US 20240294347A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2024/0294347 A1**

KAI et al. (43) **Pub. Date: Sep. 5, 2024**

(54) **SHEET FEEDING APPARATUS AND IMAGE FORMING APPARATUS**

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(21) Appl. No.: **18/589,960**

(22) Filed: **Feb. 28, 2024**

(30) **Foreign Application Priority Data**

Mar. 1, 2023 (JP) 2023-031339

Publication Classification

(51) **Int. Cl.**

B65H 7/10	(2006.01)
B65H 3/48	(2006.01)
B65H 9/10	(2006.01)

(52) **U.S. Cl.**

CPC ***B65H 7/10*** (2013.01); ***B65H 3/48*** (2013.01); ***B65H 9/101*** (2013.01); *B65H 2511/18* (2013.01); *B65H 2601/272* (2013.01); *B65H 2801/06* (2013.01)

(57) **ABSTRACT**

A sheet feeding apparatus includes a supporting portion, a sheet feeding unit, a side edge regulation plate, a separation unit configured to separate the sheets by blowing air onto the plurality of sheets supported by the supporting portion, a regulation plate position detection unit configured to detect a position of the side edge regulation plates in the width direction, and a control unit configured to execute a separation mode so as to perform an air-blow operation by the separation unit in feeding the sheets by the sheet feeding unit. In the separation mode, in a case where the position of the side edge regulation plate detected by the regulation plate position detection unit does not correspond to size of the sheets supported by the supporting portion in the width direction, the control unit is configured to stop the air-blow operation.

