is installed in a position near the front (reverse travel direction) of paper guide 6, there is a tendency for skewing to the left as shown in Fig. 9. In this case, skew can be

detected by driving the transportation means 34 an appropriate distance in the reverse direction W in Fig. 9, and similarly detecting form presence after the form is reversed a particular distance.

Instead of using the BOF sensor 21 for skew detection by detecting the trailing edge of the slip form 1, it is also possible to detect skew using the TOF sensor 22 to detect the leading edge, that is, the insertion end, of the slip form 1 placed to the entrance to the insertion area 12. Skew detection, however, requires detecting edge 1c of printing form 1, and there is a greater tendency for tears or wrinkles to appear on the long side at the leading edge of a printing form 1. The detection rate therefore drops if TOF sensor 22 is placed near this edge 1c.

In a printer 10 according to the present embodiment, the TOF sensor 22 is therefore placed in the middle of the paper path 11 to improve the printing form 1 detection rate, and the BOF sensor 21 is placed proximal to the fixed paper guide 6 to reliably detect the edge 1c of printing form 1 and dependably detect skewing.

Referring again to Fig. 4, if skewing is detecting and the error flag is set in step ST6, an error routine is implemented in step ST7, platen 36 is opened in step ST15, and the transportation means 34 is concomitantly released, thus freeing printing form 1. A message prompting the user to reset the printing paper is also displayed on the host 81 or printer 10. The printer 10 then waits for printing form 1 to be removed from insertion area 12 as determined by TOF sensor 22 no longer detecting printing form 1. When the printing form 1 is removed, the procedure returns to step ST4 and the printer waits for printing form 1 to be reset.

If it is confirmed in step ST6 that the form is not skewed, the process shifts to step ST8 and the second evaluation unit 52 executes a second evaluation process whereby the printing form 1 is reversed to detect the leading edge 1b of the printing form 1 in the paper path 11.

This second evaluation process (step ST8 in Fig. 4) is described in detail below with reference to the flow chart in Fig. 6. A typical plan view of the printing form 1 in the paper path 11 when the leading edge 1b of the form is detected is shown in Fig. 10.

At step ST31, a variable i, which is used in the subsequent steps for counting the number of times reverse transportation occurs, is initialized to 0, and is then immediately incremented 1 in step ST32. The transportation means 34 is then driven in reverse direction distance P2 (step ST33), and a second form detection operation is performed in step ST34 after waiting for the

output of TOF sensor to stabilize. If as a result of this detection TOF sensor 22 determines in step ST35 that a form is not present, the leading edge 1b of printing form 1 has passed the position of TOF sensor 22, and the position of leading edge 1b of paper 1 has been confirmed. An error flag is therefore cleared in step ST36, and the procedure ends.

On the other hand, if the presence of paper is indicated in step ST35, the position of leading edge 1b cannot be confirmed. If counter i is equal to or less than a predetermined count C0, the process returns to step ST32 and the reverse feeding and leading edge detection loop repeats.

If counter i exceeds the predetermined count C0 in step ST37, the position of leading edge 1b of paper 1 cannot be confirmed even though transportation means 34 has been driven the specified distance. An error flag is therefore set in step ST38, and the procedure ends.

As shown in Fig. 10, form stop 15 interrupts the paper path 11 when a printing form 1 is inserted to the insertion area 12 of the paper path 11, and the leading edge 1b of printing form 1 therefore stops against the form stop 15. The leading edge 1b of printing form 1 should therefore become aligned with position L of the form stop 15. However, contact between the leading edge 1b of printing form 1 and the form stop 15 can be hard for the user to detect depending on the type of medium used for the printing form 1. When this happens, there is a tendency to continue inserting the printing form 1 even though it is fully inserted to the form stop 15, resulting in the platen 36 closing with the form buckled or bent inside the paper path 11. When the form stop 15 is then retracted in order to start printing, the leading edge 1b of printing form 1 typically extends forward into the paper path 11 to a position M inside from the form stop 15. Irrespective of the tactile response of contact with the form stop 15, inserting the printing form 1 with excessive force can also result in the platen 36 closing with the form buckled or bent inside the paper path 11, again advancing forward of the form stop 15. The form can also bounce off the form stop 15, resulting in the platen 36 closing and printing starting without the leading edge 1b of printing form 1 positioned at the form stop 15.

