A paper transportation device 100 is provided with an obliquely transported condition detection unit 404 and a sensor movement controller 402. The obliquely transported condition detection unit 404 is configured to detect an obliquely transported condition of a sheet of paper based on a detection result of the travel-directional front end of the sheet of paper by obliquely transported condition detection sensors 113a and 113b. The obliquely transported condition detection sensors 113a and 113b are arranged in predetermined positions on a document transportation path. The sensor movement controller 402 is configured to move the obliquely transported condition detection sensors 113a and 113b in accordance with the width size of the sheet of paper.
FIG. 3
START

S101 DISPLAY OF INITIAL SCREEN

S102 MOVEMENT OF ALIGNMENT PLATE

S103 PRESS OF START KEY, START OF DETECTION BY SENSOR

S104 DETECTION OF F-DIRECTIONAL FRONT END OF DOCUMENT

S105 OBTAINMENT OF CONTACT SIGNAL ON BOTH SIDES

Yes

No

DETERMINATION OF CORRECTION ROLLER TO BE ROTATED BASED ON INFORMATION OF SENSOR NOT TRANSMITTING CONTACT SIGNAL

S106

S110 NON-OBliquely TRANSPORTED CONDITION

S107 ROTATION OF CORRECTION ROLLER

RESOLUTION OF OBLIQUELY TRANSPORTED CONDITION OF DOCUMENT

S108

S109 SCANNING AND FORMATION OF IMAGE

END

FIG. 5
PAPER TRANSPORTATION DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a paper transportation device, and more particularly to a paper transportation device to detect accurately a condition of a sheet of paper being transported in an oblique orientation.

[0004] 2. Background Art

[0005] Recent image forming apparatuses have a variety of functions in addition to a copy function. For example, they have a facsimile transmission function, a scan function, a print function, a staple function, and a punch function. Furthermore, image forming apparatuses with an automatic document feeder (ADF) have been produced in response to the increased functional diversity. The ADF is configured to feed automatically a single or plurality of sheets of documents one by one in a sequential order.

[0006] For the purpose of appropriately executing the above-mentioned functions, it is important to transport a sheet of a document or a sheet of paper to be used for image formation (hereinafter simply referred to as “printing paper”) on a document/printing-paper transportation path in an appropriate orientation without being obliquely transported. For example, when the document or the printing paper is transported while maintaining an oblique orientation (this condition may be hereinafter referred to as “oblique condition” or “obliquely transported condition”), an obliquely positioned image will be scanned from the obliquely-oriented document, or image formation and/or stapling will be executed with respect to the obliquely oriented printing paper. In this case, it is difficult to provide appropriately the above-mentioned functions. Specifically, when the document/printing-paper is transported in an oblique orientation, quality of the printed material will be deteriorated. Accordingly, this results in an increase of wasted printed material. This is especially a problem when the document/printing-paper is manually supplied through a manual feeding tray and the like.

[0007] Japanese Patent Application Publication No. JP-A-H01-195077 discloses an apparatus for solving the obliquely transported condition of a sheet of printing paper. The disclosed apparatus includes two obliquely transported condition detection sensors, two independent rollers, and control means. The obliquely transported condition detection sensors are configured to detect whether or not an inserted printing paper is positioned in parallel to a platen. Two rollers are configured to move the inserted printing paper in parallel to the platen. The control means is configured to process signals from the obliquely transported condition detection sensors and to control the rollers. The configuration makes it possible to adjust the oblique condition of the printing paper even when a user roughly and manually supplies the printing paper. Accordingly, it is possible to reduce printing failure caused by the manual feeding and to enhance the quality of the printed material.

[0008] According to the disclosed apparatus, it is almost impossible to change positions of the obliquely transported condition detection sensors once attached to the apparatus. In response to this, the obliquely transported condition detection sensors are attached to the apparatus for detecting an oblique condition of a sheet of standard form paper with the minimum width. In other words, the obliquely transported condition detection sensors are best suited for detecting an oblique condition of a sheet of standard form paper with the minimum width, but not for detecting an oblique condition of a sheet of standard form paper with greater width. Consequently, it is impossible for the obliquely transported condition detection sensors to detect accurately an oblique condition of a sheet of standard form paper with greater width.

[0009] Also, the art disclosed in the above-mentioned publication is assumed to be applied to a printer with a manual paper feeding function. Therefore, it is impossible to apply the art to a device with an automatic paper feeding function (e.g., ADF) without arbitrarily changing the art. On the other hand, the ADF is generally provided with a pick-up roller. The pick-up roller is arranged in the vicinity of a transportation entrance for guiding a document to a document transportation path. The pick-up roller is configured to pull and to transport a plurality of documents disposed on a disposition plate one by one. In this case, a variety of factors (e.g., the document size, the rotation speed of the pick-up roller and the disposition condition of the document) influence whether or not the document is obliquely transported. Accordingly, detection of the obliquely transported document should be done on the document transportation path on a document size basis. Otherwise, it is impossible to prevent the oblique condition of the document. Additionally, the same problem occurs when a plurality of sheets of printing paper are pulled out of a paper feeding tray/cassette one by one.

[0010] In view of the above, it will be apparent to those skilled in the art from this disclosure that there exists a need for an improved paper transportation device. This invention addresses this need in the art as well as other needs, which will become apparent to those skilled in the art from this disclosure.

SUMMARY OF THE INVENTION

[0011] Accordingly, aspects of the present invention have been created to solve the above-mentioned problems occurring in the conventional practice, and to produce a paper transportation device for accurately detecting an obliquely transported condition of a sheet of paper.

[0012] An aspect of the present invention relates to a paper transportation device. The paper transportation device includes a disposition plate, a paper transportation path, a guide member, a pair of sensors, and a sensor movement controller. The disposition plate is used to dispose a sheet of paper thereon. The paper transportation path is used to transport the sheet of paper. The paper transportation path has a transportation member to transport the sheet of paper. The guide member is used to guide the sheet of paper disposed on the disposition plate to the paper transportation path. The sensors are configured to detect a transportation direction at the front end of the sheet of paper. The sensors are arranged on the paper transportation path. At least either of the sensors is allowed to move in a paper width direction perpendicular to the paper transportation direction. The sensor movement controller is configured to control an interval between the pair of sensors by moving the pair of sensors based on the width of
the sheet of paper. The present invention may also have a paper size detection unit that is configured to detect the width size of the sheet of paper.

[0013] For example, when the sheet of paper is a document, the sensors are disposed on the paper transportation path, and are arranged between the disposition plate and an image scanning section to scan an image of the document. On the other hand, when the sheet of paper is a printing paper, the sensors are disposed on the paper transportation path, and are arranged between a paper feeding cassette and a transference unit to transfer (i.e., printing) a toner image onto the printing paper.

[0014] Any other suitable sensors may be used herein as long as it is configured to detect the travel directional front side of the sheet of paper. For example, optical transmission sensors, optical reflection sensors, contact displacement detection sensors, media sensors to detect paper material, and infrared (IR) sensors may be used.

[0015] For example, the sensors are configured to detect an obliquely transported condition of the sheet of paper by the following method. When the sensors simultaneously detect an obliquely transported condition of the sheet of paper, it is determined that the sheet of paper is not being obliquely transported. On the other hand, when the sensors detect an obliquely transported condition of the sheet of paper in different timings, it is determined that the sheet of paper is being obliquely transported. As an alternative method, when the sensors detect an obliquely transported condition of the sheet of paper in different timings and difference between the timings exceeds a predetermined threshold, it is possible to determine that the sheet of paper is being obliquely transported.