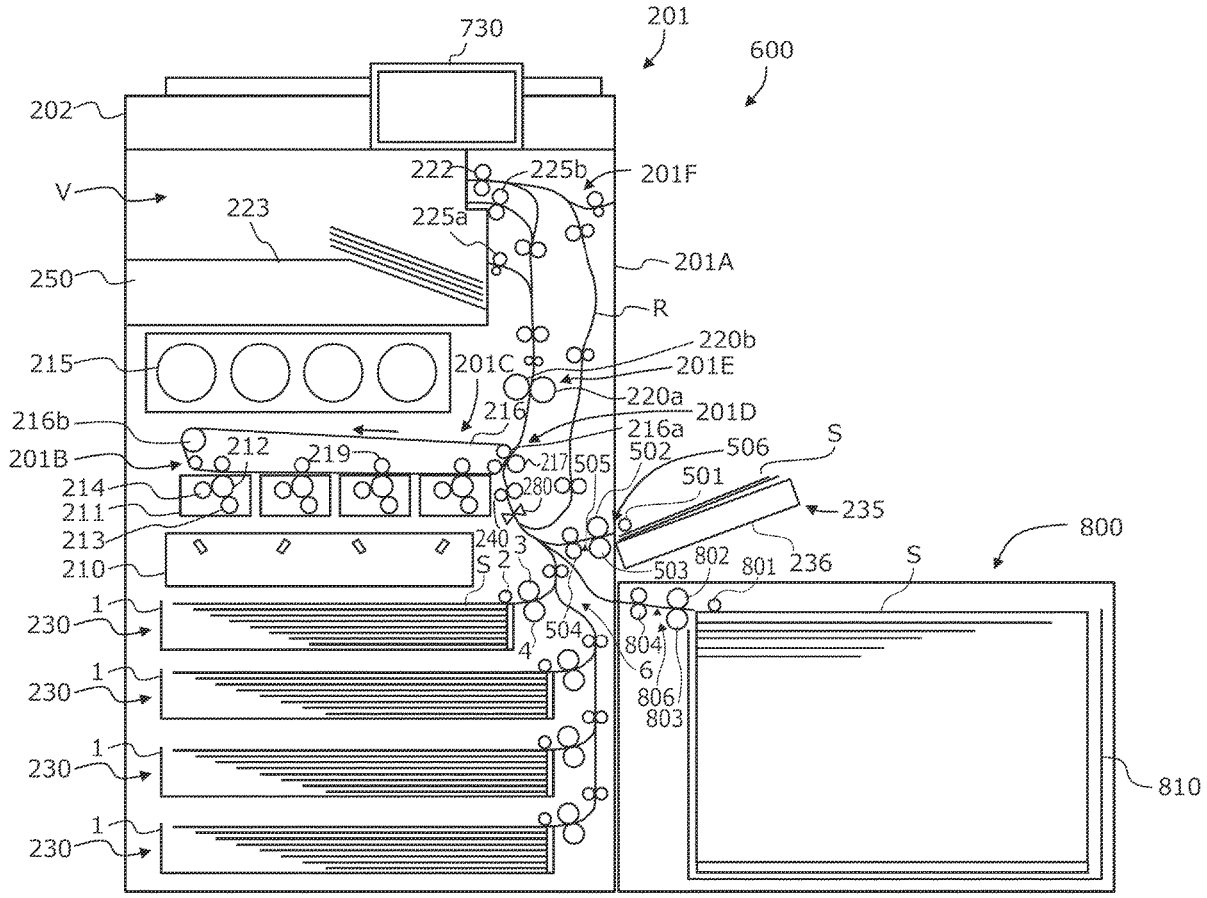


FIG.1

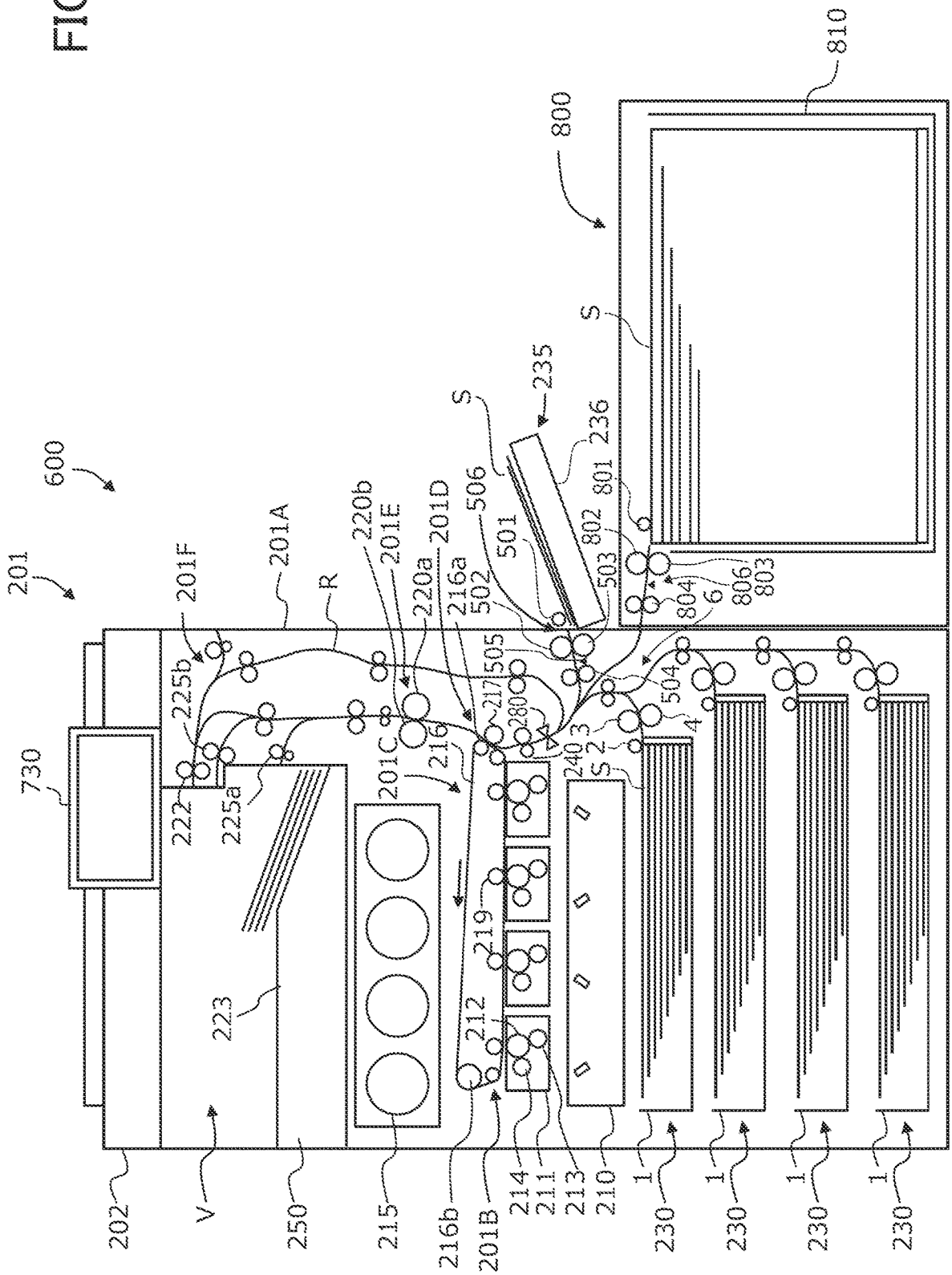

600
201
730
202
V
250
223
222
225a
225b
201F
201A
R
201C
215
216
216b
201B
212
219
214
211
213
210
217
280
240
220b
201E
220a
216a
201D
502
501
506
505
504
503
S
235
236
801
802
804
806
803
800
810
1
230

FIG.2

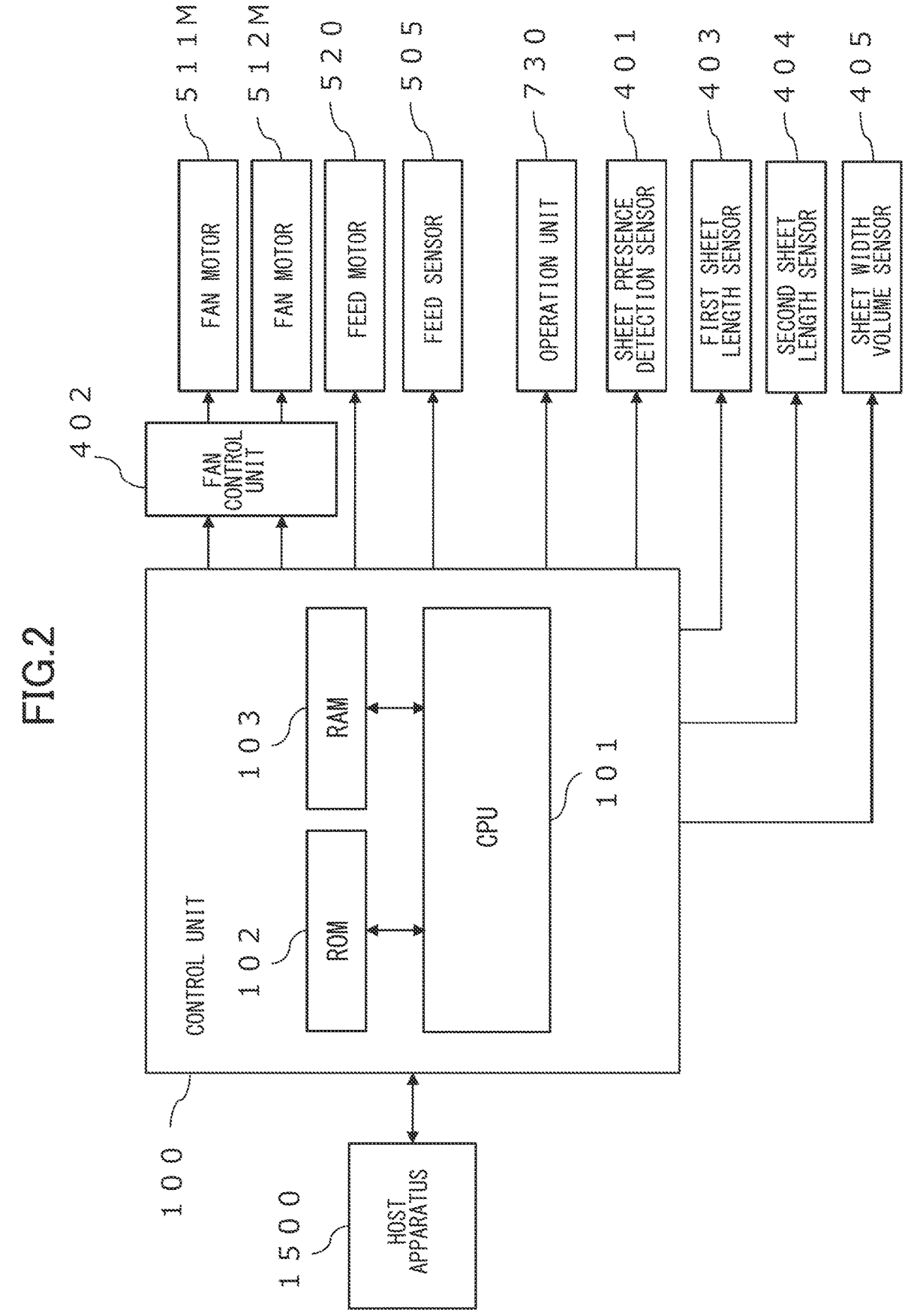

511M
512M
520
505
730
401
403
404
405
FAN MOTOR
