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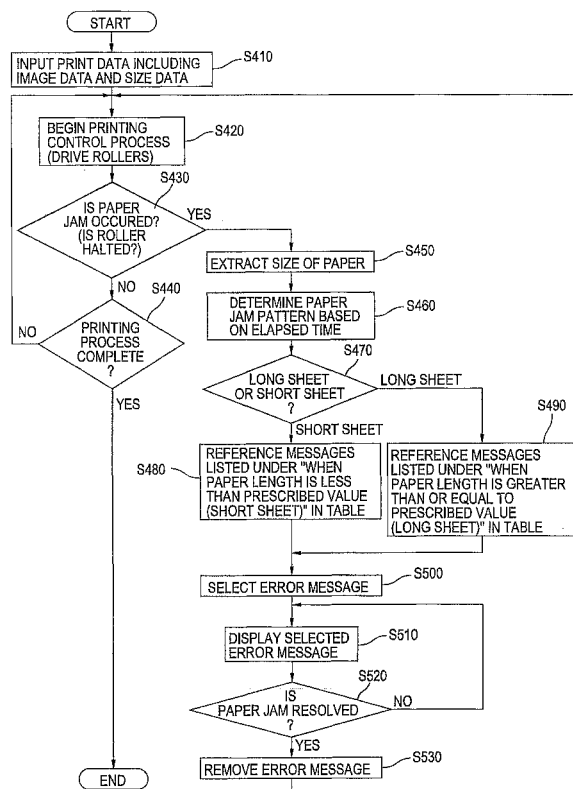
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(54) **Conveying system for an image-forming device**

(57) The conveying device includes a conveying unit, a detecting unit, a first display unit, and a first control unit. The conveying unit conveys a cut sheet along a conveying path (S420). The detecting unit detects a jam of the cut sheet on the conveying path (S430). The first display unit displays information. The acquiring unit acquires

length data indicating a length of the cut sheet (S450, S460). The first control unit controls the first display unit to display information (S500, S510). The first control unit selects, based on the length data, jam information indicating an occurrence of the jam and controls the first display unit to display the selected jam information (S480, S490).

FIG.8



Description

TECHNICAL FIELD

[0001] The invention relates to a conveying device for conveying a sheet-like medium, a conveying system provided with the conveying device, an image-forming device in which the conveying device conveys a recording medium, and an image-forming system provided with the image-forming device.

BACKGROUND

[0002] Image-forming devices for forming images on paper are commonly equipped with a conveying device configured of various rollers for conveying the paper. The conveying device conveys sheets of paper loaded in a tray along a prescribed conveying path, and the image-forming device forms images on the paper at a prescribed position during the conveying process.

[0003] In an image-forming device having this construction, a sheet of paper conveyed along the conveying path occasionally becomes jammed for one of various reasons, preventing the sheet of paper from being properly conveyed through the conveying device and discharged therefrom. Various technologies have been proposed for assisting the user in resolving such paper jams (i.e., instructions for removing the jammed paper). One such technology provides the image-forming device with paper jam sensors disposed at locations along the conveying path, and a display unit for displaying instructions to the user on how to resolve a paper jam (how to remove the jammed paper) when a paper jam is detected by one of the sensors.

SUMMARY

[0004] In the conventional image-forming device, if a paper jam occurs when a sheet of paper has been conveyed to a position near a discharge section on the downstream end of the paper-conveying path, the image-forming device displays a message indicating that a paper jam occurred near the discharge section with instructions to open a cover near the discharge section in order to remove the paper.

[0005] If the paper is relatively short in this case, the user can resolve the paper jam by following the displayed instructions. However, if the paper is considerably long, it is possible that the jammed sheet of paper extends along the entire paper-conveying path, even though the jam occurred near the discharge section. If the user follows the displayed instructions in this case by attempting to remove the jammed sheet from the area near the discharge section, the sheet may be difficult to extract. It is possible that the user will tear the sheet by forcibly attempting to pull the sheet out of the discharge section, leaving torn remnants of the paper inside the image-forming device.

[0006] Accordingly, the conventional method of displaying instructions as guidance for resolving paper jams cannot always identify the position at which a paper jam occurred due to the different lengths of paper that may be used in printing operations, and cannot always display the most suitable method for resolving the paper jam. Consequently, the conventional method cannot sufficiently support users in resolving paper jams.

[0007] In view of the foregoing, it is an object of the invention to provide an image-forming device that provides the user with appropriate support for resolving paper jams, regardless of the length of the sheet of paper that becomes jammed.

[0008] In order to attain the above and other objects, the invention provides a conveying device. The conveying device includes a conveying unit, a detecting unit, a first display unit, and a first control unit. The conveying unit conveys a cut sheet along a conveying path. The detecting unit detects a jam of the cut sheet on the conveying path. The first display unit displays information. The acquiring unit acquires length data indicating a length of the cut sheet. The first control unit controls the first display unit to display information. The first control unit selects, based on the length data, jam information indicating an occurrence of the jam and controls the first display unit to display the selected jam information.

[0009] According to another aspect, the invention provides a computer-readable storage medium storing a set of program instructions executable on a computer included in a conveying device having a conveying unit that conveys a cut sheet along a conveying path and a display unit that displays information. The program instructions includes detecting a jam of the cut sheet on the conveying path, acquiring length data indicating a length of the cut sheet, selecting, based on the length data, jam information indicating an occurrence of the jam, and controlling the display unit to display the selected jam information.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The particular features and advantages of the invention as well as other objects will become apparent from the following description taken in connection with the accompanying drawings, in which:

[0011] Fig. 1 is a center cross-sectional view of a laser multifunction peripheral according to a first embodiment;

[0012] Fig. 2 is a block diagram illustrating an electrical structure of an image-forming system according to the first embodiment;

[0013] Fig. 3 is an example of a paper jam error message table according to the first embodiment;

[0014] Fig. 4 is an example of an error message displayed on an LCD;

[0015] Fig. 5 is a flowchart illustrating steps in a printing control process executed by the laser multifunction peripheral according to the first embodiment;

[0016] Fig. 6 is a flowchart illustrating steps in a process for displaying a status of the laser multifunction pe-

ripheral executed by a PC;

[0017] Fig. 7 is an example of a paper jam error message table according to a second embodiment; and

[0018] Fig. 8 is a flowchart illustrating steps in a printing control process executed by the laser multifunction peripheral according to the second embodiment.

DETAILED DESCRIPTION

[0019] A laser multifunction peripheral according to embodiments of the invention will be described while referring to the accompanying drawings.

[First Embodiment]

(1) Overall structure of a laser multifunction peripheral

[0020] As shown in Fig. 1, the multifunction peripheral 1 according to the embodiment is integrally provided with a monochromatic printing unit 3, and a flatbed scanning unit 5 disposed above the printing unit 3. A discharge section 7 is provided between the printing unit 3 and the scanning unit 5. The discharge section 7 is for discharging sheets of a recording medium (hereinafter referred to as "paper") P, such as paper or transparency sheets, after the printing unit 3 has formed images (printed) on the paper. The sheets of paper P are accommodated in a paper tray 31 described later.

[0021] The printing unit 3 is configured of an electrophotographic image-forming device that forms images on sheets of paper P by transferring toner images thereon. The scanning unit 5 is configured of a flatbed image-reading device for scanning images from an original document placed in a stationary state on the bed of the scanning unit 5.

[0022] The printing unit 3 includes a casing 10 accommodating an image-forming unit 20 for forming images on the paper P, a feeding unit 30 for feeding sheets of paper P toward the image-forming unit 20, and a conveying unit 40 configured of a conveying path L. The conveying path L leads from the feeding unit 30 to the discharge opening 9 for guiding sheets of paper P along the bottom of the image-forming unit 20 to undergo image formation and subsequently to guide the sheets upward while reversing the conveying direction approximately 180 degrees to discharge the sheets through the discharge opening 9. A fixing unit 23 is disposed on the conveying path L between the image-forming unit 20 and the discharge opening 9. As described in detail, a U-shaped curved section is disposed on the conveying path between the fixing unit 23 and the discharge opening 9. The U-shaped curved section has a substantially U-shape.

[0023] An opening 12 is formed in the rear side of the casing 10 near the U-shaped section of the conveying path L, enabling an operator to mount the fixing unit 23 described later in the casing 10 or to remove the fixing unit 23 therefrom and to remove sheets of paper P that

become jammed in the conveying unit 40, the fixing unit 23, and the like. A rear cover 41 is mounted on the casing 10 or a frame (not shown) supporting the casing 10 and is capable of pivoting about a shaft 41A between a closed position and an open position for covering or exposing the opening 12.

[0024] A discharge tray 11 is provided on the top surface of the casing 10 above the fixing unit 23 for receiving and supporting one or more sheets of paper P discharged from the casing 10 through a discharge opening 9. The image-forming unit 20, the conveying unit 40, and the like are mounted on the frame forming part of the main body of the multifunction peripheral 1.

[0025] The feeding unit 30 includes the paper tray 31, the paper tray 31 (paper cassette), a pickup roller 32, a separating roller 33, and a separating pad 34. The paper tray 31 is detachably mounted in the bottom section of the casing 10 and can be inserted or removed in the front-to-rear direction. The pickup roller 32 is disposed above the front edge of the paper tray 31 for conveying sheets of paper P to the image-forming unit 20. The separating roller 33 and the separating pad 34 is disposed on the downstream side of the pickup roller 32 along the conveying path L for separating sheets of paper P conveyed by the pickup roller 32 so that the sheets are conveyed one at a time. A plurality of sheets of paper P is stacked in the paper tray 31, as illustrated in Fig. 1. The pickup roller 32 is disposed so as to contact the top surface of the topmost sheet of paper P among the sheets accommodated in the paper tray 31.

[0026] The sheets of paper P that can be accommodated in the paper tray 31 include various standard sizes, such as A4, A5, B5, letter, postcard, envelope, and legal, as well as user-defined custom paper sizes.

[0027] The pickup roller 32 and the separating roller 33 are fixed to the casing 10, while the separating pad 34 is fixed to the paper tray 31. Hence, the peripheral surface of the separating roller 33 is in contact with the separating pad 34 when the paper tray 31 is completely mounted in the casing 10 (the state shown in Fig. 1). However, the separating roller 33 is separated from the separating pad 34 when the paper tray 31 is removed from the casing 10 (pulled forward) since the separating pad 34 also moves forward together with the paper tray 31.

[0028] A pair of conveying rollers 35 is disposed downstream of the separating roller 33 along the conveying path L of the paper P and function to convey sheets of paper P received from the pickup roller 32 toward the image-forming unit 20. A pair of registration rollers 36 is disposed at the entrance (upstream) side of the image-forming unit 20 and functions to apply a prescribed resistance to the conveyed sheets of paper P in order to correct their conveyed orientation.