[0016] Furthermore, the disposition plate may further include a pair of alignment plates to align laterally the width directional opposed sides of the sheet of paper. At least either of the alignment plates is configured to move in the paper width direction. Each of the alignment plates includes an extended portion. The extended portions are extended from the alignment plates to a predetermined position on the paper transportation path. The extended portions are laterally opposed to each other and are perpendicular to the travel direction of the sheet of paper. Each of the above-mentioned obliquely transported condition detection sensors is arranged in each of the extended portions.

[0017] For example, a user is able to move the alignment plates in parallel to the width direction by a user. The width directional opposed sides of the sheet of paper are aligned by the parallel movement of the alignment plates. The alignment plates may have any other suitable configuration as long as at least either of them is allowed to move in parallel to the width direction. For example, the alignment plates may be attached on the upper surface of a disposition plate of the automatic document feeder (ADF) and/or the upper surface of a disposition plate in a paper feeding tray/cassette.

[0018] The extended portions may have any other suitable configuration as long as they are integrally formed with the alignment plates, respectively. For example, a coupling member may be coupled to each of the alignment plates. Each of the coupling members may be provided with an obliquely transported condition detection sensor. In this case, each of the alignment plates is moved together with each of the obliquely transported condition detection sensors because the coupling members are coupled to the alignment plates.

[0019] The paper transportation device further includes the paper size detection unit to obtain the width size of the sheet of paper. Additionally, the sensor movement controller may be configured to move the obliquely transported condition detection sensors in accordance with the width size (i.e., both sides of the sheet of paper) obtained by the paper size detection unit.

[0020] For example, the paper size detection unit may obtain the width size of the sheet of paper based on the distance between the alignment plate, a contact sensor, and a predetermined contact sensor arranged on the disposition plate of the ADF, and a user’s direct input of document/printing paper size.

[0021] According to the paper transportation device of the present invention, the pair of obliquely transported condition detection sensors is configured to be moved in accordance with both of the width directional sides of a sheet of paper.

[0022] With the configuration, the obliquely transported condition detection sensors are moved to positions to differentiate sufficiently detection timings by the obliquely transported condition detection sensors. In the positions, a period of time is maximized since one of the obliquely transported condition detection sensors detects one of the sides of the sheet of paper until the other of the obliquely transported condition detection sensors detects the other of the sides of the sheet of paper. Accordingly, regardless of width of a sheet of paper to be transported, it is possible to detect accurately an obliquely transported condition of the sheet of paper. Consequently, it is possible to detect preliminarily an obliquely transported condition of a variety of kinds of paper and prevent occurrence of troubles such as scanning of an obliquely oriented image from an obliquely transported document and formation of an obliquely oriented image onto a sheet of paper. In other words, it is possible to provide a high quality printed material. Thus, the present invention best suits the ADF to scan a variety of kinds of documents.

[0023] Furthermore, the sensor movement controller includes the extended portions. The extended portions are extended from the pair of alignment plates to a predetermined position on the paper transportation path. The extended portions are laterally opposed to each other and are perpendicular to the travel direction of the sheet of paper. Additionally, the pair of obliquely transported condition detection sensors is provided on the upper surfaces of the pairs of the extended portions, respectively.

[0024] With this configuration, when a user aligns both of the width directional opposed sides of a document with the alignment plates, at least either of the obliquely transported condition detection sensors is automatically moved with the moved alignment plate(s). Thereby the obliquely transported condition detection sensors are arranged to detect accurately an obliquely transported condition of the sheet of paper every time alignment is performed. In other words, even when a user roughly puts the document on the disposition plate, it is possible to detect accurately an obliquely transported condition of the sheet of the document. Consequently, it is possible to output a printed material without deteriorating its quality and to prevent output of unnecessary printed material caused by an obliquely transported condition of the sheet of document.

[0025] Furthermore, it is possible to obtain the width size of the sheet of paper and to move the pair of obliquely transported condition detection sensors in accordance with the obtained width size, that is, the width directional opposed sides of the sheet of paper.
[0026] With this configuration, it is possible to move automatically and appropriately the pair of obliquely transported condition detection sensors to positions to detect accurately an obliquely transported condition of the sheet of paper, for example, when a predetermined contact sensor is arranged in a predetermined position on the disposition plate and is configured to obtain the width size of the sheet of paper. Accordingly, it is not necessary for a user to put a document on the disposition plate using great care regarding accurate orientation and the like. In other words, a user is able to place readily and roughly a sheet of a document on the disposition plate. Furthermore, the quality of the printed material will not be deteriorated and a user is able to save time when aligning the sheet of paper because it is possible to detect accurately an obliquely transported condition of a sheet of document without strictly aligning the sheet of document.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Referring now to the attached drawings which form a part of this original disclosure:

[0028] FIGS. 1A to 1C are views of schematic diagrams of an automatic document feeder (ADF) and a disposition plate according to a first preferred embodiment of the present invention;

[0029] FIG. 2 is a view of a schematic diagram illustrating elements in the interior of a multifunction peripheral (MFP) having the ADF and disposition plate;

[0030] FIG. 3 is a view of a diagram of a control hardware configuration of the ADF and the MFP;

[0031] FIG. 4 is a view of a functional block diagram of the MFP;

[0032] FIG. 5 is a view of a flowchart illustrating a series of actions of the ADF and the MFP;

[0033] FIGS. 6A to 6C are views of diagrams illustrating a procedure to solve the problem of an obliquely transported condition of a document in the ADF;

[0034] FIGS. 7A and 7B are views of diagrams illustrating accuracy in detecting the obliquely transported condition of a document in the ADF;

[0035] FIGS. 8A and 8B are views of schematic diagrams illustrating an ADF and a disposition plate according a second preferred embodiment of the present invention;

[0036] FIG. 9 is a view of a functional block diagram of an MFP of the second preferred embodiment;

[0037] FIG. 10 is a view of a flowchart illustrating a series of actions of the ADF and the MFP of the second preferred embodiment; and

[0038] FIGS. 11A and 11B are views of diagrams illustrating a procedure to solve the obliquely transported condition of a document of the second embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0039] Selected embodiments of the present invention will now be explained with reference to the drawings. It will be apparent to those skilled in the art from this disclosure that the following descriptions of the embodiments of the present invention are provided for illustration only and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

First Embodiment

[0040] A paper transportation device of a first embodiment of the present invention is an automatic document feeder (ADF). The ADF is generally installed and used in an image forming apparatus. In the present embodiment, an ADF installed in an image forming apparatus will be hereinafter explained. In general, an image forming apparatus indicates a variety of apparatuses such as a printer, a scanner and a multifunction peripheral (MFP) having functions of a printer, a copier, a scanner, a facsimile machine, and the like. In the present embodiment, the image forming apparatus is configured to provide a user with a copy service, a scanner service, a facsimile service, a printer service and the like.

[0041] FIGS. 1A to 1C are views of schematic diagrams illustrating an ADF 100 and a disposition plate 101a of the first embodiment. Specifically, FIG. 1A illustrates a side view of the ADF 100. The ADF 100 includes the disposition plate 101a, a pair of alignment plates 102a and 102b, and a document transportation path 103. The disposition plate 101a is disposed outside a platen cover 101. The alignment plates 102 is configured to align the opposed sides of a single or plurality of documents P placed on the disposition plate 101a. The document transportation path 103 is formed in the interior of the platen cover 101. Additionally, a transportation entrance 104 is formed between the document transportation path 103 and the disposition plate 101a. Also, a pick-up roller (guide member) 105, a first transportation roller 106A, a second transportation roller 106B, a third transportation roller 106C, and the like are arranged in the interior of the platen cover 101. The first transportation roller 106A, second transportation roller 106B, and third transportation roller 106C are parts of the transporting member.