FAN MOTOR
FEED MOTOR
FEED SENSOR
OPERATION UNIT
SHEET PRESENCE DETECTION SENSOR
FIRST SHEET LENGTH SENSOR
SECOND SHEET LENGTH SENSOR
SHEET WIDTH VOLUME SENSOR
402
FAN CONTROL UNIT
103
RAM
102
ROM
CPU
101
CONTROL UNIT
100
1500
HOST APPARATUS

FIG.3

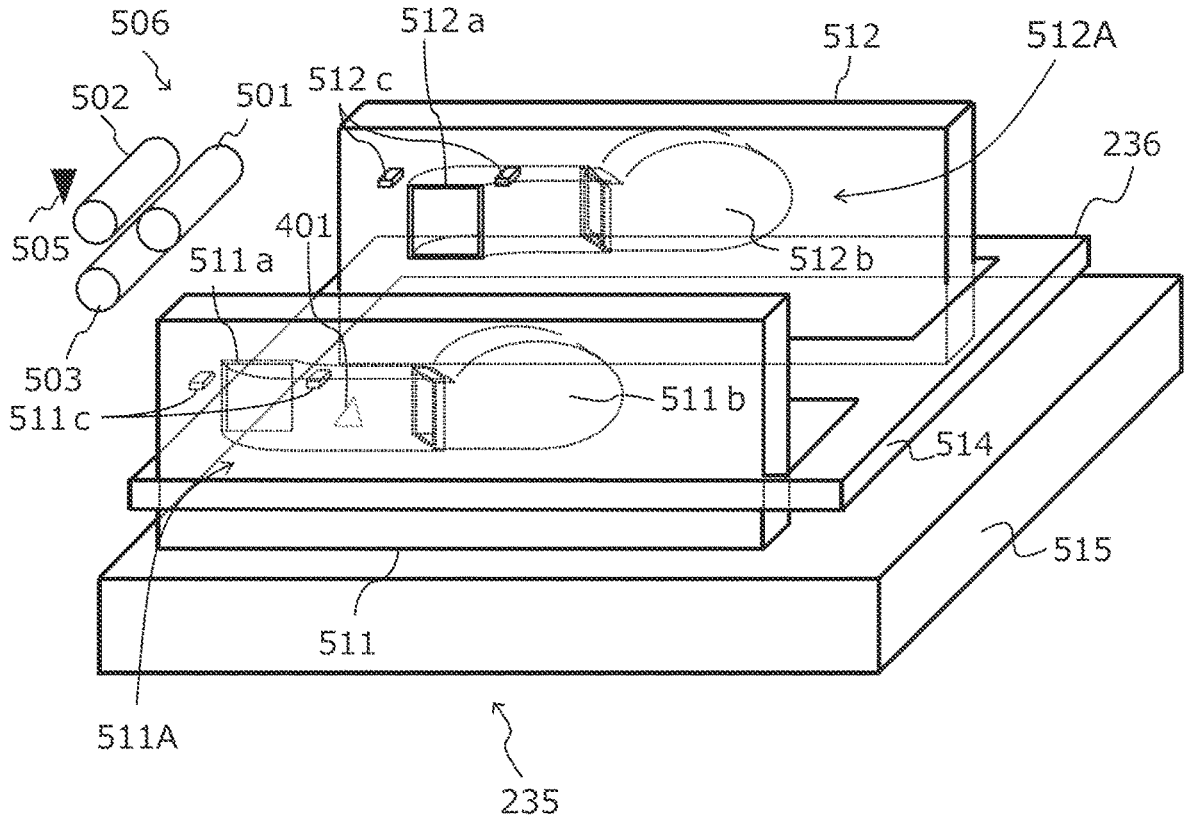

506
512 a
512
512A
502
501
512 c
236
505
401
512 b
511 a
503
511 b
511 c
514
515
511
511A
235