The reference position for printing printing form 1 is determined with platen 36 closes and transportation means 34 holding printing form 1. Therefore, in order to accurately print to the desired location on printing form 1, the leading edge 1b of each form must be set to the same position. The printer 10 according to the present embodiment therefore confirms the position of the leading edge 1b by reversing the printing form 1 inserted to the paper path 11. The distance (pitch) P2 used for this reverse feed process is preferably

approximately plural millimeters with the precise distance determined by such considerations as the printing precision and the detection precision of the TOF sensor 22. The leading edge 1b of printing form 1 can thus be precisely and reliably positioned by detecting the leading edge 1b concurrently to feeding the form in a reverse direction at a known pitch. Therefore, even if the user does not insert the leading edge 1b of printing form 1 to the same position, the leading edge 1b can be automatically aligned to a particular position N on the entrance side of the TOF sensor 22 by reversing the printing form 1 in direction W in Fig. 10 until the leading edge 1b passes the TOF sensor 22.

Paper jams and other problems can also result when the printing form 1 is inserted wrinkled or bent inside the paper path 11, and printing will not occur normally if started with the printing form 1 thus loaded. In a printer 10 according to the present embodiment, an error is generated in step ST38 when the leading edge 1b is not detected even though the form is reversed a specific distance by the transportation means 34 in step ST37. When an error is detected at step ST9 in Fig. 4, the error routine starting from step ST15 is executed.

This error routine causes the user to be prompted to reset the printing form 1 when the form cannot be correctly positioned because of a possible paper jam or other cause, and prevents printing from starting.

It is therefore possible using a printer 10 according to the present invention to reliably print personal checks and other forms without wasting forms due to loading errors, and such cut-sheet forms can be reliably loaded to a specific position.

When the leading edge 1b of printing form 1 is detected by the TOF sensor 22 at step ST8, the indexing unit 53 operates in step ST10. This causes the printing form 1 to be advanced and indexed to the desired position.

This indexing operation (step ST10) is described in detail below with reference to the flow chart in Fig. 7. A typical plan view of the printing form 1 in the paper path 11 for the indexing operation described below is shown in Fig. 10.

It should be noted that the indexing position for the leading edge 1b of printing form 1 in step ST8 can be set in a printer 10 according to the present embodiment to position N in Fig. 10, that is, to a position on the outside side of the TOF sensor 22 relative to the paper path 11. However, this printer 10 uses position L at the form stop 15 as the reference position for printing. It is therefore necessary to advance the leading edge 1b from position N forward again to position L. At step ST10, therefore, the form is advanced a small

distance in the forward direction until the TOF sensor 22 again detects the leading edge 1b for indexing. The form is therefore advanced in step ST41 the same pitch distance P2 used for reverse feeding in step ST8, and the leading edge is detected after waiting for the output of TOF sensor to stabilize. If as a result of this detection TOF sensor 22 detects the form in step ST43, indexing is completed, an error flag is therefore cleared in step ST44, and the procedure ends.

However, if the form is not detected in step ST43, the form is again advanced in the direction of arrow V, but this time using a distance P3 that is shorter than distance P2, and the form is detected in step ST 46 after waiting for the output of TOF sensor to stabilize. If the TOF sensor 22 detects the form in step ST47, indexing is completed, an error flag is therefore cleared in step ST44, and the procedure ends. If the TOF sensor 22 was unable to detect the form in step ST47, an error flag is set in step ST 48 to indicate that there is a problem, and the indexing operation stops.

As thus shown in Fig. 10, the indexing operation of step ST10 can align the leading edge 1b of printing form 1 to position L at the form stop 15 by advancing the leading edge 1b of printing form 1 in forward direction V from position N. The printing form 1 can therefore be transported reliably referenced to this same position for printing in the printing area 35 of the platen 36 (the printing position of the print head 37) with excellent precision and good reproducibility.

As described above, a printer 10 according to the present invention can selectively perform an auto-loading operation and a positioned insertion operation based on a supplied command selecting the form insertion operation to perform. When the positioned insertion operation is selected and auto-loading is disabled, the user can easily insert a form for printing to a desired location. A printer 10 according to the present invention can therefore easily accommodate printing from the leading edge (top edge) of a cut-sheet form as commonly performed with POS printers, as well as printing to a specific position on a cut-sheet form as required for printing an amount on a check. A printing form can thus be loaded either automatically or manually for reliably printing to a specific position conforming to a particular format.