[0042] When using the ADF 100, a user puts a single or plurality of documents P on the disposition plate 101a and aligns the opposed sides of the documents P by the alignment plates 102. Then, the user inserts the travel-directional front ends of the aligned documents P into the transportation entrance 104. Note that the travel direction of the document P corresponds to an F-direction illustrated by Arrow F in the figures. The pick-up roller 105 is arranged in the vicinity of the transportation entrance 104. The pick-up roller 105 is configured to move up and down. When the pick-up roller 105 moves down, its surface makes contact with an F-directional front end 110 of the top document of the single or plurality of documents P inserted into the transportation entrance 104.

[0043] When the user presses a start key of an operation section 107 arranged in the vicinity of a platen 110 while the pick-up roller 105 makes contact with the F-directional front end 110 of the top document, the pick-up roller 105 rotates and the F-directional front end 110 of the top document is pulled into the document transportation path 103.

[0044] As illustrated in FIG. 1B, the alignment plates 102 include a pair of extended portions 112 (i.e., extended portions 112a and 112b). The extended portion 112a/112b extends in the F-direction from a bottom portion 111 of the F-directional front end of the alignment plates 102a/102b. The extended portions 112 extend along and below the document transportation path 103. The tips of the extended portions 112 are positioned between the pick-up roller 105 and the transportation roller 106A. Thus, the extended portions
112 do not block transportation of the document P on the document transportation path 103. Additionally, a pair of obliquely transported condition detection sensors 113 (i.e., obliquely transported condition detection sensors 113a and 113b) are arranged on the upper surfaces of the extended portions 112. The obliquely transported condition detection sensors 113 are configured to detect contact with the F-directional front end 110 of the document P. The extended portions 112 are further provided with a pair of correction rollers (side portion transportation members) 114 (i.e., correction rollers 114a and 114b). The correction rollers 114 are configured to rotate independently from other rollers. The obliquely transported condition detection sensors 113 are arranged near the first transportation roller 106A whereas the correction rollers 114 are arranged near the pick-up roller 105.

[0045] In this case, the tips of the extended portions 112 are arranged to allow the obliquely transported condition detection sensors 113 to detect the F-directional front end 110 of the document P. At the same time as this, even when the correction rollers 114 rotate to move a portion of the pulled document P and the document P is thereby entirely turned around on the transportation path 103, the rotation of the correction rollers 114 is not blocked by other members (e.g., the pick-up roller 105). Note that turning of the document P is performed within the document transportation path 103 to correct the obliquely transported condition of the document as described above. It should be apparent from this disclosure that the correction rollers 114 may be separately arranged from the obliquely transported condition detection sensors 113.

[0046] Furthermore, the obliquely transported condition detection sensors 113 and the correction rollers 114 are arranged along the F-direction to make contact with the document P from below the transportation path 103. With this configuration, when the obliquely transported condition detection sensors 113 detect the obliquely transported condition of the document P, the correction rollers 114 are readily configured to rotate to turn around entirely the document P within the document transportation path 103.

[0047] In this case, the extended portion 112a/112b is provided with the obliquely transported condition detection sensor 113a/113b and the correction roller 114a/114b. Additionally, the extended portion 112a/112b is integrally formed with the alignment plate 102a/102b. Therefore, when the alignment plate 102a/102b is moved, the extended portion 112a/112b (and therefore the obliquely transported condition detection sensor 113a/113b and the correction roller 114a/114b) is accordingly moved. The alignment plates 102 and the extended portions 112 form the after-mentioned sensor movement controller.

[0048] FIG. 1C illustrates a plan view of the disposition plate 101a and the alignment plate 102. The alignment plates 102a and 102b are aligned on the disposition plate 101a. The alignment plates 102a and 102b are opposed to each other along a perpendicular direction to the F-direction (i.e., the width direction of the document P). The alignment plate 102a is arranged on the F-directional left side on the disposition plate 101a whereas the alignment plate 102b is arranged on the F-directional right side on the disposition plate 101a. Additionally, the alignment plate 102a is fixed in the vicinity of the width-directional edge of the disposition plate 101a whereas the alignment plate 102b is configured to be moved in the width direction in parallel to the alignment plate 102a.

[0049] The obliquely transported condition detection sensor 113a/113b and the correction roller 114a/114b are provided in the extended portion 112a/112b of the alignment plate 102a/102b. Accordingly, the obliquely transported condition detection sensors 113a and 113b are opposed to each other in the perpendicular direction to the F-direction. The correction rollers 114a and 114b are also opposed to each other in a direction perpendicular to the F-direction. As seen in a top plan view, a portion of the obliquely transported condition detection sensor 113a/113b is inwardly extended from the width-directional inner edge of the correction roller 114a/114b. The length of the extended portion of the obliquely transported condition detection sensor 113a/113b is defined as a predetermined length “y.” With this configuration, the obliquely transported condition detection sensors 113 are configured to detect reliably the F-directional front end 110 of the document P even when the document P is obliquely transported.

[0050] Furthermore, a document detection sensor 115 is arranged on the disposition plate 101a in the vicinity of the transportation entrance 104. The document detection sensor 115 is configured to detect the existence of the document P (i.e., contact with the document P). Thus, it is possible to determine whether or not the document P exists on the disposition plate 101a.

[0051] Once the document P is pulled into the document transportation path 103, it is transported to a scanning position X (see FIG. 1A) by the first and second transportation rollers 106A and 106B via the obliquely transported condition detection sensors 113 and the correction rollers 114. When the document P passes through the scanning position X, an image scanning section 109 scans an image on the document P and obtains its image information. The image scanning section 109 is arranged below the ADF 100. Then, the third transportation roller 106C discharges the document P to a discharge plate 108. Also, transportation speed of the document P is controlled by controlling the rotation speed of the first to third transportation rollers 106A to 106C.

[0052] The following relates to a brief explanation of a series of copy actions performed by a multifunction peripheral (MFP) 200 with the ADF 100. FIG. 2 is a view of a schematic diagram of the MFP 200. Note that detailed illustration of elements not directly related to the present invention will be omitted in FIG. 2.

[0053] The operation section 107 is configured to display a plurality of function items and setting items regarding a variety of functions provided by the MFP 200. When a user selects a desired setting through the displayed screen and presses a start key, print processing is started. In the ADF 100, the document P is transported to the scanning position X, and it is irradiated by a light source 201 of the image scanning section 109.

[0054] The irradiated light is reflected by the document P, and the reflected light is guided to an image pickup device 205 via a group of mirrors 202, 203, and 204. The image pickup device 205 performs photoelectric conversion with respect to the guided light. Subsequently, basic processing (e.g., correction processing, image quality processing, and compression processing) is performed with respect to an image of the document P, and image data are generated. The MFP 200 may receive the image data from an external apparatus through a cable 206 connected to a communication section of the MFP 200.
The generated image data are temporarily stored in a memory of the MFP 200. Then extraction processing is performed with respect to the image data as a target of image formation. The processed image data are transmitted to an image formation section 207 and a toner image is formed there. The image formation section 207 is provided with a photosensitive drum 208. The photosensitive drum 208 is configured to rotate at a constant speed in a predetermined direction. An electrostatic charger unit 209, an exposure unit 210, a developer unit 211, a transference unit 212, a cleaner unit 213, and the like are provided around the photosensitive drum 208. They are sequentially arranged from the upstream to the downstream in the rotational direction of the photosensitive drum 208.

The electrostatic charger unit 209 is configured to charge uniformly the surface of the photosensitive drum 208. The exposure unit 210 is configured to irradiate a laser onto the charged surface of the photosensitive drum 208 based on the image data. Accordingly, an electrostatic latent image is formed on the surface of the photosensitive drum 208. The developer unit 211 is configured to form a toner image by attaching a toner onto the transported electrostatic latent image. The transference unit 212 is configured to transfer the formed toner image onto a recording medium (e.g., a sheet of printing paper). The cleaner unit 213 is configured to remove excessive toner remaining on the surface of the photosensitive drum 208. The series of processing are performed in conjunction with the rotation of the photosensitive drum 208.