FIG.4

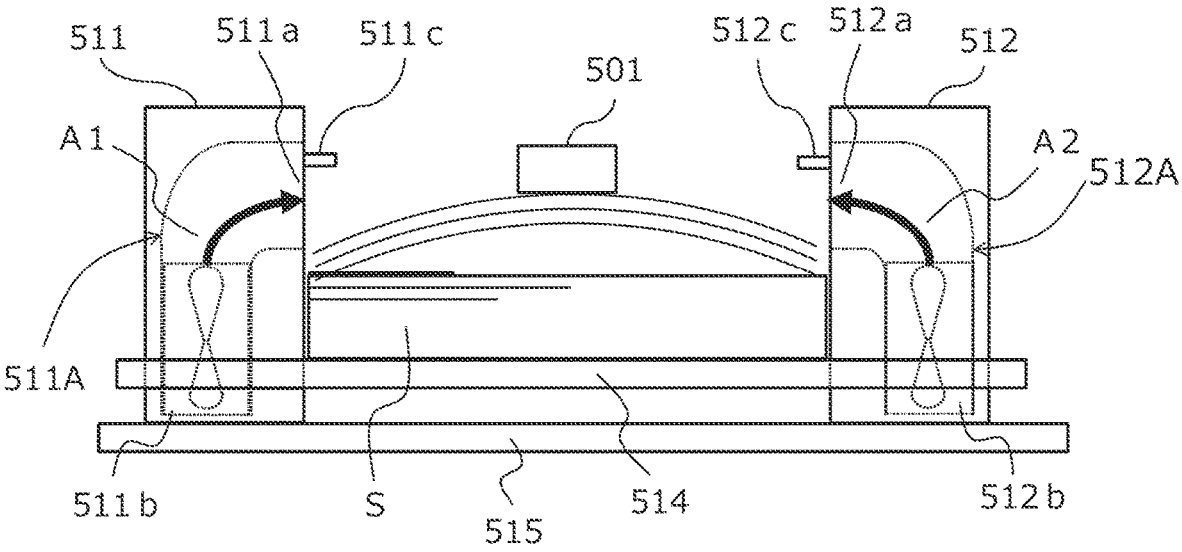

511
511a
511c
501
512c
512a
512
A1
A2
512A
511A
511b
S
515
514
512b

FIG.5

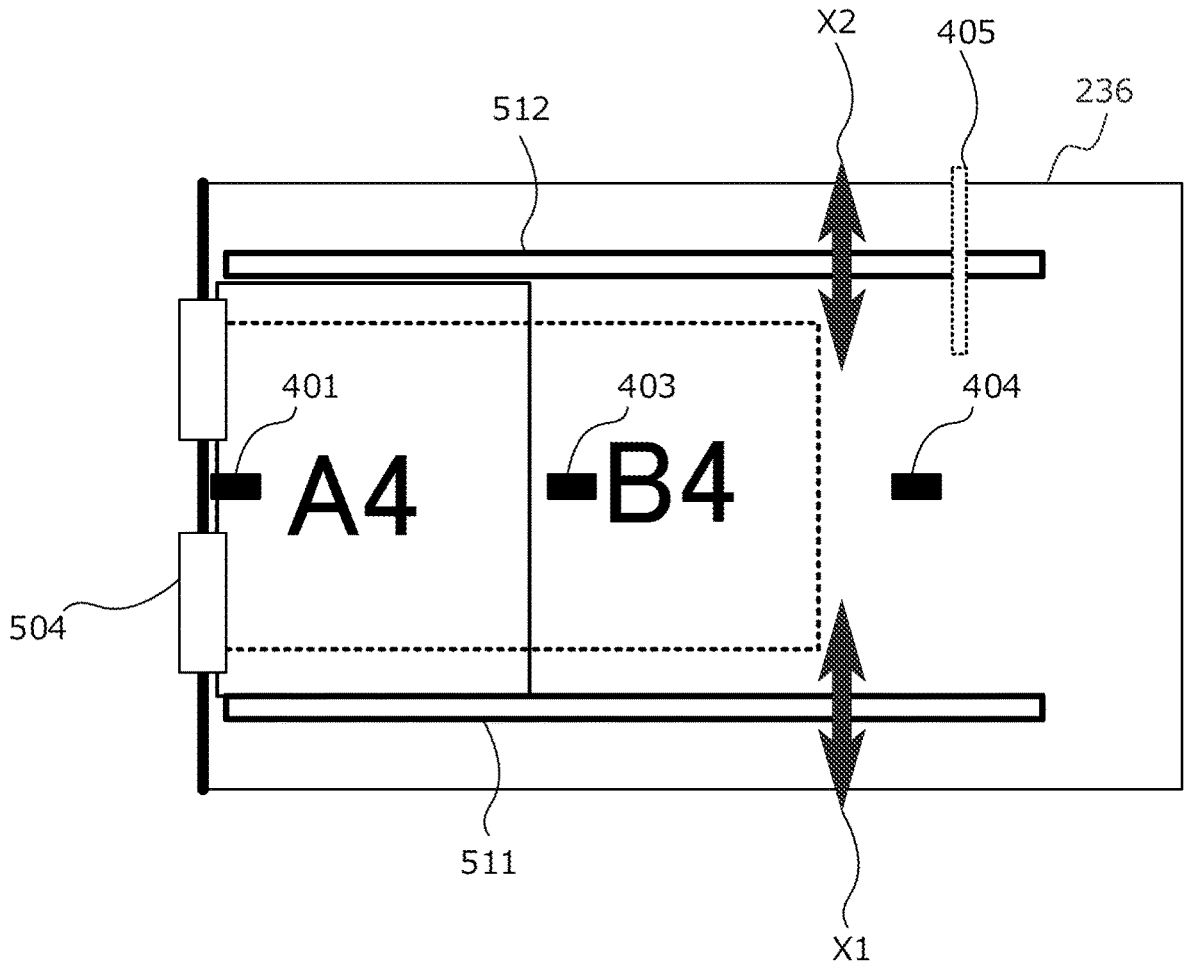


FIG.6

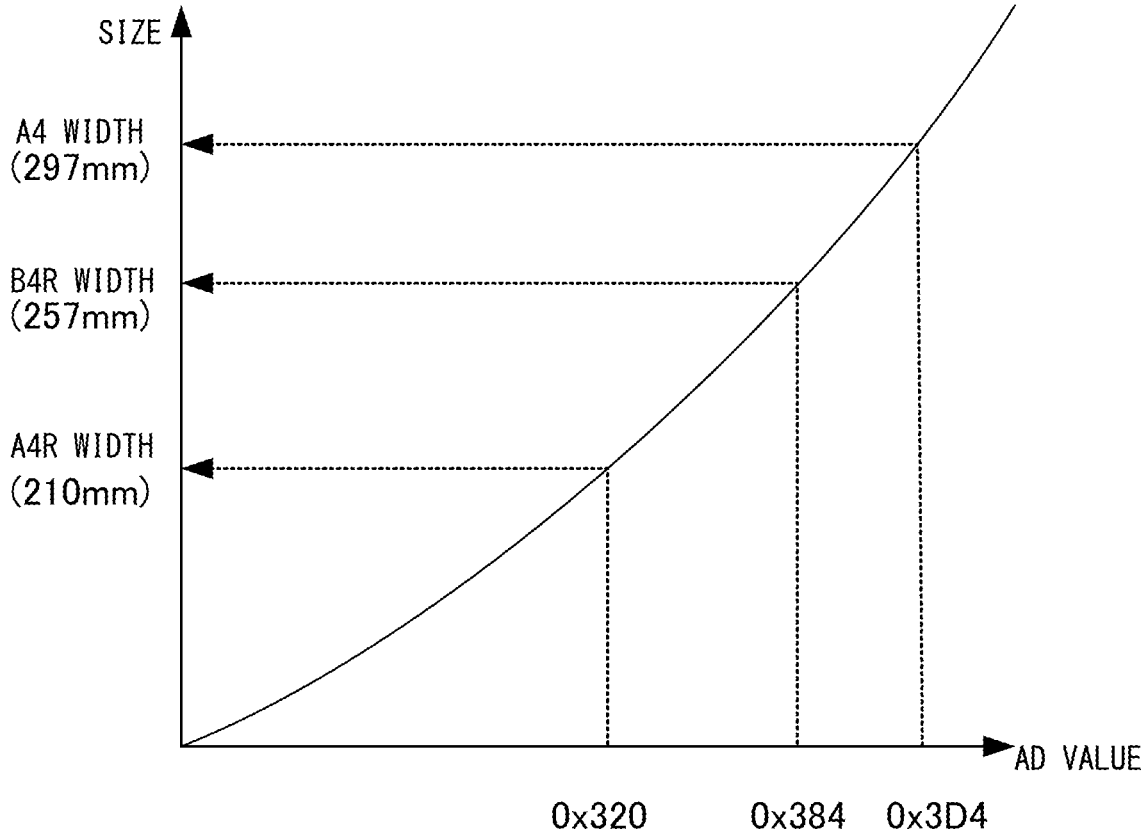

SIZE
A4 WIDTH
(297mm)
B4R WIDTH
(257mm)
A4R WIDTH
(210mm)
AD VALUE
0x320
0x384
0x3D4

FIG.7

SIZE	LENGTH IN MAIN SCANNING DIRECTION	LENGTH IN SUB-SCANNING DIRECTION	SHEET PRESENCE DETECTION SENSOR	FIRST SHEET LENGTH SENSOR	SECOND SHEET LENGTH SENSOR	SHEET WIDTH VOLUME SENSOR
A5	210	148	ON	OFF	OFF	0x320 ± 0x10
B5	257	182	ON	OFF	OFF	0x384 ± 0x10
A4	297	210	ON	OFF	OFF	0x3D4 ± 0x10
A5R	148	210	ON	OFF	OFF	0x258 ± 0x10
B5R	182	257	ON	ON	OFF	0x2E4 ± 0x10
A4R	210	297	ON	ON	OFF	0x320 ± 0x10
B4	257	364	ON	ON	ON	0x384 ± 0x10
A3	297	420	ON	ON	ON	0x3D4 ± 0x10