[0029] The image-forming unit 20 includes an exposure device 21 (scanner), a developing device 22, and the fixing unit 23. The exposure device 21 is disposed in the top section of the casing 10 and functions to form an

electrostatic latent image on the surface of a photosensitive drum 22A described later. Although not shown in the drawing, the exposure device 21 is specifically configured of a laser light source, a polygon mirror, an fθ lens, and reflecting mirrors.

[0030] The developing device 22 is detachably mounted in the casing 10 below the exposure device 21. The developing device 22 is configured of the photosensitive drum 22A for carrying a toner image to be transferred onto a sheet of paper P, a charger 22B for applying a charge to the surface of the photosensitive drum 22A, and a developer-accommodating section 22C for accommodating developer (toner in powder form).

[0031] A supply roller 22D and a developing roller 22E are disposed between the developer-accommodating section 22C and the photosensitive drum 22A for supplying developer discharged from the developer-accommodating section 22C to the photosensitive drum 22A. That is, the supply roller 22D rotates to supply developer discharged from the developer-accommodating section 22C onto the developing roller 22E, and the developing roller 22E carries developer supplied from the supply roller 22D on the surface thereof and supplies this developer to the surface of the photosensitive drum 22A after the photosensitive drum 22A has been exposed to the exposure device 21.

[0032] A transfer roller 22G is disposed at a position opposing the photosensitive drum 22A on the opposite side of the conveying path L along which the sheets of paper P are conveyed. The transfer roller 22G is given an electric charge of opposite polarity to the charge applied to the photosensitive drum 22A (the transfer roller 22G carries a negative charge in the embodiment). When the transfer roller 22G is rotated in synchronization with the photosensitive drum 22A, the developer image produced on the surface of the photosensitive drum 22A is transferred to the printing surface of the paper P.

[0033] The fixing unit 23 includes a heating roller 23A, a pressure roller 23B, and a casing 23C. The heating roller 23A is disposed on the side of the conveying path L opposing the printed surface of the paper P for applying heat to the developer image formed on the sheet. The pressure roller 23B is disposed on the opposite side of the conveying path L from the heating roller 23A for pressing the sheet of paper P against the heating roller 23A. The casing 23C is for accommodating the heating roller 23A and the pressure roller 23B. The fixing unit 23 is detachably mounted on the frame.

[0034] The conveying unit 40 is disposed downstream of the fixing unit 23 in the conveying direction of the paper P and includes the U-shaped section of the conveying path L that extends from the fixing unit 23 to the discharge opening 9. The conveying unit 40 functions to convey sheets of paper P discharged from the fixing unit 23 onto the discharge tray 11. Next, the structure of the conveying unit 40 will be described in greater detail.

[0035] The conveying unit 40 includes a pair of conveying rollers 42A and 42B that rotate in contact with a

sheet of paper P discharged from the fixing unit 23 for conveying the sheet downstream. In the embodiment, the conveying roller 42A disposed below the conveying roller 42B is a drive roller that applies a conveying force to the paper P, while the conveying roller 42B provided above the conveying roller 42A is a follow roller that presses the sheet of paper P against the conveying roller 42A and follows the rotation of the conveying roller 42A to convey the sheet of paper P.

[0036] A reversing guide 43 is disposed downstream of the conveying rollers 42A and 42B in the conveying direction. The reversing guide 43 is provided at the curved section of the conveying path L having the substantially U-shape and functions to guide the sheets of paper P discharged from the conveying rollers 42A and 42B upward while changing the conveying direction substantially 180 degrees.

[0037] A pair of discharge rollers 46A and 46B is disposed on the furthest downstream part of the conveying path L (i.e., near the discharge opening 9) for discharging sheets of paper P onto the discharge tray 11. In the embodiment, the discharge roller 46A is a drive roller that contacts the sheet of paper P on the upper surface and applies a conveying force thereto, while the discharge roller 46B is a follow roller that contacts the bottom surface of the sheet and presses the sheet against the discharge roller 46A while passively following the rotation of the discharge roller 46A.

[0038] A front cover 13 is provided on the front side of the casing 10. The front cover 13 is mounted on the casing 10 and is capable of pivoting relative to the casing 10 about a shaft 13A. The developing device 22 is detachable from the open side of the casing when the front cover 13 opens. By opening the front cover 13, the user or the operator of the multifunction peripheral 1 can view the interior of the printing unit 3 from the front of the multifunction peripheral 1. Accordingly, the operator opens the front cover 13 when it is necessary to replace the developing device 22, to perform various maintenance in the printing unit 3.

[0039] A control panel 48 is also provided on the front end of the scanning unit 5. The control panel 48 includes various operating switches, and a liquid crystal display (LCD) 49. The user can perform settings on the multifunction peripheral 1 by operating the switches provided on the control panel 48. Various data related to the multifunction peripheral 1 is displayed on the LCD 49 provided in the control panel 48, enabling the user to learn the status of the multifunction peripheral 1 and various operating conditions.

[0040] The conveying path L of the paper P is indicated by a broken line in Fig. 1. The pickup roller 32 feeds sheets of paper P accommodated in the paper tray 31 onto the conveying path L in the conveying direction, at which time the sheets begin to follow the conveying path L. At the beginning of conveyance, the sheets of paper P are separated by the separating roller 33 and the separating pad 34 so as to be conveyed one sheet at a time

toward the developing device 22 via the pairs of conveying rollers 35 and the registration rollers 36 downstream.

[0041] As the sheet of paper P passes between the photosensitive drum 22A and the transfer roller 22G (a nip part), the developing device 22 forms an image on the sheet, i.e., transfers a developer image produced on the photosensitive drum 22A onto the paper P. After the image is transferred, the paper P is conveyed to the fixing unit 23 where the image is fixed to the sheet. After the image is fixed to the sheet, the pair of conveying rollers 42A and 42B disposed downstream of the fixing unit 23 conveys the sheet toward the discharge opening 9, and the pair of discharge rollers 46A and 46B disposed at the downstream end of the conveying path L discharges the sheet onto the discharge tray 11 through the discharge opening 9.

[0042] The printing unit 3 in the multifunction peripheral 1 according to the embodiment is further provided with three paper jam sensors A, B, and C disposed at positions along the conveying path L. The upstream paper jam sensor A is disposed between the pair of registration rollers 36 and the pair of conveying rollers 35 upstream therefrom. The sensor A is on while a sheet is passing the location of the sensor A and is off while a sheet is not passing the location of the sensor A (i.e., when the sheet is not present at the position of the sensor A).

[0043] The downstream sensor C is disposed between the pair of conveying rollers 42A and 42B downstream of the fixing unit 23 and the pair of discharge rollers 46A and 46B disposed farther downstream. As with the sensor A, the sensor C is on while a sheet is passing and off while a sheet is not passing (i.e., when the sheet is not present at the position of the sensor C).

[0044] The center sensor B positioned between the sensors A and C on the conveying path L is located between the pair of registration rollers 36 and the developing device 22 positioned farther downstream. As with the sensors A and C, the sensor B is on while a sheet of paper P is passing and off while a sheet is not passing (i.e., when the sheet is not present at the position of the sensor B).

[0045] In the embodiment, the paper jam sensors A, B, and C are mechanical switches that are switched off by the urging force of a spring when in a released state and are switched on when receiving the pressing force of a sheet of paper P passing (contacting) the switch. However, a mechanical switch is merely one example of a device that can be used as the paper jam sensors A, B, and C. The invention does not limit the particular construction of the sensors, provided that the sensors can detect the presence of a sheet of paper P at their location.

[0046] The multifunction peripheral 1 of the embodiment detects a paper jam based on the relative change in the states of the three paper jam sensors A, B, and C (ON/OFF states). This detection will be described later in greater detail.

(2) Overall structure of an image-forming system

[0047] As shown in Fig. 2, the image-forming system 50 includes the multifunction peripheral 1 of Fig. 1 described above and a personal computer (hereinafter abbreviated as "PC") 60 as an example of a data processor. The multifunction peripheral 1 and the PC 60 are connected to each other by a universal serial bus (USB) cable, an Internet cable such as an Ethernet (registered trademark) cable, or a wireless LAN or other communication network and are capable of bi-directional data communications.

[0048] The electrical structure of the multifunction peripheral 1 is roughly configured as shown in Fig. 2. Specifically, the multifunction peripheral 1 includes the printing unit 3, the scanning unit 5, and the control panel 48 described earlier, as well as a control unit 51 for controlling these components, and a communication interface 57 for exchanging various data with the PC 60.

[0049] The control unit 51 is primarily configured of a microcomputer that includes a CPU 52, a ROM 53, a RAM 54, an EEPROM 55, and a timer 56. The control unit 51 controls each component of the multifunction peripheral 1 including the printing unit 3, the scanning unit 5, the control panel 48, and the communication interface 57 based on various control programs stored in the ROM 53.

[0050] The control unit 51 also functions to detect whether a paper jam occurred during a printing operation (while a sheet of paper P is being conveyed on the conveying path L) based on the states of the three paper jam sensors A, B, and C. Upon detecting a paper jam, the control unit 51 displays an error message on the LCD 49 indicating that a paper jam occurred.

[0051] In the embodiment, the error message displayed when a paper jam occurs is set according to one of eight preset paper jam patterns 1-8 corresponding to the position of the paper jam occurrence, as illustrated in Fig. 3 described later in greater detail. The content of the error message includes the position at which the paper jam occurred and the method of resolving the paper jam.

[0052] The content of the error message is further adjusted appropriately based on the length of the sheet of paper P being conveyed and consequently may differ for even the same position of paper jam occurrence (paper jam pattern).

[0053] Error messages displayed when paper jams occur are pre-stored in the ROM 53 in a paper jam error message table (see Fig. 3). When detecting a paper jam, the control unit 51 selects an error message from the paper jam error message table based on the position of occurrence (paper jam pattern) and the length of the sheet of paper P and displays this error message on the LCD 49.

[0054] The PC 60 is generally configured of a control unit 61, a user interface 67, a communication interface 66 for exchanging various data with the multifunction pe-

ripheral 1, and a graphical interface 68 for outputting an image to be displayed on a display 70 connected thereto. The control unit 61 includes a CPU 62, a ROM 63, a RAM 64, and a hard disk drive (HDD) 65. The user interface 67 is configured of a keyboard, mouse, and the like (not shown).

[0055] An operating system (OS) and various application programs, such as word-processing software and image-editing software, are installed on the HDD 65 of the control unit 61. Accordingly, the user can print images on a sheet of paper P with the multifunction peripheral 1 after creating and editing the images in application programs.

[0056] When the user inputs a print command, various print data including the command, the image data, and paper size data are inputted into the multifunction peripheral 1 from the control unit 61. At this time, the control unit 51 processes the various print data and prints the images on a sheet of paper P using the printing unit 3, while displaying the printing status and the like on the LCD 49.