A sheet of printing paper is transported from one of a plurality of paper feeding cassettes 214 provided in the MFP 200. More specifically, each of the paper feeding cassettes 214 is provided with a pick-up roller 215. The pickup roller 215 pulls a sheet of paper out of the paper feeding cassette 214 and moves it to the printing paper transportation path. The paper feeding cassettes 214 accommodate different types of printing paper, respectively, and a sheet of printing paper is fed from one of the paper feeding cassettes 214 in accordance with a setting input by a user.

Once a sheet of printing paper is moved to the printing paper transportation path, it is transported to a space between the photosensitive drum 208 and the transference unit 212 by way of a transportation roller 216 and a resist roller 217. Then, the transference unit 212 transfers the toner image onto the transported printing paper, and the printing paper is transported to a fixation unit 218. The fixation unit 218 is composed of a heat roller 220 and a pressure roller 221. Note that a sheet of printing paper may be transported to the transportation roller 216 from a manual feeding tray 219 provided in the MFP 200.

When the paper passes through a space between the heating roller 220 and the pressure roller 221 after the toner image is transferred onto the printing paper, heat and pressure are applied to the toner image on the printing paper. Accordingly, the toner image is fixed onto the printing paper. Note that the toner image fixation is appropriately performed because the amount of heat applied by the heat roller 220 is optimally set in accordance with paper types. After the toner image is fixed onto the printing paper, the paper is discharged to a discharge tray 222.

With the above-mentioned procedure, the MFP 200 provides a user with a copy service. Additionally, when the MFP 200 provides a user with other services, the ADF 100, the image scanning section 109, and the image formation section 207 perform a series of actions. In the present embodiment, a section that transports the document P by driving elements (e.g., the pick-up roller 105) provided in the ADF 100 corresponds to the automatic document feeding means. Additionally, a section that scans an image on the document P in the scanning position X by driving the image scanning section 109 corresponds to the image scanning section. Also, a section that provides a variety of services by driving a variety of driving sections provided in the MFP 200 corresponds to an after-mentioned function provision unit.

Next, control hardware of the ADF 100 and the MFP 200 will be hereinafter explained with reference to FIG. 3. FIG. 3 is a view of a schematic diagram of the control hardware of the ADF 100 and the MFP 200. Note that detailed illustration of elements not directly related to the present invention is omitted in the figure.

A control circuit of the ADF 100 includes a central processing unit (CPU) 301, a read-only memory (ROM) 302, a random-access memory (RAM) 303, an internal interface 304, and drivers 305 corresponding to a variety of driving sections. These are connected to each other through an internal bus 306.

For example, the CPU 301 is configured to use the RAM 303 as a working area, and to execute a variety of programs stored in the ROM 302 and the like. Additionally, the CPU 301 is configured to control actions of a variety of driving sections illustrated in FIGS. 1 and 2, the correction rollers 114 and the like by receiving/transmitting data and instructions from/to the drivers 305, the operation section 107 (see FIG. 2), and the oblique condition direction sensors 113 based on the execution result of the programs. Moreover, the CPU 301 obtains the width size of the sheet of paper based on the distance between the alignment plates 102a and 102b. Thus, the CPU 301 and the alignment plates 102a and 102b form parts of a paper size detection unit. Also, as illustrated in FIG. 4, after-mentioned units or devices excluding the driving sections are also realized by the execution of the program by the CPU 301. The ROM 302 and the like store programs and data that realize the after-mentioned units or devices.

The internal interface 304 is connected to an after-mentioned internal interface 312 of the MFP 200. Accordingly, the ADF 100 is connected to the MFP 200. The CPU 301 controls actions of the driving sections by transmitting/receiving data and instructions to/from the MFP 200 through the internal interface 304.

A control circuit of the MFP 200 includes a CPU 307, a ROM 308, a RAM 309, a hard disk drive (HDD) 310, drivers 311 corresponding to the driving sections, and the internal interface 312. These are connected to each other through an internal bus 313. Just like the CPU 301 of the ADF 100, the CPU 307 is configured to use the RAM 309 as a working area. The CPU 307 executes a variety of programs stored in the ROM 308, the HDD 310 and the like.

Additionally, the CPU 301 is configured to control the driving sections by transmitting/receiving data and instructions to/from the drivers 311 based on the execution result of the programs. The CPU 307 transmits/receives data and instructions to/from the ADF 100 through the internal interface 312. Note that the ADF 100 may be provided with a HDD (not illustrated in FIG. 3).

The following is an explanation of procedure executed by the ADF 100 and the MFP 200 of the first embodiment that detect an obliquely transported condition of a sheet of paper. The procedure will be hereinafter explained with reference to FIGS. 2, 4, and 5. FIG. 4 is a view of a
functional block diagram of the ADF 100 and the MFP 200 of the first embodiment. FIG. 5 is a view of a flowchart illustrating a series of actions performed by the ADF 100 and the MFP 200 of the first embodiment.

[0067] First, when a user powers on the MFP 200, a reception unit 401 displays an initial screen (in this case, copy setting screen) on a touch-panel of the operation section 107 (Step S101).

[0068] Next, a user puts a single or plurality of documents P on the disposition plate 101a of the ADF 100, and aligns the width-directional opposed sides of the single or plurality of documents P by the alignment plates 102. This will be hereinafter specifically explained with reference to FIG. 6A. Note that only a sheet of a document P is illustrated in FIG. 6A for easy understanding and the following explanation relates in case that a single document P is put on the disposition plate 101a. As illustrated in FIG. 6A, when a width-directional side of the document P is arranged to make contact with the fixed alignment plate 102a and the movable alignment plate 102c is moved parallel to the alignment plate 102a to make contact with the other width-directional side of the document P, the obliquely transported condition detection sensor 113b and the correction roller 114a are accordingly moved in parallel to the alignment plate 102a because they are provided in the extended portion 112b. In other words, the alignment plate 102a and the extended portion 112b function as a sensor movement controller 402. On the other hand, the obliquely transported condition detection sensor 113a and the correction roller 114a are fixed because they are provided in the extended portion 112a of the alignment plate 102a. Consequently, when the adjustment of both of the width directional opposed sides of the document P is completed, positions of the obliquely transported condition detection sensors 113 and the correction rollers 114 are adjusted in accordance with the width-directional opposed sides of the document P (Step S102).

[0069] When the user puts the document P on the disposition plate 101a, the document detection sensor 115 provided in the disposition plate 101a detects the existence of the document P and transmits a signal indicating the existence of the document P to the reception section 401. Thus, the reception section 401 recognizes existence of the document P. (Step S102)

[0070] In this example, even though the document P is aligned by the alignment plates 102, it is obliquely positioned at a predetermined angle as illustrated in FIG. 6A. Accordingly, compared to the right corner of the F-directional front end of the document P, the left corner thereof is positioned obliquely forward in the F-direction.

[0071] Next, when a user inputs a copy functional setting through the copy setting screen and then presses the start key, the reception section 401 transmits a signal indicating transportation of the document P to an automatic document feeder 403 and activates the obliquely transported condition detection sensors 113 of the sensor movement controller 402 (Step S103).

[0072] When the automatic document feeder 403 drives the pick-up roller 105 to pull the documents P into the transportation entrance 104, the obliquely positioned document P is then transported to the document transportation path 103 while keeping the oblique orientation. Therefore, as illustrated in FIG. 6B, the document P is obliquely transported, and a left corner 601 of the document P tilting forward firstly makes contact with the obliquely transported condition detection sensor 113b. Accordingly, the obliquely transported condition detection sensor 113b detects contact with the corner 601 of the document P, and transmits a contact signal to an obliquely transported condition detection unit 404. Subsequently, the obliquely transported condition detection unit 404 obtains a contact signal from either of the obliquely transported condition detection sensors 113 (Step S104).