FIG.8

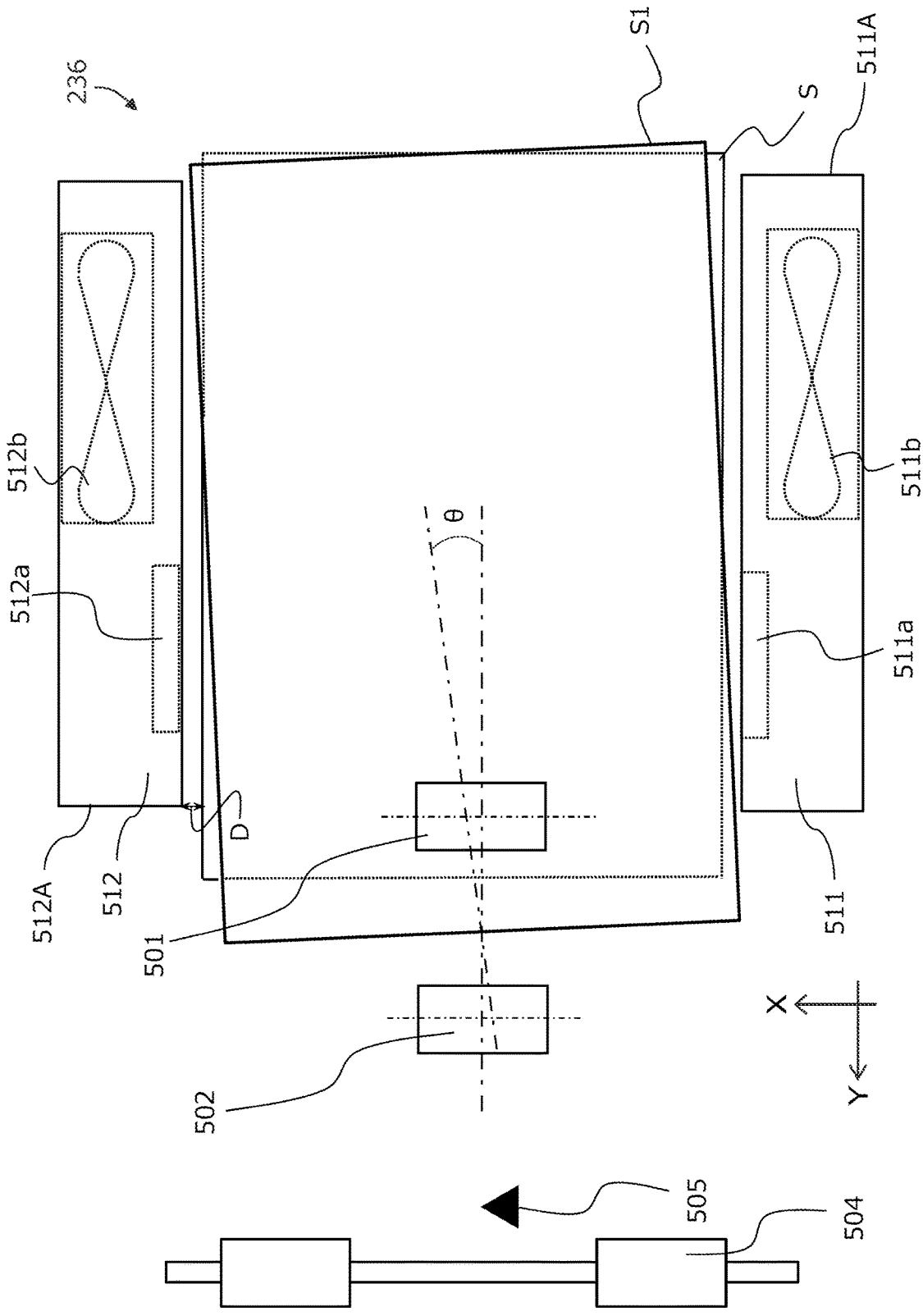

236
S1
S
511A
512b
511b
θ
512a
511a
D
512A
512
501
511
X
Y
502
505
504

FIG.9

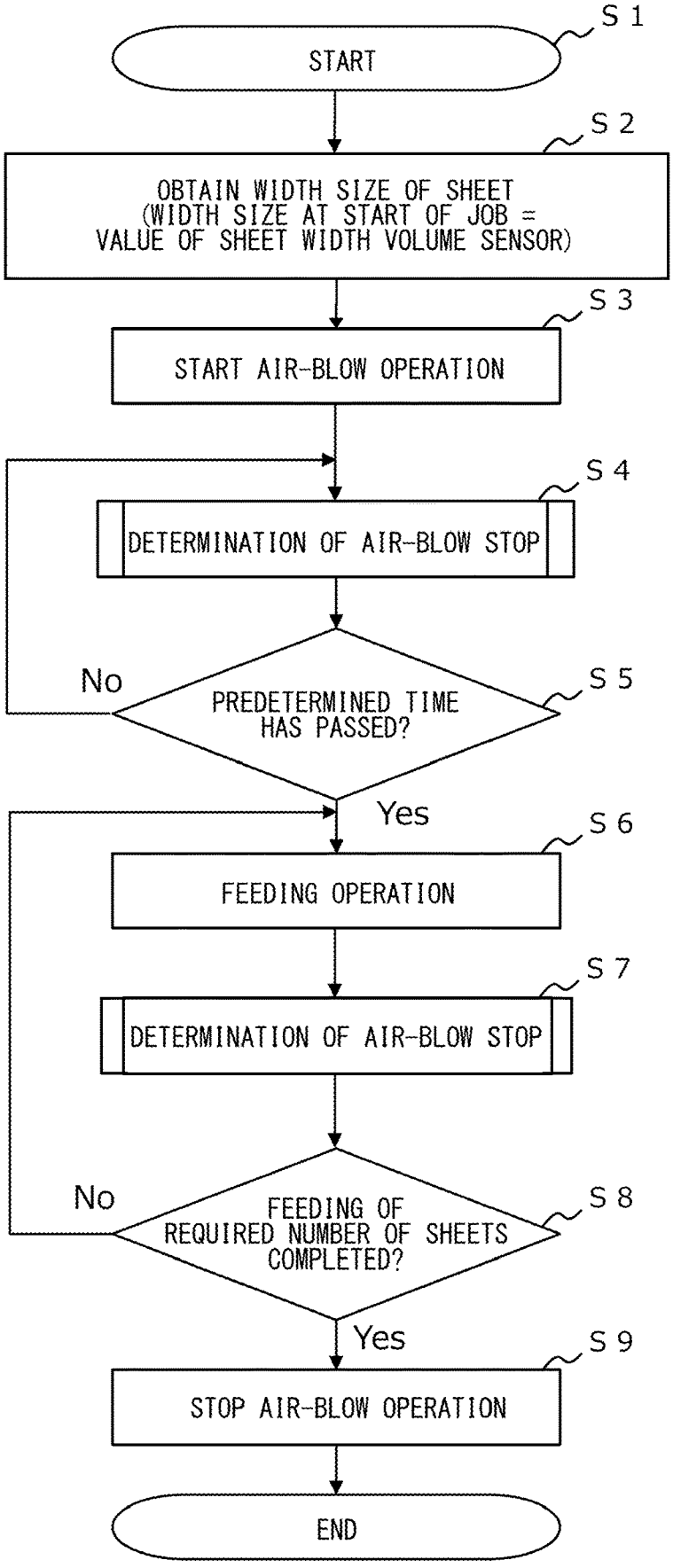
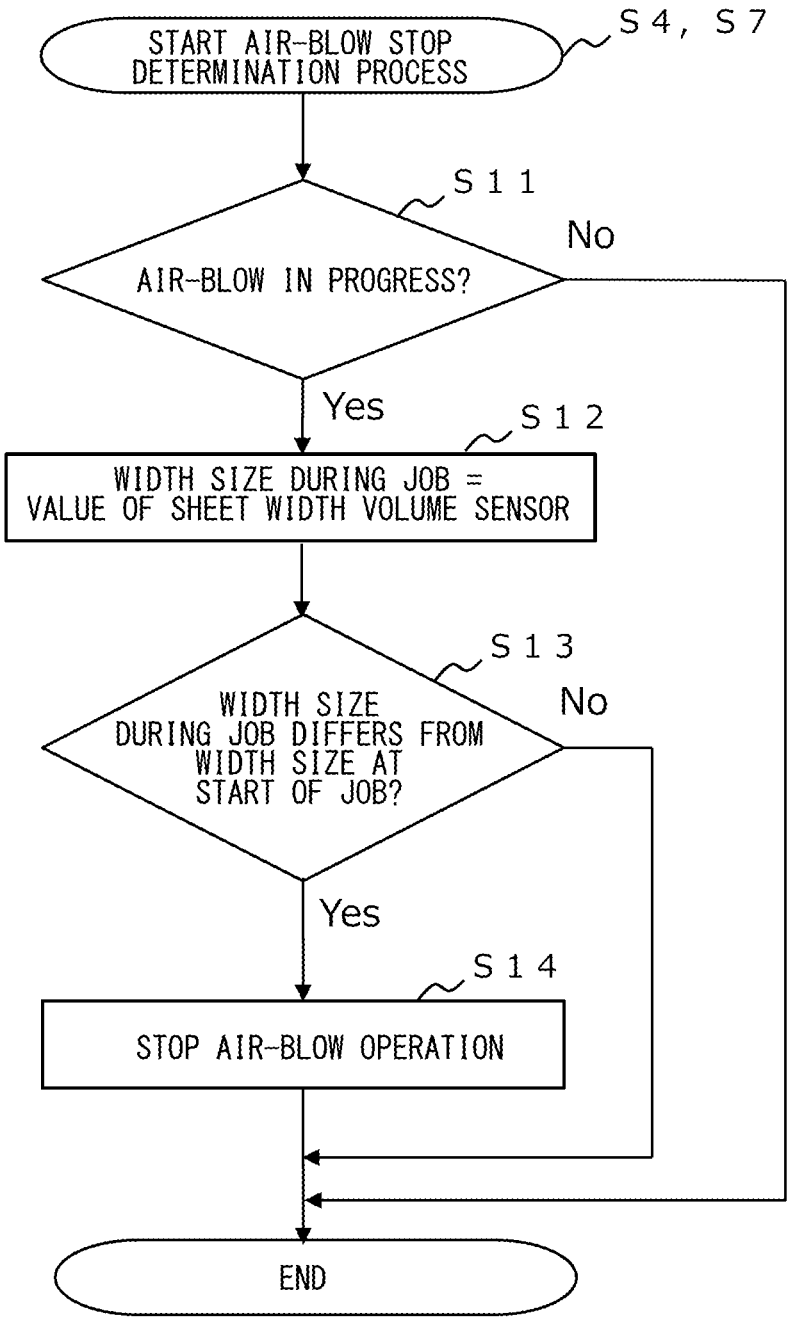

S 1
START
S 2
OBTAIN WIDTH SIZE OF SHEET
(WIDTH SIZE AT START OF JOB =
VALUE OF SHEET WIDTH VOLUME SENSOR)
S 3
START AIR-BLOW OPERATION
S 4
DETERMINATION OF AIR-BLOW STOP
No
S 5
PREDETERMINED TIME
HAS PASSED?
Yes
S 6
FEEDING OPERATION
S 7
DETERMINATION OF AIR-BLOW STOP
No
S 8
FEEDING OF
REQUIRED NUMBER OF SHEETS
COMPLETED?
Yes
S 9
STOP AIR-BLOW OPERATION
END

FIG.10


START AIR-BLOW STOP DETERMINATION PROCESS
S4, S7
S11
AIR-BLOW IN PROGRESS?
No
Yes
S12
WIDTH SIZE DURING JOB = VALUE OF SHEET WIDTH VOLUME SENSOR
S13
WIDTH SIZE DURING JOB DIFFERS FROM WIDTH SIZE AT START OF JOB?
No
Yes
S14
STOP AIR-BLOW OPERATION
END

SHEET FEEDING APPARATUS AND IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This disclosure relates to a sheet feeding apparatus including a separation unit that separates a sheet by blowing air onto a plurality of sheets manually fed to be supported on a supporting portion, and an image forming apparatus including this sheet feeding apparatus.