[0057] In addition to a function for printing image data received from the control unit 61, the multifunction peripheral 1 has functions for printing images from an original document scanned by the scanning unit 5 and for directly reading and printing image data stored on USB memory or the like.

[0058] When performing a process to print images on a sheet of paper P with the printing unit 3, the control unit 51 specifically drives the various rollers 32, 33, 35, 36, 42A, and 46A provided along the conveying path L in order to convey the sheet of paper P, while controlling operations of the image-forming unit 20 to form images on the sheet.

[0059] The control unit 51 also transmits data being displayed on the LCD 49 to the PC 60 in response to a status query received from the PC 60. As will be described later, the PC 60 issues periodic status queries to the multifunction peripheral 1. When the multifunction peripheral 1 has data to be displayed on the PC 60 side, the PC 60 receives this data as a response to the status query and displays the data on the display 70.

(3) Paper jam detection and error messages

[0060] Next, the process for detecting paper jams in the printing unit 3 of the multifunction peripheral 1 will be described. A paper jam can occur in the printing unit 3 for one of various reasons while a sheet of paper P is being conveyed along the conveying path L during a printing operation. Therefore, the control unit 51 of the multifunction peripheral 1 monitors the occurrence of paper jams and detects the position at which the paper jam occurred based on the three paper jam sensors A, B, and C provided along the conveying path L.

[0061] Each of the paper jam sensors A, B, and C outputs an ON signal while a sheet of paper P is passing thereby, and outputs an OFF signal while a sheet is not

passing thereby. In order to detect the occurrence of paper jams, the control unit 51 of the multifunction peripheral 1 monitors the time that elapses after a sheet of paper P is initially conveyed and until each of the paper jam sensors A, B, and C turns on, and the time that elapses after each of the paper jam sensors A, B, and C turns on until the respective paper jam sensors A, B, and C turn off.

[0062] For example, the control unit 51 determines that a paper jam has occurred if the sensor A on the upstream end of the conveying path L does not turn on when a prescribed time has elapsed after the beginning of conveyance, indicating that the sheet of paper P did not reach the position of the sensor A. The control unit 51 also determines that a paper jam has occurred when the upstream sensor A turned on but the center sensor B has not turned on after a subsequent prescribed time has elapsed. The control unit 51 also determines that a paper jam has occurred when the center sensor B turned on but the downstream sensor C has not turned on after a subsequent prescribed time has elapsed.

[0063] When a paper jam occurs, the control unit 51 detects the position of the sheet of paper P that becomes jammed based on the combination of on/off signals from the paper jam sensors A, B, and C at the time of detection. That is, the control unit 51 determines one of the paper jam patterns 1-8 described later corresponding to the currently detected paper jam. Next, the control unit 51 selects an error message from the paper jam error message table stored in the ROM 53 based on the determined paper jam pattern and the length of the sheet.

[0064] Fig. 3 shows an example of the paper jam error message table stored in the ROM 53. In the embodiment, the paper jam error message table shown in Fig. 3 has eight paper jam patterns 1-8 corresponding to various combinations of output signals received from the paper jam sensors A, B, and C when a paper jam occurs, and error messages corresponding to each of the paper jam patterns. Different error messages are stored for each paper jam pattern based on the length of the sheet of paper P.

[0065] In the embodiment, the control unit 51 selects one of the two error messages for the corresponding paper jam pattern based on whether the length of the sheet is less than a prescribed value (a relatively short sheet, or a short sheet) or greater than or equal to the prescribed value (a relatively long sheet or a long sheet). Here, the two error messages corresponding to each of the paper jam patterns 1-8 are not necessarily different when printing on a short sheet or a long sheet. Specifically, in the embodiment, the two error messages differ between short sheets and long sheets only for paper jam patterns 4-7.

[0066] Accordingly, the same error message can be used for appropriately guiding the user in resolving the paper jam for paper jam patterns 1-3 and 8, regardless of the length of the sheet of paper P.

[0067] Next, the status, error messages, and methods

of resolution for paper jams corresponding to the eight paper jam patterns 1-8 in the embodiment will be described.

(3-1) Paper jam pattern 1

[0068] Paper jam pattern 1 denotes a case in which all of the paper jam sensors A, B, and C are off when the control unit 51 detects a paper jam. This pattern may arise when a paper jam occurs within a relatively short time after the paper P is initially conveyed. Paper jam pattern 1 likely indicates a paper jam occurring near the feeding unit 30 before the sheet reaches the initial sensor A.

[0069] The error message displayed for paper jam pattern 1 is "JAM A Open tray and remove paper," whether the sheet of paper is shorter than the prescribed value (short sheet) or greater than or equal to the prescribed value (long sheet).

[0070] The "JAM A" portion of this error message indicates that the paper jam occurred near the feeding unit 30 immediate after conveyance begins (hereinafter referred to as a "feeding unit jam"), "Open tray" is an instruction telling the user to pull out the paper tray 31, and "remove paper" is an instruction telling the user to extract the jammed sheet of paper P.

[0071] In other words, the error message displayed for paper jam pattern 1 notifies the user that a paper jam occurred near the feeding unit 30 and instructs the user to open the paper tray 31 and remove the jammed sheet.

[0072] Thus, if a sheet becomes jammed near the feeding unit 30, the user should open the paper tray 31 and remove the jammed sheet, whether the paper P is short or long.

(3-2) Paper jam pattern 2

[0073] Paper jam pattern 2 denotes a case in which the upstream sensor A is on, while the remaining sensors B and C are off when the control unit 51 detects a paper jam. This pattern likely indicates that the sheet of paper P becomes jammed near the pair of registration rollers 36 after the leading edge of the sheet passes the initial sensor A.

[0074] The error message displayed for paper jam pattern 2 is "JAM A Open tray and remove paper," whether the sheet of paper P is shorter than the prescribed value or longer than the prescribed value. This message is the same as paper jam pattern 1 described above.

[0075] Hence, even though the jammed paper according to paper jam pattern 2 has progressed to a position slightly downstream from that in paper jam pattern 1, this case can be treated as a feeding unit jam occurring immediately after conveyance is begun, and the user can resolve the paper jam by opening the paper tray 31. Accordingly, the same error message used for paper jam pattern 1 is also set for paper jam pattern 2.

(3-3) Paper jam pattern 3

[0076] Paper jam pattern 3 denotes a case in which the two upstream sensors A and B are both on while the downstream sensor C is off when the control unit 51 detects a paper jam. This pattern is likely the result of a paper jam occurring near the developing device 22, near the fixing unit 23, or near the pair of conveying rollers 42A and 42B downstream of the fixing unit 23, for example.

[0077] The error message displayed for paper jam pattern 3 is "JAM B Open front cover and remove paper," regardless of whether the sheet of paper P is shorter than the prescribed value or greater than or equal to the prescribed value.

[0078] In this error message, "JAM B" signifies that the paper jam occurred in substantially the middle section of the conveying path L (hereinafter referred to as an "interior paper jam"), while "Open front cover" is an instruction telling the user to open the front cover 13.

[0079] In other words, the error message for paper jam pattern 3 notifies the user that a paper jam occurred in the interior section of the multifunction peripheral 1 and instructs the user to open the front cover 13 to extract the jammed sheet of paper P.

[0080] In the case of an interior paper jam, the user opens the front cover 13 and removes the jammed sheet, regardless of whether the sheet is long or short. When necessary, it is also possible to remove the developing device 22.

(3-4) Paper jam pattern 4

[0081] Paper jam pattern 4 denotes a case in which the upstream sensor A and the downstream sensor C are both on, while the middle sensor B is off when the control unit 51 detects a paper jam.

[0082] Since the middle sensor B is off, this pattern occurs when the length of the sheets of paper P is short. For example, it is possible that the paper jam occurred when one sheet of paper P is conveyed to a position near the end of the conveying path L, while the next sheet to be printed is conveyed from the paper tray 31 and arrives at least at the position of the upstream sensor A.

[0083] When both the upstream and downstream sensors A and C are on when printing on a long sheet of paper P, naturally the center sensor B should also be on at this time. Accordingly, paper jam pattern 4 essentially cannot occur when long sheets of paper P are being printed. However, it is conceivable that a sheet of paper P is present at the position of the center sensor B, but that the sensor B cannot detect the sheet (does not turn on) due to bending or sagging in the sheet. Since there is such a possibility for paper jam pattern 4 to exist even when printing on a long sheet of paper P, differing error messages are provided for cases in which the sheets of paper P are short and long. Thus, the appropriate error message is displayed according to the length of the

sheet.

[0084] Specifically, the error message for paper jam pattern 4 is "JAM C Open rear cover and remove paper" when the length of the sheet of paper P is less than the prescribed value (a short sheet). In this error message, "JAM C" indicates that a paper jam occurred in the downstream section of the conveying path L (hereinafter referred to as a "discharge section paper jam") and "Open rear cover" is an instruction telling the user to open the rear cover 41. Hence, the error message used for paper jam pattern 4 when printing on shorter sheets of paper P notifies the user that a paper jam occurred in the latter half of the conveying path L and instructs the user to open the rear cover 41 and extract the jammed sheet.

[0085] By opening the rear cover 41 to resolve the paper jam in the case of this discharge section paper jam, the user can at least remove the sheet contacting the downstream sensor C.

[0086] However, it is likely that a separate sheet contacting the upstream sensor A has not been removed. Accordingly, after the sheet has been extracted from the rear cover 41, the error status switches from paper jam pattern 4 to paper jam pattern 2 and the error message for paper jam pattern 2 is displayed. Hence, the user must subsequently extract the sheet contacting the upstream sensor A according to the displayed error message.

[0087] The error message displayed for paper jam pattern 4 when the length of the paper P is greater than the prescribed value (a long sheet) is "JAM Open rear cover and open tray; remove paper from rear side." In this error message, "JAM" indicates that a paper jam has occurred while a long sheet of paper P occupies a relatively wide range of the conveying path L, "Open rear cover and open tray" is an instruction telling the user to open both the rear cover 41 and the paper tray 31, and "remove paper from rear side" is an instruction telling the user to extract the sheet of paper P from the rear cover 41 side (through the opening 12).

[0088] If a paper jam corresponding to paper jam pattern 4 occurs when using long sheets of paper P, it is likely that the leading edge of the sheet reached the downstream end of the conveying path L, while the trailing edge is near the feeding unit 30 and pinched between the separating roller 33 and the separating pad 34. In such a case, it may be difficult to extract the sheet of paper P simply by opening the rear cover 41 and attempting to pull the sheet out from the rear cover 41 side and may result in the sheet tearing in the interior of the printing unit 3 if the user pulls with too much force.

[0089] Therefore, if long sheets of paper P are being used, the user opens the rear cover 41 and pulls out the paper tray 31 to separate the separating pad 34 from the separating roller 33, reducing the restraining force on the sheet near the feeding unit 30. Consequently, the sheet can easily be removed from the rear cover 41 side.