[0073] When the obliquely transported condition detection unit 404 obtains a contact signal from only one of the obliquely transported condition detection sensors 113 (in this case, the obliquely transported condition detection sensor 113b), it determines that the transported document P is obliquely transported. Then, the obliquely transported condition detection unit 404 transmits a signal to a correction unit 407 to indicate that the obliquely transported condition detection unit 404 has not received a contact signal from the other of the obliquely transported condition detection sensors 113 (in this case, the obliquely transported condition detection sensor 113a), that is, to indicate that a right corner 602 of the document P has not reached the obliquely transported condition detection sensor 113a (No in Step S105 and then Step S106).

[0074] Subsequently, the correction unit 407 moves only the corner 602 of the document P forward by causing the automatic document feeder 403 to stop the pick-up roller 105 and the like and by moving only the correction roller 114a (Step S107). In this case, rotation of the correction roller 114b is prevented. Therefore, as illustrated with the arrow in FIG. 6C, the document P is entirely turned around the end portion 603 of the left side of the document P. Note that the end portion 603 makes contact with the correction roller 114b. Also, the correction unit 407 may cause the automatic document feeder 403 to move up slightly the pick-up roller 105 to turn easily the document P as needed.

[0075] When the obliquely transported condition detection sensor 113a detects a contact with the corner 602 of the document P after the document P is entirely turned around, the obliquely transported condition detection unit 404 determines that the obliquely transported condition of the document P is resolved. Accordingly, the obliquely transported condition detection unit 404 causes the correction unit 407 to stop only the rotation of the correction roller 114a and causes the automatic document feeder 403 to resume the transportation of the document P (Step S108).

[0076] After the obliquely transported condition of the document P is resolved, the document P is transported to the scanning position X. Then an image scanner 405 scans an image on the document P and obtains its image data. A function provision unit 406 forms an image onto a sheet of printing paper based on the image data (Step S109 and then Step S110).

[0077] On the other hand, when the obliquely transported condition detection unit 404 simultaneously receives contact signals from the obliquely transported condition detection sensors 113, it determines that the transported document P is not obliquely transported. Then it transmits the information to the automatic document feeder 403 (YES in Step S105 and then Step S110).

[0079] Subsequently, the automatic document feeder 403 drives the first transportation roller 106a and the like, and resumes the transportation of the document P while maintaining the position of the document P without any changes. Furthermore, the image scanner 405 scans an image on the document P in the scanning position X, and transmits the
obtained image data to the function provision unit 406. The function provision unit 406 forms an image onto a sheet of paper based on the image data (Step S109).

[0080] With the above-mentioned procedure, the obliquely transported condition of the document P is detected, and a copy service is completely provided. In the above-mentioned example, the document P is obliquely transported while the corner 601 of the F-directional end of the document P is positioned obliquely forward. However, even when the document P is obliquely transported while the corner 602 is positioned obliquely forward, basically the same procedure will be performed.

[0081] Next, accuracy of detecting an obliquely transported condition of the document P will be hereinafter explained in detail referring to FIGS. 7A and 7B. FIG. 7A is a view of a diagram that illustrates a positional relation of the obliquely transported condition detection sensors 113 with respect to the obliquely transported document P of the first embodiment. FIG. 7B is a view of a diagram illustrating a positional relation of fixed obliquely transported condition detection sensors 701 and 702 of the conventional art. Note that the oblique conditions of the document P in FIGS. 7A and 7B are the same. In FIGS. 7A and 7B, a line 703 corresponds to the F-directional front side of the obliquely positioned document P, and a dotted line 704 connects two obliquely transported condition detection sensors 113a-113b/701-702. The lines 703 and 704 form an angle “α.” In other words, the left corner of the document P is positioned obliquely forward compared to the right corner thereof.

[0082] As illustrated in FIG. 7A, when positions of the obliquely transported condition detection sensors 113a and 113b are adjusted in accordance with both of the width-directional sides of the document P and accordingly the corner 601 of the document P makes contact with the obliquely transported condition detection sensor 113b, distance from the corner 602 of the document P to the obliquely transported condition detection sensor 113a corresponds to “delayed distance d1,” **On the other hand, when the obliquely transported condition detection sensor 113c is positioned between the corners 601 and 602 of the document P, distance from the obliquely transported condition detection sensor 113c to the line 703 corresponds to “delayed distance d2.” The delayed distance d1 is greater than the delayed distance d2. The delayed distance d1 is the maximum delayed distance.

[0083] In this case, the maximum period of time will be elapsed since the corner 601 of the document P makes contact with the obliquely transported condition detection sensor 113b until the corner 602 of the document P makes contact with the obliquely transported condition detection sensor 113c, and the period of time elapsed between the contact between the corner 601 and the obliquely transported condition detection sensor 113b and the contact between the corner 602 and the obliquely transported condition detection sensor 113a is hereinafter referred to as “delayed time.” Accordingly, even when documents of various sizes are obliquely transported, the delayed time will be always maximally set. In other words, a difference will be easily generated between detection timings by the obliquely transported condition detection sensors 113a and 113b. The obliquely transported condition detection unit 404 is thereby configured to determine easily that the document P is obliquely transported. Consequently, accuracy in detecting the obliquely transported condition of the document P will be enhanced.

[0085] On the other hand, a comparison example is illustrated in FIG. 7B. In this case, the obliquely transported condition detection sensors 701 and 702 are arranged in accordance with positions of both of the width-directional opposed sides of a standard form paper of the minimum size. As illustrated in FIG. 7B, the obliquely transported condition detection sensors 701 and 702 are positioned in approximately central position of the obliquely positioned document. In other words, when a left portion of the F-directional front side of the document P makes contact with the obliquely transported condition detection sensor 702, delayed distance d3 is less than the delayed distance d1 of the present embodiment in FIG. 7A even though the document P is obliquely transported at the same angle α as the present embodiment in FIG. 7A. In short, delayed time corresponding to the delayed distance d3 in the comparison example is less than that corresponding to the delayed distance d1, and accordingly difference is not easily generated between detection timings by the obliquely transported condition detection sensors 701 and 702 in the comparison example. Due to this structure, the obliquely transported condition unit 404 of the comparison example may have a greater chance in determining that the document P is not obliquely transported even if the document P is actually obliquely transported. In response to this, it may be possible for the comparison example in FIG. 7B to detect an obliquely transported condition of the document P by using predetermined obliquely transported condition detection sensors with higher accuracy of detecting a contact with the document P or by elaborating a setting of the criterion to determine whether or not the document P is obliquely transported. However, it should apparent from this disclosure that it is easier to detect the existence of an obliquely transported condition by moving the obliquely transported condition detection sensors in accordance with the width size of the document P as described in the present embodiment of FIG. 7A.

[0086] As described above, positions of a pair of obliquely transported condition detection sensors are configured to be adjusted in accordance with the width-directional sides of the document.

[0087] Accordingly, positions of the obliquely transported condition detection sensors are appropriately adjusted to generate sufficient difference between detection timings by the obliquely transported condition detection sensors. In other words, positions of the obliquely transported condition detection sensors are appropriately adjusted to maximize a period of time since either of the obliquely transported condition detection sensors detects one of the travel-directional front corners of a document until the other of the obliquely transported condition detection sensors detects the other of the travel-directional front corners of the document. Accordingly, it is possible to detect accurately the obliquely transported condition of a document regardless of the document width.

[0088] Furthermore, each of a pair of alignment plates has an extended portion extending to a predetermined position on the document transportation path. Addition of each of the extended portions is provided with an obliquely transported condition detection sensor, and the obliquely transported condition detection sensors are opposed to each other.