Description of the Related Art

[0002] In image forming apparatuses such as, for example, copy machines, facsimiles, and printers, as sheet feeding apparatuses feeding a sheet to an image forming unit that forms an image on a sheet, manual sheet feed trays and sheet feed cassettes are included, or sheet feed decks are externally attached. Further, in recent years, there is an increasing demand to form the image on various types of the sheets, and, sometimes, sheets with a smooth surface, such as coated paper, are used. When a sheet bundle composed of the sheets with the smooth surface as described above is set to the sheet feeding apparatus as described above, since an adhesion force between the sheets is high, there is a risk of defective feeding resulting from a difficulty in separating the sheets. Therefore, a technique that is known as an air separation in which air blows to a set sheet bundle so as to levitate and thus separate the sheet is suggested (refer to Japanese Patent Laid-Open No. H04-23747).

[0003] Incidentally, in the image forming apparatuses, a pair of side edge regulation plates that regulate the sheet from both sides in a width direction are disposed in the manual sheet feed tray onto which a user sets the sheet by manual feeding, and a position of the sheet in the width direction is regulated. In a case where positions of the side edge regulation plates are aligned with the size of a set sheet in the width direction, even in a case where the air separation is performed to levitate the sheet as described in Japanese patent Laid-Open No. H04-23747, the position of the sheet in the width direction is regulated. However, for example, in a case where the user moves the side edge regulation plates subsequent to setting the sheet, or in a case where the user fails to properly regulate the position of the sheet in the width direction by the side edge regulation plates when setting the sheet, there is a risk of the disruption of the posture of the sheet that has been levitated by the air separation. When the sheet with such a disrupted posture is fed, it causes a problem of creating the skew of the sheet, which can lead to a sheet jam.

SUMMARY OF THE INVENTION

[0004] According to a first aspect of the present invention, a sheet feeding apparatus includes a supporting portion configured to support a plurality of sheets that have been manually set, a sheet feeding unit configured to feed the sheets supported by the supporting portion, a side edge regulation plate configured to move in a width direction perpendicular to a feed direction, the side edge regulation plate being configured to regulate a position of the sheets supported by the supporting portion in the width direction, a separation unit configured to separate the sheets by blowing air onto the plurality of sheets supported by the supporting portion, a regulation plate position detection unit configured to detect a position of the side edge regulation plates in the width direction, and a control unit configured to execute a separation mode so as to perform an air-blow operation by the separation unit in feeding the sheets by the sheet feeding unit. In the separation mode, in a case where the position of the side edge regulation plate detected by the regulation plate position detection unit does not correspond to size of the sheets supported by the supporting portion in the width direction, the control unit is configured to stop the air-blow operation.

[0005] According to a second aspect of the present invention, a sheet feeding apparatus includes a supporting portion configured to support a plurality of sheets that have been manually set, a sheet feeding unit configured to feed the sheets supported by the supporting portion, a side edge regulation plate configured to move in a width direction perpendicular to a feed direction, the side edge regulation plate being configured to regulate a position of the sheets supported by the supporting portion in the width direction, a separation unit configured to separate the sheets by blowing air onto the plurality of sheets that are supported by the supporting portion, a regulation plate position detection unit configured to detect a position of the side edge regulation plate in the width direction, and a control unit configured to execute a separation mode so as to perform an air-blow operation by the separation unit in feeding the sheets by the sheet feeding unit. In the separation mode, in a case where a position of the side edge regulation plate, detected by the regulation plate position detection unit, subsequent to starting the air-blow operation differs from a position of the side edge regulation plate, detected by the regulation plate position detection unit, prior to starting the air-blow operation, the control unit is configured to stop the air-blow operation.

[0006] Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a diagram illustrating a schematic configuration of an image forming system of the present embodiment.

[0008] FIG. **2** is a block diagram illustrating a control system of the image forming system of the present embodiment.

[0009] FIG. **3** is a schematic diagram illustrating a configuration of a manual sheet feed portion of the present embodiment.

[0010] FIG. **4** is a schematic diagram illustrating a state in which an air-blow operation has been performed in the manual sheet feed portion of the present embodiment.

[0011] FIG. **5** is a schematic diagram illustrating the detection of a sheet size in the manual sheet feed portion of the present embodiment.

[0012] FIG. **6** is a diagram illustrating a relationship between a sheet width size and a value of a sheet width volume sensor of the present embodiment.

[0013] FIG. **7** is a diagram illustrating relationships between the sheet size and detection results of various sensors.

[0014] FIG. **8** is a schematic diagram illustrating the posture of the sheet in a case where side edge regulation plates of the present embodiment are positioned at positions not aligned with the sheet width size.

[0015] FIG. **9** is a flowchart illustrating a sheet feed control in a separation mode of the present embodiment.

[0016] FIG. **10** is a flowchart illustrating an air-blow stop determination process of the present embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0017] Hereinafter, with reference to drawings, an embodiment of this disclosure will be described in detail. First, using FIG. **1**, an image forming system **600** including an image forming apparatus **201** and a manual sheet feed portion **235**, serving as a sheet feeding apparatus connected to the image forming apparatus **201**, will be described. FIG. **1** is a diagram illustrating a schematic configuration of the image forming system of the present embodiment.

Schematic Configuration of Image Forming System

[0018] As illustrated in FIG. **1**, the image forming system **600** includes the image forming apparatus **201**, the manual sheet feed portion **235**, and a sheet feed deck **800** connected to the image forming apparatus **201**. The sheet feed deck **800** is connected to the right side of the image forming apparatus **201** in FIG. **1**, and is configured to feed a sheet S to the image forming apparatus **201**. Further, the manual sheet feed portion **235** is also configured to feed the sheet S to the image forming apparatus **201**.

Schematic Configuration of Image Forming Apparatus

[0019] As illustrated in FIG. **1**, the image forming apparatus **201** includes an apparatus body **201**A incorporating an image forming unit **201**B that forms an image on the sheet. Further, an image reading apparatus **202** disposed substantially horizontally is arranged on the top of the apparatus body **201**A. Further, a sheet discharge space V for discharging the sheet is formed between the image reading apparatus **202** and the apparatus body **201**A. Further, an operation unit **730**, serving as a user interface (UI) constituted by such as a touch panel capable of displaying a screen, is arranged on the top of the apparatus body **201**A. To be noted, the operation unit **730** of the present embodiment forms a sheet type input portion for inputting a sheet type in a user setting mode.

[0020] The image forming unit **201**B utilizes a four-drum full-color system. The image forming unit **201**B includes a laser scanner **210** and four process cartridges **211**Y, **211**M, **211**C, and **211**K, forming toner images of four colors: yellow (Y), magenta (M), cyan (C), and black (K). Each of the process cartridges **211** includes a photosensitive drum **212**, a charge roller **213**, serving as a charge unit, and a developing unit **214**, serving as a developing unit. Further, the image forming unit **201**B includes an intermediate transfer unit **201**C arranged on the top of the process cartridges **211**, and a fixing unit **201**E. To be noted, toner cartridges **215** for supplying toner to the developing units **214** are disposed above the intermediate transfer unit **201**C.

[0021] The intermediate transfer unit **201**C includes an intermediate transfer belt **216** wound around a drive roller **216***a* and a tension roller **216***b*. To be noted, primary transfer rollers **219** that come into contact the intermediate transfer belt **216** at positions facing the photosensitive drums **212** are disposed inside of the intermediate transfer belt **216**. Here, the intermediate transfer belt **216** is rotated in an arrow direction in FIG. **1** by the drive roller **216***a* driven by a drive unit, not shown.

[0022] Then, a negatively charged toner images of each color on the photosensitive drums are sequentially transferred in multiple layers onto the intermediate transfer belt **216** by the primary transfer rollers **219**. At a position facing the drive roller **216***a* of the intermediate transfer unit **201**C, a secondary transfer roller **217** for transferring a color image formed on the intermediate transfer belt **216** onto the sheet S is disposed. A secondary transfer portion **201**D is formed between these intermediate transfer belt **216** and secondary transfer roller **217**. Further, above this secondary transfer roller **217**, the fixing unit **201**E including a pressing roller **220***a* and a heating roller **220***b* is arranged. Further, above this fixing unit **201**E, a first sheet discharge roller pair **225***a*, a second sheet discharge roller pair **225***b*, and a duplex reverse portion **201**F are arranged. In this duplex reverse portion **201**F, a reverse roller pair **222** that can rotate in both directions, a re-conveyance path R for conveying the sheet, on whose one surface the image has been formed, again to the image forming unit **201**B, and the like are disposed.