(3-5) Paper jam pattern 5

[0090] Paper jam pattern 5 denotes a case in which all three paper jam sensors A, B, and C are on when the control unit 51 detects a paper jam.

[0091] This pattern is likely the result of a paper jam occurring when a plurality of short sheets of paper P is present along the conveying path L or when a single long sheet becomes jammed in the conveying path L while extending through at least the positions of the three paper jam sensors A, B, and C.

[0092] The error message displayed for paper jam pattern 5 when the length of the paper P is less than the prescribed value (a short sheet) is "JAM C Open rear cover and remove paper." This message is identical to the error message used for paper jam pattern 4 when printing on short sheets. Similarly to paper jam pattern 4, after the sheet has been extracted from the rear cover 41, the error status switches from paper jam pattern 4 to paper jam pattern 2 and the error message for paper jam pattern 2 is displayed. Hence, the user must subsequently extract the sheet contacting the upstream sensor A according to the displayed error message.

[0093] When the length of the sheet of paper P is greater than or equal to the prescribed value (a long sheet), the error message for paper jam pattern 5 is "JAM Open rear cover and open tray; remove paper from rear side." This message is identical to the error message used for paper jam pattern 4 when printing on long sheets.

[0094] Therefore, when a paper jam corresponding to paper jam pattern 5 occurs, the user can resolve the paper jam according to the same procedure used for paper jam pattern 4 described above.

(3-6) Paper jam pattern 6

[0095] Paper jam pattern 6 denotes a case in which the upstream sensor A is off, while the other sensors B and C are on when the control unit 51 detects a paper jam. For this pattern, it is possible that the leading edge of a sheet of paper P has arrived at the downstream end of the conveying path L or has already been discharged through the discharge opening 9, while the trailing edge of the paper P has passed the upstream sensor A.

[0096] The error message displayed for paper jam pattern 6 when the length of the paper P is less than the prescribed value (a short sheet) is "JAM C Open rear cover and remove paper." This message is identical to the error message used for paper jam patterns 4 and 5 when printing on short sheets of paper P.

[0097] However, when the length of the paper P is greater than or equal to the prescribed value (a long sheet), the error message for paper jam pattern 6 is "JAM Open rear cover and remove paper." Hence, the part of the error message indicating the position of the jam occurrence is simply changed from "JAM C" used in the error message for short sheets to "JAM." The part of the message related to the method of resolving the paper

jam is the same, whether the sheets are long or short.

(3-7) Paper jam pattern 7

[0098] Paper jam pattern 7 denotes a case in which the center sensor B is on while the other sensors A and C are off when the control unit 51 detects a paper jam. This case may result from a paper jam occurring with a short sheet of paper P when the paper P is positioned in the center of the conveying path L.

[0099] Generally, the condition in which only the center sensor B is on will not occur with a long sheet of paper P. However, as described with reference to paper jam pattern 4, there is a possibility that another sensor will not detect the presence of the sheet due to bending or sagging in the sheet. Accordingly, since paper jam pattern 7 may result even with a long sheet of paper P, different error messages are set for short and long sheets and selectively displayed based on the length of the sheet of paper P.

[0100] The error message corresponding to paper jam pattern 7 when the length of the paper P is less than the prescribed value (a short sheet) is "JAM B Open front cover and remove paper," which is the same as the error message for paper jam pattern 3 when printing on short sheets of paper P.

[0101] The error message corresponding to paper jam pattern 7 when the length of the sheet is greater than or equal to the prescribed value (a long sheet) is "JAM Open rear cover and open tray; remove paper from rear side," which is the same as the error message corresponding to paper jam patterns 4 and 5 when printing on a long sheet of paper P.

(3-8) Paper jam pattern 8

[0102] Paper jam pattern 8 denotes a case in which the downstream sensor C is on while the other sensors A and B are off when the control unit 51 detects a paper jam. This case may result if a paper jam occurs when conveyance of the sheet is nearly complete, regardless of the length of the sheet.

[0103] Accordingly, the error message corresponding to paper jam pattern 8 is "JAM C Open rear cover and remove paper" for both cases in which the length of the paper P is shorter than the prescribed value (a short sheet) and greater than or equal to the prescribed value (a long sheet). This message is the same as the error message corresponding to paper jam patterns 4-6 when printing on a short sheet of paper P.

[0104] The length of the sheet of paper P can be uniquely determined based on the absolute size of the sheet, whereby a sheet smaller than the A4 size is considered a short sheet and a sheet greater than or equal to the A4 size is considered a long sheet, for example.

[0105] However, if the multifunction peripheral 1 is large and has a long conveying path L, it may be appropriate to treat an A4-size sheet as a short sheet relative

to the long conveying path L. Conversely, if the multifunction peripheral 1 is compact and has a short conveying path L (shorter than the length of an A4-size sheet, for example), it may be appropriate to treat an A4-size sheet as a long sheet relative to this short conveying path L.

[0106] Hence, in the embodiment, the paper P is determined to be either a short sheet or a long sheet based on the relationship between the overall length of the conveying path L and the size of the paper P, and the prescribed value used as reference for determining whether a sheet is short or long is set accordingly.

[0107] As shown in Fig. 4, the error messages corresponding to paper jam patterns 1-8 shown in Fig. 3 are displayed on the LCD 49 of the control panel 48. Fig. 4 shows an example of an error message displayed on the LCD 49 when paper jam pattern 4 occurs while printing on a long sheet of paper P.

[0108] In the embodiment, the LCD 49 is capable of displaying two rows of 16 characters each. Therefore, as shown in Fig. 4, the initial display state for this example is "JAM Open rear cover ", and more specifically, "JAM" is displayed in the first row and "Open rear cover" in the second row. If the user then performs a scrolling operation on the control panel 48, the characters displayed in the second row are shifted leftward 16 characters so that each subsequently portion of the message not displayed in the initial display appears in the second row after each scrolling operation.

[0109] The same content displayed on the LCD 49 is similarly displayed on the display 70 of the PC 60.

(4) Printing control process executed on the multifunction peripheral

[0110] Next, a printing control process executed by the control unit 51 of the multifunction peripheral 1 when print data is received from the PC 60 will be described with reference to Fig. 5. Fig. 5 is a flowchart illustrating steps in the printing control process executed by the control unit 51. Upon receiving print data from the PC 60, the CPU 52 of the control unit 51 reads a program for the printing control process from the ROM 53 and performs the process based on the program.

[0111] In S110 at the beginning of the printing control process, the CPU 52 performs a process to input the print data from the PC 60. The print data received from the PC 60 includes a command to execute a printing operation, image data representing the image to be printed on the paper P, and size data indicating the size of the paper P to be subjected to the printing process.

[0112] In S120 the CPU 52 begins a process to print images on the paper P based on the inputted print data. More specifically, the CPU 52 controls the driving of the pickup roller 32 and various other rollers to begin conveying the sheet of paper P and controls the image-forming unit 20 to begin printing on the sheet.

[0113] In S130 the CPU 52 determines whether a pa-

per jam has occurred. This step is performed after the printing process in S120 has progressed a prescribed amount. Here, the prescribed amount indicates a feeding amount of the recording sheet that is estimated by counting a start time of the recording sheet. If a paper jam has not occurred (S130: NO), in S140 the CPU 52 determines whether the printing process is complete, that is, whether the image has been completed on the sheet of paper P and the sheet has been discharged onto the discharge tray 11. If the printing operation is complete (S 140: YES), the CPU 52 ends the printing control process. However, if the printing operation is not complete (S 140: NO), the CPU 52 continues the printing process in S120.

[0114] When the CPU 52 detects a paper jam in S130 (S130: YES), in S150 the CPU 52 extracts the size of the paper P from the size data and in S 160 determines the appropriate paper jam pattern (the position of the paper P) based on the combination of on/off signals received from the three paper jam sensors A, B, and C. In other words, the CPU 52 determines which of the paper jam patterns 1-8 corresponds to the combination of on/off signals received from the paper jam sensors A, B, and C.

[0115] In S 170 the CPU 52 determines whether the paper P is a long sheet having a length greater than or equal to the prescribed value or a short sheet having a length less than the prescribed value based on the paper size acquired in S150. In other words, the CPU 52 classifies the paper P into the short sheet if the length of the sheet of paper is less than the prescribed value whereas the CPU 52 classifies the paper P into the long sheet if the length of the cut sheet is greater than or equal to the prescribed value. When printing on a short sheet, in S 180 the CPU 52 references the set of error messages listed under "When the paper length is less than the prescribed value (short sheet)" in the paper jam error message table and in S200 selects the error message corresponding to the paper jam pattern determined in S160. That is, the CPU 52 selects the error message based on the length data and the position of the paper P when the jam occurs.

[0116] When printing on a long sheet, in S190 the CPU 52 references the error messages listed under "When the paper length is greater than or equal to the prescribed value (long sheet)" in the paper jam error message table and in S200 selects the error message corresponding to the paper jam pattern determined in S160.

[0117] In S210 the CPU 52 performs a process to display the selected error message, that is, to display the message on the LCD 49 and to output the message to the PC 60. When outputting the message to the PC 60, the control unit 51 of the multifunction peripheral 1 does not directly output the error message to the PC 60 without prompting, but returns the error message as a response to a status query from the PC 60.

[0118] After completing the process to display the error message, in S220 the CPU 52 determines whether the paper jam has been resolved and continuously loops back to S210 to maintain the displayed error message

while the paper jam has not been resolved. When the paper jam is resolved, in S230 the CPU 52 performs a process to remove the displayed error message and subsequently returns to S120 to resume the printing process.

5 The process in S230 for removing the displayed error message involves both erasing the error message displayed on the LCD 49 and issuing an instruction to the PC 60 for erasing the error message displayed on the display 70. In this case as well, the CPU 52 returns the
10 instruction for erasing the error message to the PC 60 as a response to a status query received from the PC 60.

[0119] As described above, in the cases of the paper jam patterns 4 and 5 when the length of the recording sheet is short, it is possible that a plurality of paper jams occurs for the plurality of the recording sheet, for example, one sheet of paper P that is conveyed to a position near the end of the conveying path L and the next sheet to be printed that is conveyed from the paper tray 31 and arrives at least at the position of the upstream sensor A. In these cases, in S210 the LCD 49 displays "JAM C Open rear cover and remove paper" in order to notify the user that a paper jam occurred in the latter half of the conveying path L and to tell the user to open the rear cover 41 and extract the jammed sheet. In S220, the CPU 52 determines whether all of the paper jams has been resolved. That is, in S220 the CPU 52 determines whether the paper jam that has been occurred in the latter half of the conveying path L has been resolved and whether the paper jam that has been occurred in the former half of the conveying path L has been resolved. When the paper jam occurred in the latter half of the conveying path L is not resolved, the CPU 52 backs to S210 and the LCD 49 continue to display "JAM C Open rear cover and remove paper". When, in S220, the CPU 52 determines
35 that the paper jam that has been occurred in the latter half of the conveying path L is resolved and that the paper jam that has been occurred in the former half of the conveying path L is not resolved, the CPU 52 backs to S210 and the CPU 52 switches the LCD 49 to display "JAM A Open tray and remove paper" in order to tell the user to pull out the paper tray 31 and to extract the jammed sheet of paper P. When, in S220, the CPU 52 determines that the paper jam that has been occurred in the latter half of the conveying path L is resolved and that the paper jam that has been occurred in the former half of the conveying path L is resolved, in S230 the CPU 52 performs a process to remove the displayed error message

(5) Process for displaying the status of the multifunction peripheral performed on the PC

[0120] Next, a process for displaying the status of the multifunction peripheral 1 executed by the control unit 61 of the PC 60 will be described with reference to the flow-chart in Fig. 6. The control unit 61 of the PC 60 begins
55 executing the process for displaying the status of the multifunction peripheral 1 when the PC 60 is turned on based on the resident program, which is continuously running

in the background.