[0089] With this configuration, when a user aligns the width-directional opposed sides of a document by the pair of alignment plates, the obliquely transported condition detection sensors are automatically moved in conjunction with the
alignment plates. Accordingly the obliquely transported condition detection sensors are constantly arranged to detect accurately an obliquely transported condition of the document. Consequently, even when a user does not accurately put a document on a document disposition plate, it is possible to detect accurately an obliquely transported condition of the document.

Second Embodiment

[0090] A second embodiment will now be explained. In view of the similarity between the first and second embodiments, the parts of the second embodiment that are identical to the parts of the first embodiment will be given the same reference numerals as the parts of the first embodiment. Moreover, the descriptions of the parts of the second embodiment that are identical to the parts of the first embodiment may be omitted for the sake of brevity.

[0091] The following is an explanation of procedure executed by the ADF 100 and the MFP 200 of the second embodiment to detect accurately an obliquely transported condition of a sheet of document. The procedure will be explained with reference to FIGS. 8A, 8B, 9, 10, 11A and 11B. The second embodiment is primarily different from the first embodiment in that width size of the document is herein obtained and two obliquely transporting condition detection sensors are moved in accordance with the obtained width size of the document. The first and second embodiments are similar or basically the same excluding this point. Therefore, the second embodiment will be explained with reference to figures (FIGS. 1A to 71) used in the first embodiment as needed.

[0092] First, the sensor movement controller provided in the ADF 100 of the second embodiment will be explained in detail.

[0093] As illustrated in FIG. 8A, an alignment plate 801 is disposed on the disposition plate 101a. The alignment plate 801 is used to align a side of the document P. The alignment plate 801 does not have an extended portion in its bottom end. The alignment plate 801 is simply fixed to a disposition plate 101a. Instead of the extended portion provided in the first embodiment, a pair of auxiliary members 802 (i.e., auxiliary members 802a and 802b in FIG. 8B) are disposed on the lower side of the document transportation path 103. Each of the auxiliary members 802 holds each of a pair of obliquely transported condition detection sensors 113 (i.e., obliquely transported detection sensors 113a and 113b) and each of a pair of correction rollers 114 (i.e., correction rollers 114a and 114b) in predetermined positions between a pick-up roller 104 and a first transportation roller 106A in a document transportation path 103 of the ADF 100. More specifically, each of the obliquely transported condition detection sensors 113 is provided on the upper surface of each of the auxiliary members 802, and is arranged near the first transportation roller 106A. On the other hand, each of the correction rollers 114 is provided in each of the auxiliary members 802, and is disposed near the pick-up roller 105. Note that each of the auxiliary members 802 is separately disposed from the alignment plate 801.

[0094] As illustrated in FIG. 8B, the body of the alignment plate 801 is parallel to the F-direction. The body of the alignment plate 801 is fixed to the F-directionally right end portion of the disposition plate 101a. A first contact sensor 803 is arranged in a predetermined position on the disposition plate 101a. Specifically, the first contact sensor 803 is arranged in the vicinity of the end of the alignment plate 801 and a transportation entrance 104. The first contact sensor 803 is configured to detect contact with a corner of the document P. Therefore, the first contact sensor 803 is arranged to detect one of the four corners of the document P every time when a side of the document P is aligned by the alignment plate 801.

[0095] In addition to the first contact sensor 803, a plurality of contact sensors 804 is arranged in predetermined positions on the disposition plate 101a. In this example, there are preferably five contact sensors 804 arranged at different width and length positions on the disposition plate 101a. In the example of FIG. 8B, when a document P of a predetermined standard form size (e.g., A4 and B5) is disposed on the disposition plate 101a and a side of the standard form document P is aligned by the alignment plate 801, the first contact sensor 803 and one of the contact sensors 804 are arranged below the diagonally-opposed corners of the standard form document P. In other words, positions of the contact sensors 804 correspond to those of corners of standard form documents P of various sizes. With this configuration, the size (i.e., width) of the disposed standard form document P is determined based on signals from the first contact sensor 803 and a corresponding contact sensor 804.

[0096] For example, when a B5 document is put in the landscape direction, the first contact sensor 803, contact sensors 804a and 804b make contact with the B5 document. In this case, the first contact sensor 803 and the contact sensor 804a correspond to diagonally-opposed corners of the B5 document put in the landscape direction. However, the B5 document inevitably makes contact with the contact sensor 804b. Therefore, the width of the B5 paper is determined based on contact signals from the first contact sensor 803, the contact sensor 804a and the contact sensor 804b. Note that an after-mentioned width size storage stores a criteria table that determines the width of the B5 document put in the landscape direction. In the criteria table, a predetermined sensor transmitting a contact signal is associated with the width of the document P corresponding to the contact signal.

[0097] Furthermore, as seen in the planview of FIG. 8B, the auxiliary member 802 (i.e., auxiliary members 802a and 802b) is arranged in the interior of the platen cover 110. The auxiliary members 802a and 802b are opposed in the width direction perpendicular to the F-direction.

[0098] Seen in the F-direction, the auxiliary member 802a is arranged in the right side, and the right side obliquely transported condition detection sensor 113a is arranged on the upper surface of the auxiliary member 802a. Also, the obliquely transported condition detection sensor 113a is arranged near the transportation roller 106A. On the other hand, the auxiliary member 802b is arranged in the left side. The auxiliary member 802b is configured to move in parallel to the width direction. The auxiliary member 802b includes a stick portion 805 on its lateral side. The stick portion 805 is inwardly extended along the width direction. The stick portion 805 has teeth 806 (not illustrated in the figure) on its lateral side. Furthermore, a stepper motor 808 is arranged in the center of the interior of the platen cover 110. The stepper motor 808 is arranged to rotate in the forward and reverse directions. The pinion gear 807 meshes with the teeth 806 of the stick portion 805. Thus, the auxiliary member 802b is configured to move in parallel to the width direction. When the stepper motor 808
rotates the pinion gear 807 at the predetermined number of rotations, the stick portion 805 moves in parallel to the width direction while the teeth 806 meshes with the pinion gear 807. Accordingly, the auxiliary member 802b moves in parallel to the width direction because it is coupled to the stick portion 805.

[0100] In this case, the predetermined number of rotations of the pinion gear 807 is controlled by the after-mentioned sensor movement controller 402. For example, when the auxiliary member 802b is moved in parallel to the width direction at a predetermined distance, rotations of the stepper motor 808 are controlled by converting the distance necessary for rotations of the stepper motor 808 into a predetermined pulse number to indicate the number of pulse signals.

[0101] The following is an explanation of the procedure executed by the ADF 100 and the MFP 200 of the second embodiment to detect an obliquely transported condition of the document P. FIG. 9 is a view of a functional block diagram of the ADF 100 and the MFP 200 of the second embodiment. FIG. 10 is a view of a flowchart illustrating actions of the ADF 100 and the MFP 200 of the second embodiment.

[0102] When a user powers on the MFP 100, the reception section 401 displays a copy setting screen as the initial screen (Step S201). Then, a user puts a plurality of documents P on the plate portion 101a of the ADF 100 as illustrated in FIG. 11A, the first contact sensor 803 and a predetermined contact sensor 804 corresponding to the size of the document P detect the contact with the document P. The reception section 401 recognizes disposition of the document P on the plate portion 101a based on the contact signals from the contact sensors 803 and 804. Additionally, a width size obtained unit 901 refers to a data table stored in the width size storage 902, and obtains a width z1 of the disposed document P based on the table and the detected contact signals from the contact sensors 803 and 804 (Step S202). In this case, the left corner of the F-directional side from the side of the document P is disposed obliquely forward compared to the right side thereof.