[0023] In a lower part of the apparatus body **210**A, a plurality of sheet feed units **230** feeding the placed sheet S to the image forming unit **201**B are disposed. Each of the plurality of sheet feed units **230** includes a sheet feed cassette **1**, storing a plurality of sheets (sheet bundle), and a sheet feeding unit **6**, serving as a sheet feeding unit feeding the sheet S stored in the sheet feed cassette **1**. The sheet feeding unit **6** includes a pickup roller **2**, a feed roller **3**, and a retard roller **4**. The feed roller **3** and the retard roller **4** serve as a separation unit separating the sheet S sent in multiples from the pickup roller **2**.

[0024] Further, the sheet feed deck **800** sending the placed sheet S to the image forming unit **201**B is disposed on the right side of the apparatus body **201**A in FIG. **1** and below the manual sheet feed portion **235**. As with the sheet feed unit **230**, the sheet feed deck **800** includes a sheet feeding unit **806**. That is, the sheet feeding unit **806** includes a pickup roller **801**, a feed roller **802**, and a retard roller **803**. The feed roller **802** and the retard roller **803** serve as a separation unit separating the sheet S sent in multiples from the pickup roller **802**. Further, a drawing roller pair **804** is disposed downstream of the sheet feeding unit **806** in a sheet conveyance direction.

[0025] Further, the manual sheet feed portion **235** feeding the sheet S from a plurality of manually fed sheets S (sheet bundle) to the image forming unit **201**B is disposed on the right side surface of the apparatus body **201**A in FIG. **1**. The manual sheet feed portion **235** is pivotably attached to the apparatus body **201**A so as to be openable and closable with respect to the apparatus body **201**A. That is, the manual sheet feed portion **235** is arranged to switch between an opening state, in which the manual sheet feed portion is opened with respect to the apparatus body **201**A, and a closed state, in which the manual sheet feed portion is closed with respect to the apparatus body **201**A. The manual sheet feed portion **235** includes a manual sheet feed tray **236**, serving as a manual sheet feed tray supporting the sheet S when the manual sheet feed portion **235** is in the opening state, and, as with the sheet feed unit **230**, includes a sheet feeding unit **506**. That is, the sheet feeding unit **506** includes a pickup roller **501**, a feed roller **502**, and a retard roller **503**. The feed roller **502** and the retard roller **503** serve as a separation unit separating the sheet S sent in multiples from

the pickup roller **501**. Further, a drawing roller pair **504** is disposed downstream of the sheet feeding unit **506** in the sheet conveyance direction.

[0026] To be noted, a media detection sensor **280**, serving as a sheet type detection unit, is arranged in a conveyance path of the apparatus body **201**A, and detects a grammage and surface properties of the sheet S by reading the sheet S that has been conveyed.

Operation of Image Forming Apparatus

[0027] Next, an image forming operation of the image forming apparatus **201** will be described. First, for example, when the image information of a document has been read by the image reading apparatus **202**, after image processing, this image information is converted into an electrical signal, and is transmitted to the laser scanner **210** of the image forming unit **201**B. To be noted, this image information can be transmitted from, for example, a host apparatus **1500** (refer to FIG. **2**) such as an external computer via a network.

[0028] In the image forming unit **201**B, surfaces of the photosensitive drums **212** have been charged to a predetermined polarity and potential by the charge units **213**, and the surfaces of the photosensitive drums **212** are sequentially exposed by a laser light. Thereby, electrostatic latent images of yellow, magenta, cyan, and black are sequentially formed on each of the photosensitive drums **212** of the respective process cartridges **211**.

[0029] Thereafter, these electrostatic latent images are visualized by being developed with toners of each color, and, by applying a primary transfer bias to the primary transfer rollers **219**, toner images of each color on the respective photosensitive drums are sequentially superimposed and transferred onto the intermediate transfer belt **216**. Thereby, the toner image is formed on the intermediate transfer belt **216**.

[0030] On the other hand, the sheet S fed from the sheet feed unit **230** (or the manual sheet feed portion **235**, or the sheet feed deck **800**) is conveyed to a registration roller pair (hereinafter, referred to as a registration roller pair) **240** constituted from a drive roller and driven roller. At this time, the drive of the registration roller pair **240** is being stopped, and a leading edge of the sheet S is abutted against the registration roller pair **240**. Thereby, the leading edge of the sheet S follows the registration roller pair **240**.

[0031] Thereafter, since the sheet S is continuously conveyed from such as the feed roller **3** (or the feed roller **502**, or the feed roller **802**), bending (loop) is formed in the sheet S. Thereafter, the registration roller pair **240** is driven in synchronization with a timing of the toner image on the intermediate transfer belt **216**. Thereby, the skew of the sheet S is corrected by the registration roller pair **240**, and the sheet S with the skew corrected is conveyed to the secondary transfer portion **201**D by the registration roller pair **240**.

[0032] Subsequently, in the secondary transfer portion **201**D, the toner image is collectively transferred onto the sheet S by a secondary transfer bias applied to the secondary transfer roller **217**. Then, the sheet S onto which the toner image has been transferred is conveyed to the fixing unit **201**E, and, by being applied with heat and pressure in the fixing unit **201**E, the toners of each color are melted and blended, so that the image is fixed on the sheet S as a color image.

[0033] Thereafter, the sheet S on which the image has been fixed is discharged to the sheet discharge space V by the first sheet discharge roller pair **225***a* or the second sheet discharge roller pair **225***b* disposed downstream of the fixing unit **200**E in the sheet conveyance direction, and is loaded on a supporting portion **223** formed on a bottom surface of the sheet discharge space V. To be noted, when forming the image on both surfaces of the sheet S, after the image has been fixed, the sheet S is conveyed to the re-conveyance path R by the reverse roller pair **222**, and is again conveyed to the secondary transfer portion **201**D.

Configuration of Manual Sheet Feed Portion

[0034] Next, using FIGS. **1** and **3**, the manual sheet feed portion **235**, serving as the sheet feeding apparatus, will be described. FIG. **3** is a schematic diagram illustrating a configuration of the manual sheet feed portion **235** of the present embodiment.

[0035] As illustrated in FIGS. **1** and **3**, the manual sheet feed portion **235** includes the manual sheet feed tray **236**, serving as the supporting portion, and the sheet feeding unit **506**, serving as the sheet feeding unit feeding the sheet and separating the sheets sent in multiples. Further, the sheet feeding unit **506** includes the pickup roller **501**, serving as a feed roller that feeds an uppermost sheet by coming into contact with the uppermost sheet of the sheet bundle. Further, the sheet feeding unit **506** includes the feed roller **502** and the retard roller **503**, serving as the separation unit separating the sheet S fed from the pickup roller **501**.

[0036] Further, in the manual sheet feed portion **235**, the drawing roller pair **504** that feeds the sheet S to the image forming apparatus **201** by drawing the sheet S from the feed roller **502** is arranged downstream of this feed roller **502** in a sheet feed direction. Further, a feed sensor **505**, serving as a sheet detection unit, is arranged between the feed roller **502** and the drawing roller pair **504**. That is, the feed sensor **505** is arranged further downstream than the sheet feeding unit **506** in the sheet feed direction. This feed sensor **505** detects a passage of the sheet S by outputting a signal based on the presence or absence of the sheet S.

[0037] Further, as illustrated in FIG. **3**, the manual sheet feed tray **236** includes a manual sheet feed tray base **515** and a lifter plate **514**, serving as a sheet supporting portion loading and supporting the sheet bundle constituted from the plurality of sheets S. Further, a sheet presence sensor **401**, serving as the sheet detection unit detecting that the sheet S is supported by the manual sheet feed tray **236** is included in the lifter plate **514**. A position of this lifter plate **514** in a height direction is controlled by a lifting mechanism, not shown, depending on a loading amount of the sheet S.