[0121] In S310 at the beginning of the process to display the multifunction peripheral status, the CPU 62 issues a status query to the multifunction peripheral 1. In S320 the CPU 62 determines whether the status received from the multifunction peripheral 1 is a status requiring the PC 60 to perform a display process. In other words, the CPU 62 determines whether it is necessary to display or erase the display of data related to the status of the multifunction peripheral 1 on the display 70 of the PC 60.

[0122] If the status of the multifunction peripheral 1 requires that an error message be displayed, such as when a paper jam has occurred on the multifunction peripheral 1 (S320: YES), in S330 the CPU 62 performs a display process to acquire this error message from the multifunction peripheral 1 and to display the message on the display 70. Subsequently, the CPU 62 returns to S310. If the status of the multifunction peripheral 1 indicates that an error message displayed previously for a paper jam, for example, should be erased because the paper jam has been resolved, the CPU 62 determines that the display process must be performed on the PC 60 (S320: YES), and in S330 performs a process to erase the error message.

(6) Effects of the first embodiment

[0123] In the first embodiment described above, the multifunction peripheral 1 detects paper jams based on changes over time in the status of the three paper jam sensors A, B, and C. When a paper jam occurs, the multifunction peripheral 1 displays an error message that includes information related to the position at which the paper jam occurred and the method of resolving the paper jam.

[0124] These error messages are prepared in advance for each on/off combination of the paper jam sensors A, B, and C (paper jam patterns 1-8). Further, different message content may be selected for the same on/off combination (the same paper jam pattern) based on the length of the paper P.

[0125] More specifically, while a conventional image-forming device displays the same error message for paper jam patterns 4-7 (the error message shown in Fig. 3 for a short sheet and a long sheet), regardless of the length of the paper P, the error message displayed in the embodiment when printing on long sheets of paper P differs from the error message used for short sheets.

[0126] Therefore, when a paper jam occurs, the user can take appropriate steps for resolving the paper jam based on the position of the sheet when the jam occurred, regardless of the length of the paper P.

[0127] While three or more classifications may also be used for the length of the paper P, such as long, medium, and short, the sheets of paper P are classified under the minimum necessary lengths (long and short) in the embodiment, and the error message displayed when a paper jam occurs is selected based on whether the sheet

is long or short. Accordingly, the multifunction peripheral 1 according to the embodiment can sufficiently adjust the displayed error message based on the length of the paper P, thereby providing the user with an appropriate error message while maintaining a simplified device configuration.

[0128] Further, in the embodiment, three paper jam sensors A, B, and C are provided along the conveying path L in order to detect paper jams and to detect the position of the paper P. With this construction, the multifunction peripheral 1 can easily and accurately detect the occurrence of paper jams and the position of the paper at the time the paper jam occurred (and by extension, to which of the paper jam patterns 1-8 the paper jam corresponds).

[0129] In addition to displaying an error message on the LCD 49 of the multifunction peripheral 1 when a paper jam occurs, the multifunction peripheral 1 also notifies the PC 60 to display the error message on the display 70. Accordingly, the user can learn when paper jams occur and when paper jams are resolved while operating the PC 60, thereby user-friendliness.

[Second Embodiment]

[0130] In the first embodiment described above, the multifunction peripheral 1 is provided with three paper jam sensors A, B, and C disposed along the conveying path L and detects the occurrence of paper jams and the position of the paper P at the time of the occurrence based on the status of the paper jam sensors A, B, and C. However, the laser multifunction peripheral according to the second embodiment detects paper jams and the position of the paper P during a paper jam without using paper jam sensors.

[0131] The multifunction peripheral 1 according to the second embodiment has essentially the same structure as the multifunction peripheral 1 according to the first embodiment shown in Fig. 1, but without the paper jam sensors A, B, and C. Hence, the following description will cover aspects of the multifunction peripheral 1 that differ from the multifunction peripheral 1 described in the first embodiment, such as the method of detecting paper jams, the method of detecting the position of the paper P when a paper jam occurs (identifying paper jam patterns), and the error messages displayed when a paper jam occurs.

(1) Method of detecting paper jams.

[0132] As described in the first embodiment, sheets of paper P are conveyed by the pickup roller 32 and various other rollers disposed along the conveying path L. With this construction, if a sheet of paper P becomes jammed and can no longer be conveyed along the conveying path L, the sheet forcibly halts the rotation of one or a plurality of the various rollers due to contact resistance. While it is not absolutely certain that a paper jam will halt the

rotation of one or more rollers and, in fact, in some cases the rollers may all continue to rotate idly, in most cases, rollers contacting a jammed sheet of paper P are forcibly halted by contact resistance with the sheet.

[0133] Therefore, the multifunction peripheral 1 according to the second embodiment determines that a paper jam has occurred when any of the various conveying rollers (33, 34, 35, 36, 22A, 22G, 23A, 23B, 41A, 42B, 46A, 46B) stops rotating in the period after a sheet of paper P is initially conveyed and before the conveying operation for the sheet is complete. More specifically, in the second embodiment, each of conveying rollers (33, 34, 35, 36, 22A, 22G, 23A, 23B, 41A, 42B, 46A, 46B) includes a rotating body and a sensor that detects a rotation of the rotating body. Hence, the CPU 52 determines that the conveying roller is forcibly halted when the CPU 52 begins the process to print images on the paper P and when the sensor provided in the roller detects that the roller body does not rotate. In this embodiment, the sensor is provided for each of the rollers (33, 34, 35, 36, 22A, 22G, 23A, 23B, 41A, 42B, 46A, 46B), however the sensors may be provided for some of the conveying rollers in the multifunction peripheral.

(2) Method of detecting the position of the paper P when a paper jam occurs

[0134] The multifunction peripheral 1 according to the second embodiment detects the position of the sheet when a paper jam occurs based on the elapsed time between the moment that the sheet is initially conveyed and the moment that the paper jam is detected. In the second embodiment, three paper jam patterns 1-3 are set based on this elapsed time. Specifically, paper jam pattern 1 indicates that the paper jam occurred in the upstream section of the conveying path L when the elapsed time after initial conveyance is less than three seconds; paper jam pattern 2 indicates that the paper jam occurred in the center section of the conveying path L when the elapsed time is at least three seconds and less than seven seconds; and paper jam pattern 3 indicates that the paper jam occurred in the downstream section of the conveying path L when the elapsed time is at least seven seconds. Error messages displayed when a paper jam occurs are preset for each of the paper jam patterns 1-3, as shown in Fig. 7.

[0135] The timer 56 provided in the control unit 51 measures the elapsed time from the start of the conveying operation. The three paper jam patterns described above for the elapsed time from the beginning of conveyance until the paper jam occurs (less than three seconds; at least three seconds and less than seven seconds; and at least seven seconds) are merely one example, and the number of paper jam patterns and the ranges of elapsed times can be adjusted as appropriate.

(3) Error messages displayed when a paper jam is detected

[0136] Fig. 7 shows the paper jam error message table pre-stored in the ROM 53 of the multifunction peripheral 1 according to the second embodiment. As shown in Fig. 7, in the paper jam error message table, three paper jam patterns 1-3 have been set in the second embodiment based on the elapsed time after a sheet of paper P is initially conveyed until a paper jam is detected, and error messages are set for each of the paper jam patterns. As in the first embodiment described above, the error message displayed for each of the paper jam patterns can differ according to the length of the sheet being printed.

[0137] The error message corresponding to paper jam pattern 1 is "JAM A Open tray and remove paper" and is the same whether the length of the paper P is less than a prescribed value (a short sheet) or greater than or equal to the prescribed value (a long sheet). This error message is the same as the message displayed for paper jam patterns 1 and 2 in the first embodiment.

[0138] The error message corresponding to paper jam pattern 2 is "JAM B Open front cover and remove paper" and is the same whether the paper P is a short sheet or a long sheet. This error message is the same as the message displayed for paper jam pattern 3 in the first embodiment.

[0139] The error message corresponding to paper jam pattern 3 differs for short and long sheets of paper P. Specifically, the error message for long sheets of paper P is "JAM C Open rear cover and remove paper." This message is the same as the error message corresponding to paper jam patterns 4-6 and 8 in the first embodiment for long sheets of paper P.

[0140] The error message for paper jam pattern 3 when printing on long sheets of paper P is "JAM Open rear cover and open tray; remove paper from rear side." This message is the same as the error message corresponding to paper jam patterns 4, 5, and 7 in the first embodiment for long sheets of paper P.

(4) Printing control process executed on the multifunction peripheral

[0141] Next, a printing control process executed on the multifunction peripheral 1 according to the second embodiment will be described with reference to the flowchart in Fig. 8.

[0142] The CPU 52 of the control unit 51 begins the printing control process after the multifunction peripheral 1 receives print data from the PC 60. As in S110 and S120 of the printing control process shown in Fig. 5, in S410 the CPU 52 performs a process to input the print data from the PC 60 and in S420 begins a process to print images on the paper P based on the inputted print data. In S420 the CPU also starts to measure the elapsed time.

[0143] In S430 the CPU 52 determines whether a pa-

per jam has occurred. This step is performed each time the printing process in S420 has progressed a prescribed amount. In the second embodiment, the CPU 52 determines in S430 whether a paper jam has occurred based on whether one of the various rollers involved in conveying the paper P has been forcibly halted, as described earlier.

[0144] When the CPU 52 detects a paper jam in S430 (S430: YES), in S450 the CPU 52 extracts the size of the paper P and in S460 determines the appropriate paper jam pattern based on the elapsed time after the sheet of paper P is initially conveyed. In other words, the CPU 52 determines which of the paper jam patterns 1-3 shown in Fig. 7 corresponds to the amount of elapsed time from the start of conveyance until the paper jam is detected.

[0145] Steps beginning from S470 in Fig. 8 after a paper jam pattern is determined are identical to the steps from S170 in Fig. 5 according to the first embodiment. Therefore, a description of the process from S470 will not be repeated.