[0103] The obtained width z1 is transmitted from the width size obtained unit 901 to the sensor movement controller 402. The sensor movement controller 402 computes a predetermined number of the number of rotations of the pinion gear 807 and further supplies the obtained width z1 to the sensor movement controller 402. The sensor movement controller 402 moves the left side obliquely transported condition detection sensor 113b in parallel to the width direction by rotating the pinion gear 807 of the stepper motor 808 at the number of rotations corresponding to the pulse number (Step S203). Accordingly, the obliquely transported condition detection sensor 113b is opposed to the left corner 1101 of the document P. In other words, positions of the obliquely transported condition detection sensor 113a and 113b are adjusted in accordance with the width-directional both sides of the document P.

[0104] In this case, distance z2 is defined as a distance between the obliquely transported condition detection sensor 113b and 113b. The distance z2 may not be matched with the received width z1 in consideration of the structure of the ADF 100. The distance z2 may be computed by multiplying the width z1 by a predetermined correction coefficient (e.g., correction coefficient depending on tilt angle of the obliquely transported document) as needed.

[0105] Next, when a user inputs settings of the copy function through the copy setting screen and then presses a start key, the reception section 401 transmits a signal indicating transportation of the document P to the automatic document feeder 403. Simultaneously, the reception section 401 activates the obliquely transported condition detection sensor 113a and 113b (Step S204).

[0107] As illustrated in FIG. 11B, when the automatic document feeder 403 pulls the document P into the transportation entrance 104, the obliquely disposed document P is transported to the document transportation path while keeping the current oblique orientation. Accordingly, the left corner 1101 of the front side of the document P first makes contact with the obliquely transported condition detection sensor 113b. Then, the obliquely transported condition detection unit 404 obtains a contact signal from the obliquely transported condition detection sensor 113b (Step S205). In other words, the obliquely transported condition detection unit 404 receives a contact signal from either of the obliquely transported condition detection sensors 113a and 113b.

[0108] When the obliquely transported condition detection unit 404 obtains a contact signal from either of the obliquely transported condition detection sensors 113a and 113b (in this case, a contact signal from the obliquely transported condition detection sensor 113b), it determines that the document P is obliquely transported. Then the obliquely transported condition detection unit 404 transmits a signal to the correction unit 407 that indicates that arrival of the other corner of the front side of the document P (in this case, the right corner 1102) is delayed because a contact signal has not been obtained from the other (in this case, the obliquely transported condition detection sensors 113a) of the obliquely transported condition detection sensors 113 (No in Step S206 and then Step S207).

[0109] In response to this, the correction unit 407 causes the automatic document feeder 403 to stop the pick-up roller 105 and the like, and rotates only the F-directional right side correction roller 114a. Accordingly, the right corner 1102 of the document P is moved forward (Step S208). Then, when the right corner 1102 of the document P moves forward, the obliquely transported condition detection sensor 113a detects the contact with the right corner 1102 of the document P. Based on the detection, the obliquely transported condition detection unit 404 determines that the obliquely transported condition of the document P is resolved. Accordingly, the obliquely transported condition detection unit 404 causes the correction unit 407 to stop only rotation of the correction roller 114a, and causes the automatic document feeder 403 to resume transportation of the document P (Step S209).

[0111] After the obliquely transported condition of the document P is resolved, the document P is transported to the scanning position X. The image scanner 405 scans an image on the document P in the scanning position X. Based on the image data, the function provision unit 406 forms an image onto a sheet of printing paper (Step S209 and then Step S210).

[0112] On the other hand, when the obliquely transported condition detection unit 404 simultaneously receives contact signals from both of the obliquely transported condition detection sensor 113a and 113b, it determines that the document P is not obliquely transported. Then the obliquely transported condition detection unit 404 transmits a signal that indicates that the document P is not obliquely transported to the automatic document feeder 403 (Yes in Step S206 and then Step S211).

[0113] Subsequently, the automatic document feeder 403 drives the first transportation roller 106a and the like, and
resumes transportation of the document P without any changes. Furthermore, the image scanner 405 scans an image on the document P arrived at the scanning position X, and transmits the obtained image data to the function provision unit 406. The function provision unit 406 forms an image onto a sheet of printing paper based on the image data (Step S210).

[0114] Thus the copy service is completed through the above described procedure.

[0115] According to the second embodiment, it is possible to obtain the width size of the document and move two obliquely transported condition detection sensors in accordance with the both sides of the document with the obtained width size.

[0116] With the configuration, it is possible to move automatically and appropriately two obliquely transported condition detection sensors to detectable positions, for example, by obtaining the width size of a document with predetermined contact sensors arranged in predetermined positions on a disposition plate without making a user move the alignment plate. Accordingly, a user is able to put readily a document on the disposition plate without caring tilted orientation of the document.

OTHER EXAMPLE EMBODIMENTS

Example (a)

[0117] According to the first and second embodiments, the correction unit is configured to resolve the oblique condition of the document P with the correction roller. However, the oblique condition of the document P may be resolved by any other suitable methods. For example, the document transportation path is normally configured to loosen a transported document at a predetermined position. However, a loosening device may be provided in the position to resolve the obliquely transported condition of a document by further loosening the document to a predetermined extent.

[0118] Furthermore, as an alternative method, an image data obliquely positioning device may be provided to resolve the obliquely transported condition of a document by obliquely positioning an image of the scanned data of the document in a predetermined angle.

Example (b)

[0119] According to the first and second embodiments, the correction roller is arranged on the extended portion of the alignment plate or the upper surface of the auxiliary while it is aligned with the obliquely transported condition detection sensor along the f-direction. However, the correction roller may be arranged in any other suitable positions as long as it is configured to resolve the obliquely transported condition of the document. For example, the correction roller may be arranged in a predetermined position on the document transportation path. If the correction roller is arranged away from the oblique condition sensor, it should be apparent from this disclosure that it is necessary for the obliquely transported condition detection unit to compute preliminarily delayed distance of the document and perform correction based on the delayed distance.

Example (c)

[0120] According to the first and second embodiments, the two obliquely transported condition detection sensors are arranged in the vicinity of the pick-up roller on the document transportation path. However, the two obliquely transported condition detection sensors may be arranged in any other suitable positions as long as they are configured to detect the obliquely transported condition of the document within the document transportation path. For example, the obliquely transported condition detection sensors may be arranged away from the pick-up roller through a predetermined distance.

Example (d)

[0121] According to the first and second embodiments, the correction unit is configured to rotate only the correction roller corresponding to either of the obliquely transported condition detection sensors not having received a contact signal until the obliquely transported condition detection sensor receives the contact signal. However, the correction unit may be configured to control rotation of the correction roller with any other suitable methods as long as it is configured to resolve appropriately the obliquely transported condition of the document. For example, the obliquely transported condition detection unit may be configured to compute preliminarily the delayed distance of the document and the correction roller may be configured to be rotated to resolve the delayed distance.

Example (e)

[0122] According to the first and second embodiments, two obliquely transported condition detection sensors, the obliquely transported condition detection unit and the sensor movement controller are provided in the disposition plate of the automatic document feeding device. However, these elements and means may be provided in the disposition plate to transport a sheet of printing paper (e.g., a disposition plate in the interior of a paper feeding tray). In this case, it is possible to realize the above-mentioned working effects as well.

Example (f)

[0123] According to the first and second embodiments, the two obliquely transported condition detection sensors and the two correction rollers are provided in the extended portion or on the upper surface of the auxiliary member. However, they may be provided on the lower surface or the lateral surface thereof as long as the working effects of the present invention are realized as well.

Example (g)

[0124] According to the first embodiment, the F-directional right side alignment plate is fixed in the vicinity of the end of the disposition plate while the F-directional left side alignment plate is configured to move in parallel to the width direction. However, the right side alignment plate may be configured to be moved in parallel to the width direction whereas the left side alignment plate may be fixed. Furthermore, both of the alignment plates may be configured to be moved in parallel to the width direction.