It will be obvious that while the present invention has been described with reference to a printer comprising a form stop, it can also be applied to a printer not having a form stop. In this type of printer, the platen and transportation rollers can be closed and printing started when the BOF sensor and TOF sensor detect that a form has been inserted when positioned insertion

(targeted printing) is selected. When auto-loading is selected, skew and the leading edge of the form are detected as described above, and printing can again commence reliably referenced to a common printing position.

It will also be obvious that the control method for the above described printing apparatus according to the present invention can be provided as a control program for executing the processes shown in the accompanying flow charts and stored to any recording medium that can be read or accessed by a CPU or other processor. Such a control program can obviously be provided using a wide range of media, including but limited to floppy disks and other non-fixed, exchangeable media. In addition, the control program can be provided via a computer network or communications network, including the Internet, and can be recorded to a hard disk or other fixed recording medium.

Advantages of the Invention

As will be known from the preceding description, a printing apparatus according to the present invention can selectively implement the operation performed when a cut-sheet form is inserted thereto, and can therefore be used with either auto-loading or manually positioned insertion loading according to the specific printing objective. If manually positioned insertion loading is selected, targeted printing to a manually adjusted printing position is possible with the printing form used as positioned by the user. A printer that can be used for printing to media of different formats can therefore be provided.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

WHAT IS CLAIMED IS:

1. A printing apparatus for communicating with a host device through an interface, said printing apparatus comprising:
 - a printing means for printing to a cut-sheet form according to print data or a print command received from a host device;
 - a detection means for detecting the presence of a cut-sheet form;
 - a transportation means for transporting a cut-sheet form;
 - a control means for positioning a leading edge of a cut-sheet form to a specific position based on a detection result from said detection means by driving the transportation means; and
 - a selection means for enabling or disabling operation of the control means according to a specific command received from the host device.
2. The printing apparatus according to claim 1, further comprising a storage means for storing a value set by the selection means.
3. The printing apparatus according to claim 1, further comprising a means for temporarily enabling operation regulated by the control means irrespective of the selection means setting if a detection result from the detection means indicates there is no paper after print data or a print command has been received from the host device when operation regulated by the control means has been disabled by the selection means.
4. The printing apparatus according to claim 1, further comprising a first insertion opening for inserting a cut-sheet form parallel to the direction in which a cut-sheet form is transported by the transportation means; and
 - a second insertion opening for inserting a cut-sheet form in a direction substantially perpendicular to said transportation direction.
5. The printing apparatus according to claim 4, further comprising a housing for housing at least the printing means where the housing has a mark proximal to the printing means on the second insertion opening side.
6. A control method for controlling a printing apparatus comprising an interface for communicating with a host device, a detection means for detecting the presence of a cut-sheet form, a transportation means for transporting a cut-sheet form, and a printing means for printing to a cut-sheet form, said control method comprising:



a receiving step for receiving print data or a print command from a host device;

a detecting step for detecting a presence of a cut-sheet form;

a positioning step for positioning a leading edge of an inserted cut-sheet form to a specific position by transporting and detecting the cut-sheet form;

a printing step for printing to the cut-sheet form according to received print data or a received print command; and

a skipping step for skipping the printing form positioning step according to a specific command from a host device.

7. The printing apparatus control method according to claim 6, further comprising:

a storing step for storing a setting controlling whether the printing form positioning step is skipped.

8. The printing apparatus control method according to claim 6, wherein when the positioning step is set to skip and the form detecting step detects that a form is not present, the positioning step is executed.

9. A recording medium for recording a control program for a printing apparatus comprising:

a receiving process for receiving print data or a print command from a host device;

a detecting process for detecting a presence of a cut-sheet form;

a positioning process for positioning a leading edge of an inserted cut-sheet form to a specific position by transporting and detecting the cut-sheet form;

a printing process for printing to the cut-sheet form according to received print data or a received print command; and

a skipping process for skipping the printing form positioning process according to a specific command from a host device.

10. A control program recording medium according to claim 9, wherein the control program further comprises:

a storing process for storing a setting controlling whether the printing form positioning process is skipped.

11. A control program recording medium according to claim 9,



wherein when the positioning process is set to skip and the form detecting process detects that a form is not present, the positioning process is executed.