(5) Effects of the second embodiment

[0146] The multifunction peripheral 1 according to the second embodiment described above does not include paper jam sensor or the like but detects the occurrence of paper jams based on whether rollers that convey the paper P are forcibly halted. Accordingly, the multifunction peripheral 1 can detect paper jams with a simpler construction. Moreover, the multifunction peripheral 1 detects the position of the paper P when the paper jam occurs (i.e., determines a paper jam pattern) based on the amount of elapsed time after the sheet is initially conveyed. Accordingly, by eliminating the need for paper jam sensors, the multifunction peripheral 1 can easily detect the position of the jammed sheet using a simpler construction.

[0147] Further, since the amount of elapsed time from the beginning of conveyance is sorted into three ranges and error messages are prepared for each range of elapsed times (i.e., for each paper jam pattern), the multifunction peripheral 1 can provide the user with appropriate information on the paper jam based on the position of the paper P.

Variations of the embodiments

[0148] The content of the error messages stored in the paper jam error message tables shown in Figs. 3 and 7 are merely examples and may be modified in various ways, provided that the messages include appropriate information required for resolving the paper jam based on the position that the paper jam occurred and the length of the sheet of paper P.

[0149] Further, error messages may be selected in a variety of ways based on the length of the sheet. For example, the error message may simply include "A paper jam occurred with a long sheet" when printing on long

sheets of paper P, or "A paper jam occurred with a short sheet" when printing on short sheets of paper P. Such simple messages may be sufficient to enable a user to take appropriate measures based on the length of the paper P. Alternatively, rather than directly displaying information related to the length of the sheet, a message indicating only the method of resolving the jam, such as where to remove the sheet or the like, may be selected based on the length of the paper P.

[0150] Further, classifying the length of the paper P as either long or short in the embodiments is merely one example. It is also possible to classify the length of the paper P as one of three or more ranges of lengths and to select an appropriate error message corresponding to each range.

[0151] Further, while the multifunction peripheral 1 according to the embodiments acquires the length of the paper P based on paper size data included in print data received from the PC 60, the multifunction peripheral 1 may acquire the length of the paper P using another method. For example, the user may be prompted to input the length of the sheet on the control panel 48 of the multifunction peripheral 1. Alternatively, if the paper tray 31 is provided with a paper guide that can be slidably adjusted to match the length of the paper P in order to hold the paper P at a prescribed position in the paper tray 31, the multifunction peripheral 1 may be provided with a sensor or the like to acquire the position of the paper guide in order to detect the length of the paper P.

[0152] Further, the multifunction peripheral 1 according to the first embodiment is provided with three paper jam sensors A, B, and C. However, the multifunction peripheral 1 may be provided with any number of paper jam sensors disposed at arbitrary positions along the conveying path L.

[0153] Further, while the multifunction peripheral 1 according to the second embodiment detects paper jams and the position of the paper without using paper jam sensors, the multifunction peripheral 1 of the second embodiment may also be provided with one or a plurality of paper jam sensors disposed along the conveying path L and may detect the occurrence of paper jams and the position of the jammed paper (paper jam pattern) based on data that includes the on/off signals of the paper jam sensors. That is, the multifunction peripheral 1 detects the occurrence of paper jams based on the condition of rollers (whether the rollers rotates or are halted) and the condition of the jam sensors (whether the jam sensors are on or off). In this way, the multifunction peripheral 1 can detect paper jams with even greater accuracy.

[0154] In the embodiments described above, the multifunction peripheral 1 and the PC 60 are connected to each other and an error message is displayed on both the LCD 49 of the multifunction peripheral 1 and the display 70 of the PC 60 when a paper jam occurs. However, the error message for a paper jam may be displayed only on the LCD 49 or only on the display 70, rather than both the LCD 49 and the display 70.

[0155] Further, the invention is not limited to the printing unit 3 (or the multifunction peripheral 1), but may be applied to a conveying device for conveying a sheet-like medium and various devices and systems provided with this conveying device.

Claims

1. A conveying device (1) comprising:

a conveying unit (33, 34, 35, 36, 22A, 22G, 23A, 23B, 41A, 42B, 46A, 46B) that conveys a cut sheet along a conveying path (L);
 a detecting unit (S130, S430) that detects a jam of the cut sheet on the conveying path;
 a first display unit (49) that displays information;
 an acquiring unit (57, S110, S410) that acquires length data indicating a length of the cut sheet; and
 a first control unit (S200, S210, S500, S510) that controls the first display unit to display information,
characterized in that the first control unit selects, based on the length data, jam information indicating an occurrence of the jam and controls the first display unit to display the selected jam information.

2. The conveying device according to claim 1, **characterized in that:**

the conveying unit conveys a plurality of kinds of cut sheets;
 the conveying device further comprises a length classifying unit (S 170, S470) that classifies a length of the cut sheet into one of a plurality of length regions based on the length data; and
 the first control unit selects the jam information corresponding to the one of the plurality of length regions and controls the first display unit to display the selected jam information.

3. The conveying device according to claim 2, **characterized in that:**

the plurality of length regions includes a first region and a second region; and
 the length classifying unit classifies the length of the cut sheet into the first length region if the length of the cut sheet is less than a threshold value whereas the length classifying unit classifies the length of the cut sheet into the second length region if the length of the cut sheet is greater than or equal to the threshold value.

4. The conveying device according to claim 1 or 2, **characterized in that:**

the detecting unit includes a position specifying unit (A, B, C, S200, S500) that specifies a position of the cut sheet on the conveying path when the jam occurs; and
 the first control unit selects the jam information based on the length data and the position of the cut sheet and controls the first display unit to display the selected jam information.

5. The conveying device according to claim 4, **characterized in that:**

the jam information includes at least one of information about the position of the cut sheet and information about a method to remove the cut sheet.

6. The conveying device according to claim 4 or 5, **characterized in that:**

the position specifying unit includes, on the conveying path, a sheet detecting sensor (A, B, C) that detects a presence of the cut sheet; and
 the position specifying unit specifies the position of the cut sheet based on a detection by the sheet detecting sensor.

7. The conveying device according to any of claims 4 to 6, **characterized in that:**

the position specifying unit includes a plurality of sheet detecting sensors (A, B, C) on the conveying path, each of the plurality of sheet detecting sensors outputting one of ON signal and OFF signal according to presence or absence of the cut sheet;
 the position specifying unit specifies the position of the cut sheet based on the combination of the ON and OFF signals outputted from the plurality of sheet detecting sensors.

8. The conveying device according to claim 7, **characterized in that** the conveying device further comprises a storing unit (53) that previously stores the jam information for each of the lengths of the cut sheet and for each of the combinations of the ON and OFF signals outputted from the plurality of sheet detecting sensors.

9. The conveying device according to any of claims 4 to 8, **characterized in that:**

the conveying device further comprises a timer (56) that measures an elapsed time from a start time at which the conveying unit starts to convey the cut sheet;
 the detecting unit detects the jam if an operation of the conveying unit is forcibly halted after the

conveying unit starts to convey the cut sheet;
and
the position specifying unit specifies the position
of the cut sheet based on the elapsed time from
the start time to a detection time at which the
detecting unit detects the jam. 5

10. The conveying device according to claim 9, characterized in that:

the conveying device further comprises:

a time classifying unit (S460) that classifies,
into one of the plurality of time regions, the
elapsed time from the start time to the de-
tection time; and 15
a storing unit (53) that previously stores the
jam information for each of the lengths of
the cut sheet and for each of the plurality of
time regions; and 20

the position specifying unit specifies the position
of the conveying sheet based on a result of the
classification by the time classifying unit. 25

11. A conveying system (1, 60) comprising:

the conveying device according to any of claims
1 to 10, further comprising a sending unit (57)
that sends the jam information; and 30
a processing device (60) comprising:

a receiving unit (66) that receives the jam
information from the sending unit;
a second display unit (70) that displays in-
formation; and 35
a second control unit (S330) that controls
the second display unit to display the jam
information. 40

12. An image-forming device (1) comprising:

the conveying device according to any of claims
1 to 10;
an inputting unit (S110, S410) that inputs image
data; and 45
an image-forming unit (20) that forms an image
on the cut sheet conveyed by the conveying de-
vice based on the image data, the cut sheet be-
ing an image recording sheet. 50

13. An image-forming system (50) comprising:

the image-forming device according to claim 12,
the image-forming device further comprising a
sending unit that sends the jam information; and 55
a processing device (60) comprising:

a receiving unit (66) that receives the jam
information from the sending unit;
a second display unit (70) that displays in-
formation; and
a second control unit (S330) that controls
the second display unit to display the jam
information.

**14. A computer-readable storage medium storing a set
of program instructions executable on a computer
included in a conveying device (1) having a convey-
ing unit (33, 34, 35, 36, 22A, 22G, 23A, 23B, 41A,
42B, 46A, 46B) that conveys a cut sheet along a
conveying path (L) and a display unit (49) that dis-
plays information, the program instructions compris-
ing:**

detecting (S130) a jam of the cut sheet on the
conveying path;
acquiring (57, S110, S410) length data indicat-
ing a length of the cut sheet;
selecting (S200, S500), based on the length da-
ta, jam information indicating an occurrence of
the jam; and
controlling (S210, S510) the display unit to dis-
play the selected jam information.