Example (h)

[0125] According to the second embodiment, the F-directional right side auxiliary member is fixed in a predetermined position whereas the F-directional left side auxiliary member is configured to be moved in parallel to the width direction. However, the right side auxiliary member may be configured...
to be moved in parallel to the width direction whereas the left side auxiliary member may be fixed. Furthermore, both of the auxiliary members may be configured to be moved in parallel to the width direction.

Example (i)

[0126] When both of the auxiliary members are configured to be moved in parallel to the width direction, a stepper motor may be further added and may be configured to move separately the auxiliary members in parallel to the width direction. Also, the stepper motor may be configured to move simultaneously both of the auxiliary members in parallel to the width direction. For moving both of the auxiliary members simultaneously and in parallel, for example, a stick member with a teeth portion may be provided for each of the auxiliary members and a stepper motor with a gear member may be arranged to mesh the gear member with the teeth portion of the stick member.

Example (j)

[0127] According to the second embodiment, when the document is put on the disposition plate, the width size obtainment unit is configured to obtain the width size of the document based on contact signals from contact sensors corresponding to the obliquely opposed corners of the document. However, the width size obtainment unit may be configured to obtain the width size of the document at any other suitable timing. For example, it may be configured to obtain the width size after the reception unit receives a signal of a start key, or while the reception unit receives a predetermined condition.

Example (k)

[0128] According to the second embodiment, the width size obtainment unit is configured to obtain the width size of the document from a table stored in the width size storage based on contact signals from contact sensors arranged in predetermined positions. However, the width size obtainment unit may be configured to obtain the width size of the document by any other suitable methods with a variety of means for detecting the size of the document (e.g., a displacement sensor, a line sensor and a charge-coupled device (CCD) sensor).

Example (l)

[0129] According to the second embodiment, the width size obtainment unit is configured to obtain the width size of the document based on the contact sensor and the table stored in the width size storage. However, the width size obtainment unit may be configured to obtain the width size of the document by any other suitable methods. For example, based on a user’s input of a standard/non-standard form document size, the width size obtainment unit may be configured to obtain the width size of the document corresponding to the inputted document size.

Example (m)

[0130] According to the second embodiment, the sensor movement controller is configured to adjust positions of the two sensors before the reception unit receives an input to set the copy function. However, the sensor movement controller may be configured to adjust their positions while the input is being received or after the input is received.

Example (n)

[0131] According to the first and second embodiments, the present invention is applied to the copy service. However, the present invention may be applied to any other suitable services such as a facsimile service, a scanner service, a printer service, a network scanning service and a post-processing service.

INDUSTRIAL APPLICABILITY

[0132] As described above, it should be apparent from this disclosure the paper transportation device of the present invention is useful not only when used as an independent device but also when installed in a variety of apparatuses such as a copier, a printer, an MFP, and the like. Furthermore, it is useful as a device to detect accurately an obliquely transported condition of a sheet of paper.

General Interpretation

[0133] A used herein, the following directional terms “forward, rearward, above, downward, vertical, horizontal, below, and transverse” as well as any other similar directional terms refer to those directions of a device equipped with the present invention. Accordingly, these terms, as utilized to describe aspects of the present invention, should be interpreted relative to a device equipped with the present invention.

[0134] The term “configured” as used herein to describe a component, section or part of a device includes hardware and/or software that is constructed and/or programmed to carry out the desired function.

[0135] Terms that are expressed as “means-plus function” in the claims should include any structure that can be utilized to carry out the function of that part of the present invention.

[0136] The term “comprising” and its derivatives, as used herein, are intended to be open ended terms that specify the existence of the stated features, elements, components, groups, integers, and/or steps, but do not exclude the presence of other unstated features, elements, components, groups, integers, and/or steps. The foregoing also applied to words having similar meanings such as the terms, “including,” “having,” and their derivatives. Also, the term “part,” “section,” “portion,” “member,” or “element” when used in the singular can have the dual meaning of a single part or a plurality of parts.

[0137] The terms of degree such as “substantially,” “about,” and “approximately” as used herein mean a reasonable amount of deviation of the modified term such that the end result is not significantly changed.

[0138] While only selected embodiments have been chosen to illustrate the present invention, it will be apparent to those skilled in the art from his disclosure that various changes and modifications can be made herein without departing from the scope of the invention as defined in the appended claims. Furthermore, the foregoing descriptions of the embodiments according to the present invention are provided for illustration only, and not for the purpose of limiting the invention as defined by the appended claims and their equivalents. Thus, the scope of the invention is not limited to the disclosed embodiments.
What is claimed is:

1. A paper transportation device, comprising:
   a disposition plate, at least one sheet of paper being disposed thereon;
   a paper transportation path being configured to transport
   the sheet of paper, the paper transportation path having a
   transporting member transporting the sheet of paper;
   a guide member being configured to guide the sheet of
   paper disposed on the disposition plate to the paper
   transportation path;
   a pair of sensors detecting a transportation directional front
   end of the sheet of paper, the sensors being arranged on
   the paper transportation path, at least one of the sensors
   being allowed to move in a paper width direction per-
   pendicular to the paper transportation direction; and
   a sensor movement controller being configured to control
   an interval between the pair of sensors by moving the
   pair of sensors based on the width of the sheet of paper.

2. The paper transportation device according to claim 1,
   further comprising an obliquely transported condition detection
   unit that detects an obliquely transported condition of the
   sheet of paper on the paper transportation path based on the
   detection result by the pair of sensors.

3. The paper transportation device according to claim 2,
   further comprising
   a pair of side portion transportation members that trans-
   ports width directionally opposed end portions of the sheet
   of paper, respectively, the side portion transportation
   members being allowed to be separately operated, the
   side portion transportation members being arranged in
   the paper width direction in predetermined intermediate
   positions on the paper transportation path, and
   a correction unit that controls operation of the side portion
   transportation members based on the detection result by
   the obliquely transported condition detection unit.

4. The paper transportation device according to claim 1,
   further comprising
   a pair of alignment plates that align width directionally
   opposed sides of the sheet of paper, the alignment plates
   being arranged on the disposition plate, at least either of
   the alignment plates being allowed to move in the paper
   width direction, the alignment plates including extended
   portions, respectively, the extended portions extending
   from the pair of alignment plates in the paper transport-
   ation direction, and
   wherein the sensors are arranged in the extended portions,
   respectively.

5. The paper transportation device according to claim 3,
   further comprising
   a pair of alignment plates that align width directionally
   opposed sides of the sheet of paper, the alignment plates
   being arranged on the disposition plate, at least one of
   the alignment plates being allowed to move in the paper
   width direction, the alignment plates including extended
   portions, respectively, the extended portions extending
   in the paper transportation direction, and
   wherein each of the sensors and each of the side portion
   transportation members are arranged in each of the
   extended portions.

6. The paper transportation device according to claim 1,
   further comprising
   a pair of auxiliary members, the auxiliary members
   arranged on the lower surface of the paper transportation
   path, at least one of the auxiliary members being allowed
   to move in the paper width direction, and
   wherein the sensors are arranged in the auxiliary members,
   respectively.

7. The paper transportation device according to claim 6,
   further comprising
   a plurality of sensors that detect a paper size by detecting at
   least two of the four corners of a plurality of kinds of
   paper disposed on the disposition plate
   wherein the sensor movement controller moves the pair of
   sensors based on the detection result of the plurality of
   sensors.

8. The paper transportation device according to claim 3,
   further comprising
   a pair of auxiliary members, the auxiliary members
   arranged on the lower surface of the paper transportation
   path, at least one of the auxiliary members being allowed
   to move in the paper width direction, and
   wherein each of the sensors and each of the side portion
   transportation members are arranged in each of the aux-
   iliary members.