FIG. 1

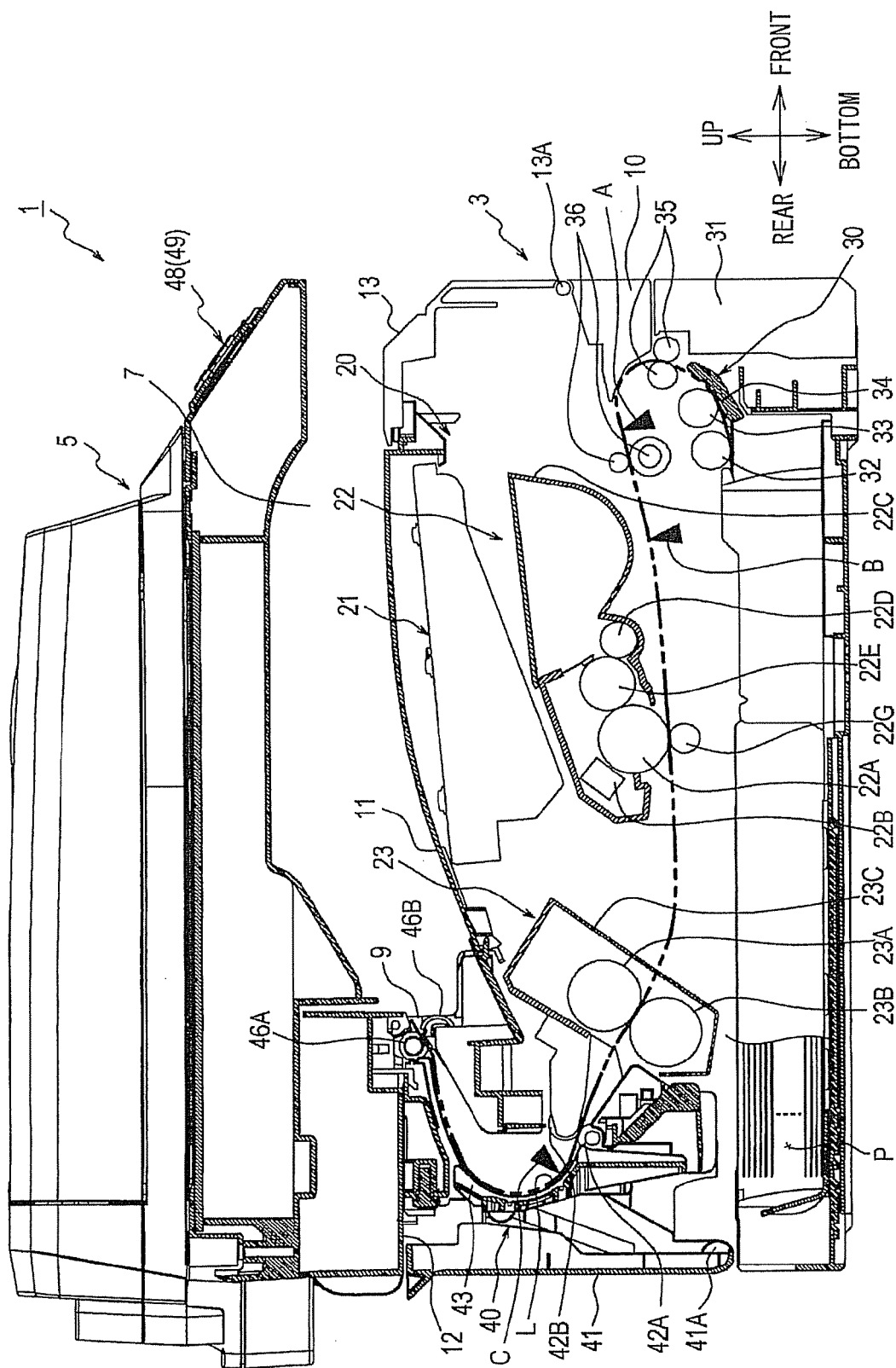


FIG.2

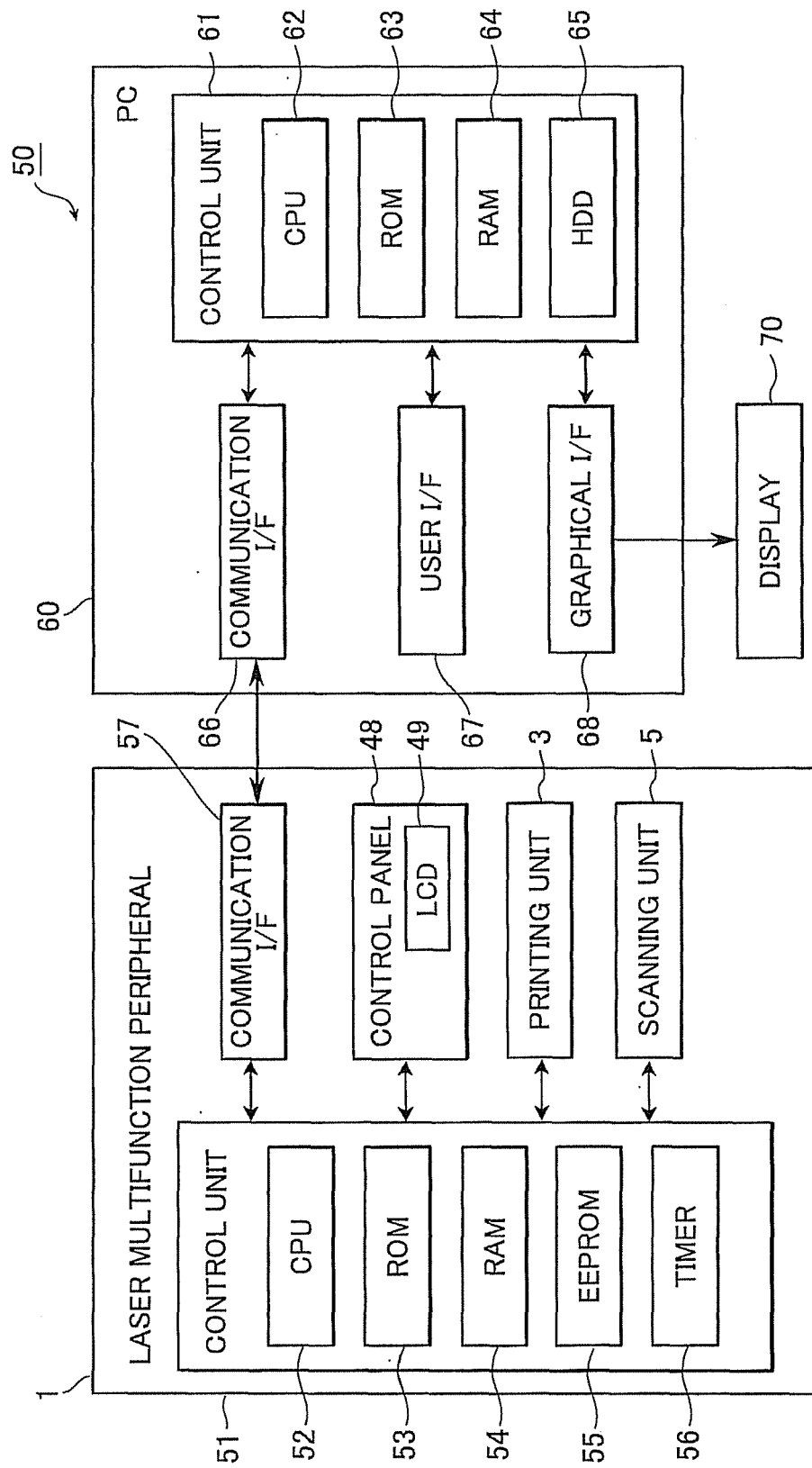


FIG.3

<PAPER JAM ERROR MESSAGE TABLE>

PAPER JAM PATTERN	STATE OF SENSOR A	STATE OF SENSOR B	STATE OF SENSOR C	ERROR MESSAGE	
				WHEN PAPER LENGTH IS LESS THAN PRESCRIBED VALUE (SHORT SHEET)	WHEN PAPER LENGTH IS GREATER THAN OR EQUAL TO PRESCRIBED VALUE (SHORT SHEET)
1	OFF	OFF	OFF	JAM A OPEN TRAY AND REMOVE PAPER	JAM A OPEN TRAY AND REMOVE PAPER
2	ON	OFF	OFF	JAM A OPEN TRAY AND REMOVE PAPER	JAM A OPEN TRAY AND REMOVE PAPER
3	ON	ON	OFF	JAM B OPEN FRONT COVER AND REMOVE PAPER	JAM B OPEN FRONT COVER AND REMOVE PAPER
4	ON	OFF	ON	JAM C OPEN REAR COVER AND REMOVE PAPER	JAM OPEN REAR COVER AND OPEN TRAY; REMOVE PAPER FROM REAR SIDE
5	ON	ON	ON	JAM C OPEN REAR COVER AND REMOVE PAPER	JAM OPEN REAR COVER AND OPEN TRAY; REMOVE PAPER FROM REAR SIDE
6	OFF	ON	ON	JAM C OPEN REAR COVER AND REMOVE PAPER	JAM OPEN REAR COVER AND REMOVE PAPER
7	OFF	ON	OFF	JAM B OPEN FRONT COVER AND REMOVE PAPER	JAM OPEN REAR COVER AND OPEN TRAY; REMOVE PAPER FROM REAR SIDE
8	OFF	OFF	ON	JAM C OPEN REAR COVER AND REMOVE PAPER	JAM C OPEN REAR COVER AND REMOVE PAPER

FIG.4

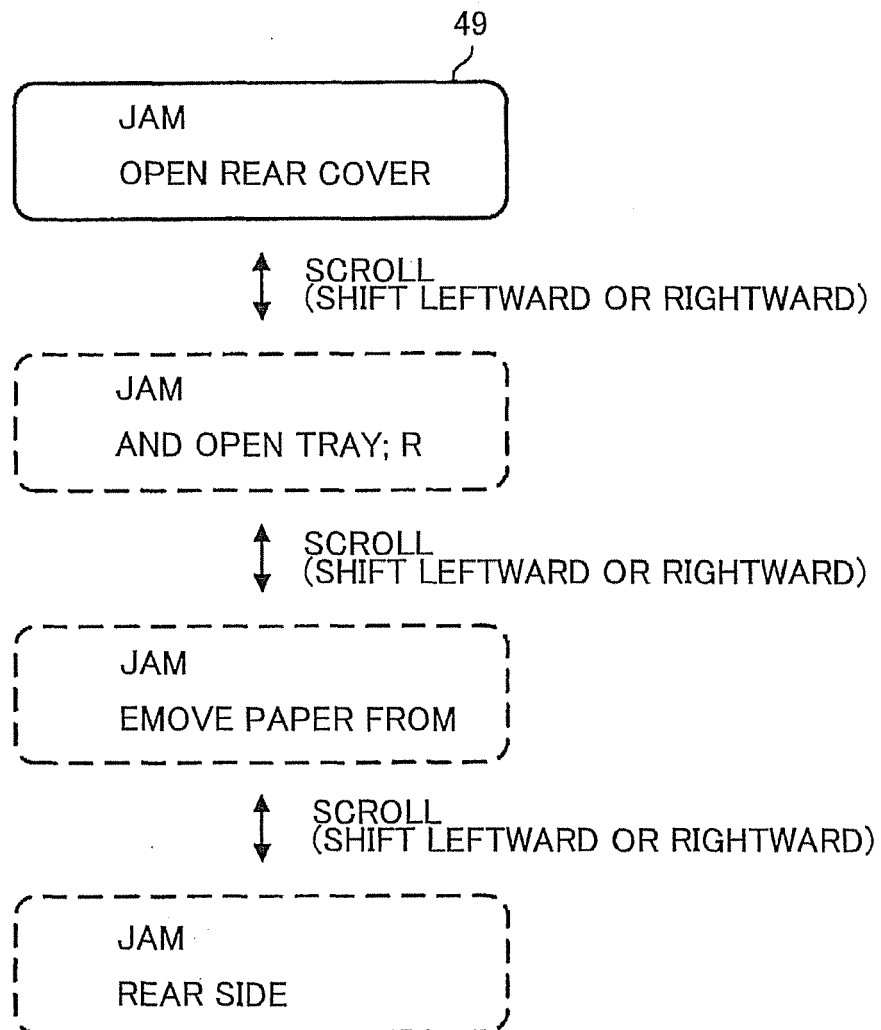


FIG.5

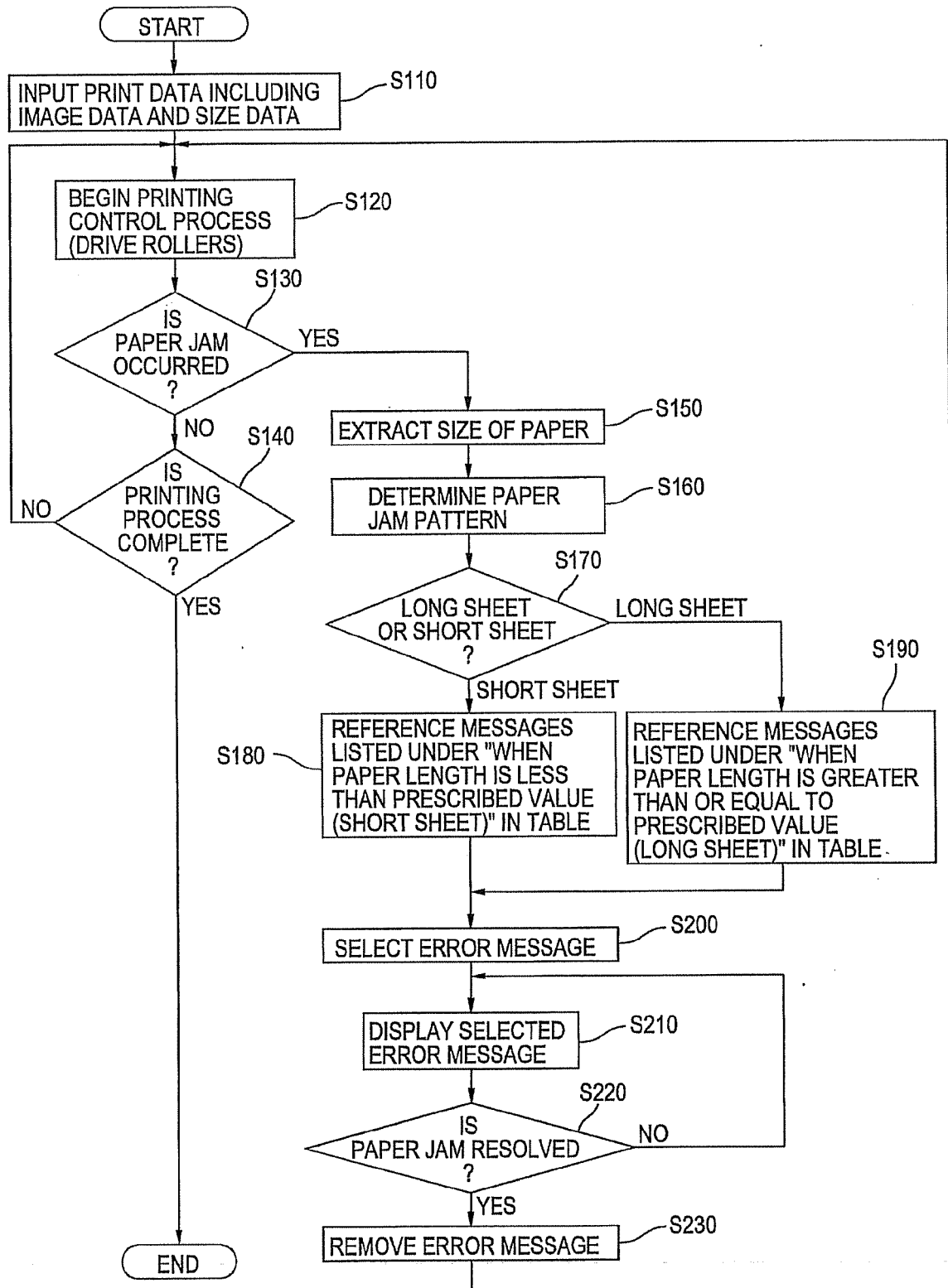


FIG.6

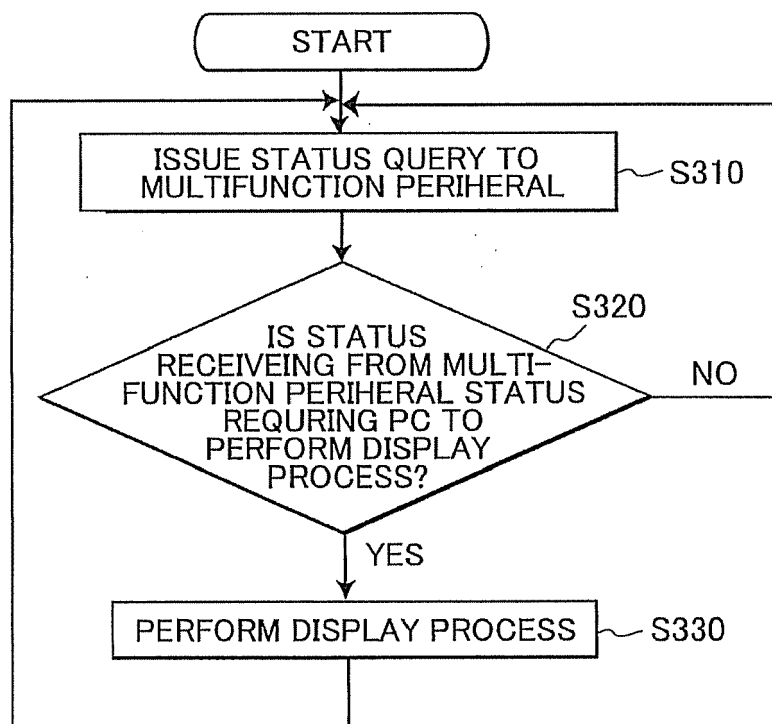
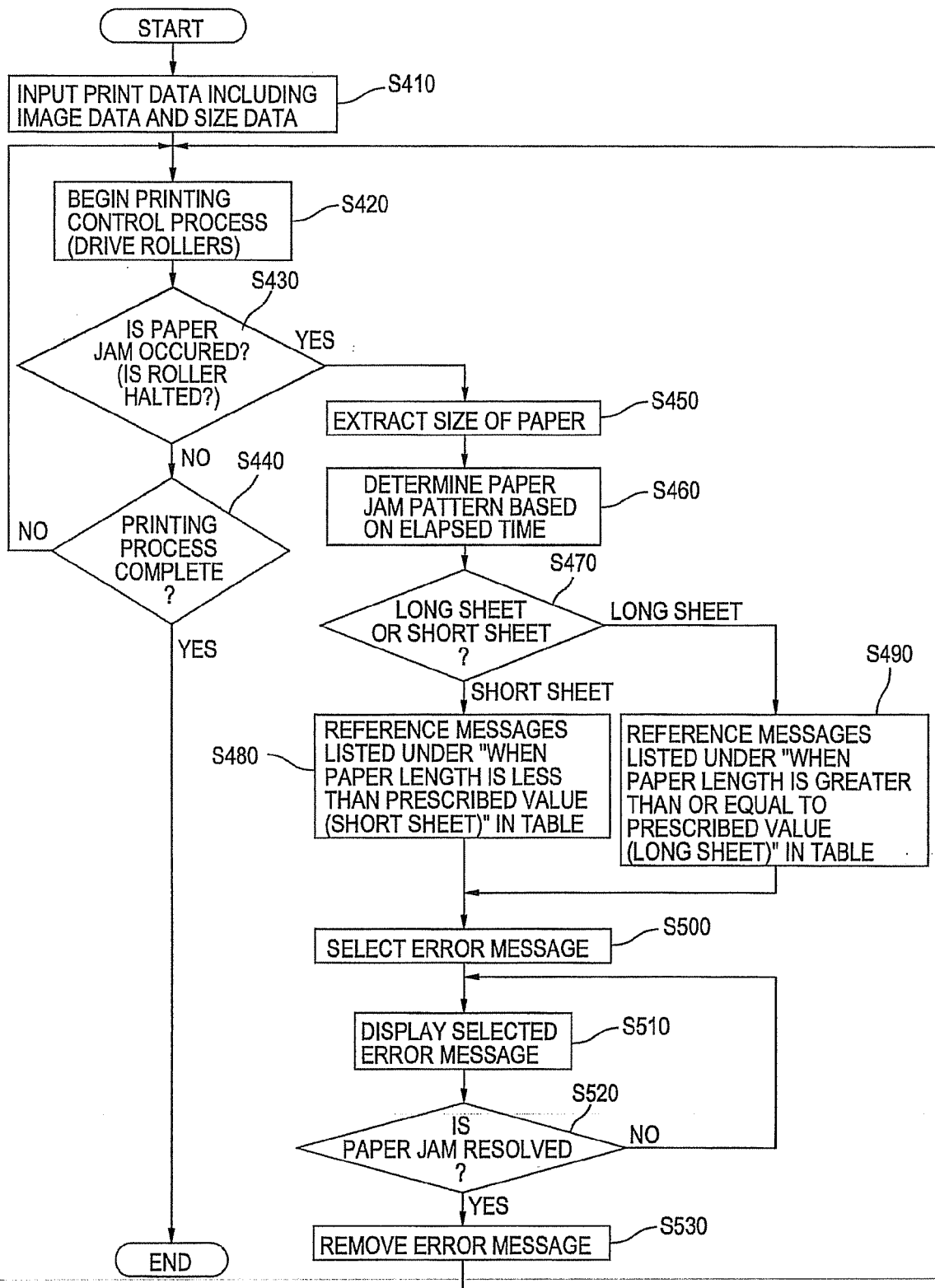


FIG.7

<PAPER JAM ERROR MESSAGE TABLE>

PAPER JAM PATTERN	ELAPSED TIME	ERROR MESSAGE	
		WHEN PAPER LENGTH IS LESS THAN PRESCRIBED VALUE (SHORT SHEET)	WHEN PAPER LENGTH IS GREATER THAN OR EQUAL TO PRESCRIBED VALUE (SHORT SHEET)
1	ELAPSED TIME IS LESS THAN THREE SECONDS	JAM A OPEN TRAY AND REMOVE PAPER	JAM A OPEN TRAY AND REMOVE PAPER
2	ELAPSED TIME IS AT LEAST THREE SECONDS AND LESS THAN SEVEN SECONDS	JAM B OPEN FRONT COVER AND REMOVE PAPER	JAM B OPEN FRONT COVER AND REMOVE PAPER
3	ELAPSED TIME IS AT LEAST SEVEN SECONDS	JAM C OPEN REAR COVER AND REMOVE PAPER	JAM OPEN REAR COVER AND OPEN TRAY; REMOVE PAPER FROM REAR SIDE

FIG.8





EUROPEAN SEARCH REPORT

Application Number
EP 09 16 9927

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			G03G
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 January 2010	Examiner Kys, Walter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 09 16 9927

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27-01-2010

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