[0038] Further, as illustrated in FIG. **3**, the manual sheet feed tray **236** includes side edge regulation plates **511** and **512** that regulate a position of the sheet S supported by the manual sheet feed tray **236** in a width direction perpendicular to the sheet feed direction. The side edge regulation plates **511** and **512** regulate positions of edges in the width direction of the sheet S (side edges of the sheet) placed on the lifter plate **514**. Air-blow portions **511**A and **512**A, each serving as the separation unit, are respectively disposed in these side edge regulation plates **511** and **512**. The air-blow portion **511**A includes a fan **511***b* driven by a fan motor **511**M (refer to FIG. **2**), and a duct **511***a* that guides airflow delivered from the fan **511***b* to pass through an interior of the side edge regulation plate **511**, and blows the air onto the side of the sheet bundle. Similarly, the air-blow portion **512**A includes a fan **512***b* driven by a fan motor **512**M (refer

to FIG. **2**), and a duct **512***a* that guides airflow delivered from the fan **512***b* to pass through an interior of the side edge regulation plate **512**, and blows the air onto the side of the sheet bundle. Further, on the side edge regulation plates **511** and **512**, in adjacent to openings of the ducts **511***a* and **512***a*, hold-down plates **511***c* and **512***c* are disposed so as to prevent the sheet S, levitated by the airflow, from crossing over the side regulation plates **511** and **512**.

Detection of Sheet Size in Manual Sheet Feed Portion

[0039] Next, using FIGS. **5**, **6**, and **7**, a configuration and a method for detecting a sheet size placed on the manual sheet feed tray **236** of the manual sheet feed portion **235** will be described. FIG. **5** is a schematic diagram illustrating the detection of the sheet size in the manual sheet feed portion of the present embodiment. FIG. **6** is a diagram illustrating a relationship between a sheet width size and a value of a sheet width volume sensor in the present embodiment. FIG. **7** is a diagram illustrating relationships between the sheet size and detection results of various sensors.

[0040] When the plurality of sheets (sheet bundle) are placed on the manual sheet feed tray **236**, the sheet presence detection sensor **401** described above detects the presence of the sheet. Further, in the width direction perpendicular to the sheet feed direction, the placed sheet is sandwiched by the side edge regulation plates **511** and **512** that are located on both side across the sheet, and is regulated in a correct posture along the sheet feed direction while being positioned in the width direction. Thereby, the skew of the sheet is prevented during feeding the sheet. These side edge regulation plates **511** and **512** are movable by sliding in arrow X**1** and X**2** directions that are the width direction, and can accommodate the sheets that vary in width sizes. Then, via a link, not shown, the side edge regulation plates **511** and **512** are connected to a sheet width volume sensor **405**, serving as a regulation plate position detection unit detecting positions of these side edge regulation plates **511** and **512** in the width direction. In particular, with respect to a central processing unit (CPU) **101**, the sheet width volume sensor **405** outputs an analog to digital (AD) value corresponding to the position of the side edge regulation plate **512**, and the CPU **101** detects the sheet width in a main scanning direction based on the input AD value.

[0041] On the other hand, in the manual sheet feed tray **236**, for example, near a central area in the width direction, on a straight line which serves as a center for feeding the sheet, a first sheet length sensor **403** and a second sheet length sensor **404** are located at different positions in the sheet feed direction. The first and second sheet length sensors **403** and **404** are configured as a flag-type sensor. The first and second sheet length sensors **403** and **404** are capable of detecting the length of the sheet in the sheet feed direction (hereinafter, referred to as a sheet length) in three stages based on ON/OFF statuses of each of the first and second sheet length sensors **403** and **404** activated in response to the length of the sheet placed on the manual sheet feed tray **236**.

[0042] In particular, the sheet width volume sensor **405** is a sensor that outputs a 10 bit AD value, and provides an output that is substantially linear for AD values ranging from 0 to 0x400. As illustrated in FIG. **6**, when the AD value of the sheet width volume sensor **405** is 0x320, the sheet width is 210 millimeters (mm) that is an A4R width. Similarly, when the AD value of the sheet width volume sensor **405** is 0x384, the sheet width is 257 mm that is a B4R width. When the AD value of the sheet width volume sensor **405** is 0x3D4, the sheet width is 297 mm that is an A4 width. Using the AD value from the sheet width volume sensor **405** and output results of the first and second sheet length sensors **403** and **404**, the CPU **101** determines the sheet size by referring to the table shown in FIG. **7**.

[0043] As illustrated in FIG. **7**, for example, an A5 size is identified in a case where the sheet presence sensor **401** is ON, the first sheet length sensor **403** is OFF, the second sheet length sensor **404** is OFF, and the output value of the sheet width volume sensor **405** is 0x320±0x10. Similarly, for example, the A4R size is identified in a case where the sheet presence sensor **401** is ON, the first sheet length sensor **403** is ON, the second sheet length sensor **404** is OFF, and the output value of the sheet width volume sensor **405** is 0x320±0x10. As described above, even in a case where the output value of the sheet width volume sensor **405** is the same, it becomes possible to determine that the sizes are different based on the differences in the output results of the first and second sheet length sensors **403** and **404**. On the contrary, for example, in a case of a B5 size, the output results of the first and second sheet length sensors **403** and **404** become identical to the output results for the A5 size described above. However, the AD value of the sheet width volume sensor **405** becomes 0x384±0x10, and it becomes possible to determine the size of the sheet also based on variations in the output value of the sheet width volume sensor **405**.

Configuration of Control System of Image Forming System

[0044] Next, using FIG. **2**, a configuration of a control system in the image forming system **600** will be described. FIG. **2** is a block diagram illustrating the control system of the image forming system of the present embodiment.

[0045] A control unit **100** of the present embodiment is included, for example, in the image forming apparatus **201**, and is configured by including the CPU **101**, a read only memory (ROM) **102**, and a random access memory (RAM) **103**. The control unit **100** is a control unit that performs control by coordinating the image forming apparatus **201**, the sheet feed deck **800**, and the manual sheet feed portion **235**. The control unit **100** is connected to the host apparatus **1500** and the operation unit **730**, and, while exchanging information with these connected apparatus and unit, performs such as signal processing and sequence control operations for various process equipment. To be noted, the host apparatus **1500** refers to external equipment such as a personal computer, an image scanner, and a facsimile. Further, the control unit **100** is connected to such as a fan control unit **402**, a feed motor **520**, serving as a motor that drives the pickup roller **501**, and the sheet feed sensor **505** described above. Further, the control unit **100** is also connected to such as the sheet presence sensor **401**, the first and second sheet length sensor **403** and **404**, and the sheet width volume sensor **405**, described above.

Operation at Air-Blow

[0046] Next, using FIG. **4**, an operation at the time of an air-blow onto the side of the sheet bundle by the air-blow portions **511**A and **512**A will be described. FIG. **4** is a schematic diagram illustrating a state in which an air-blow operation has been performed in the manual sheet feed portion **235** of the present embodiment.

[0047] As illustrated in FIG. **4**, when the control unit **100** starts the air-blow operation, as illustrated by arrows A**1** and A**2** in FIG. **4**, the air blows from the fans **511***b* and **512***b* of the air-blow portions **511**A and **512**A toward the side of the sheet bundle. Then, several to several dozen sheets located in an upper part of the sheet bundle are separated and levitated, and, since an uppermost sheet S comes into contact with the hold-down plates **511***c* and **512***c*, the levitation of the separated sheet S is regulated. Thereby, an adhesive force between those sheets S decreases, and, for example, even in a case where the sheet S possesses a smooth surface characteristic comparable to such as coated paper, it becomes possible to feed the sheet S by a conveyance force of the pickup roller **501**.

Problem in a Case where Sheet Width Size and Side Edge Regulation Plates are not Aligned

[0048] Here, using FIG. **8**, a problem caused in a case where the sheet size in the width direction (hereinafter referred to as a width size) and the positions of the side edge regulation plates **511** and **512** are not aligned, namely, in a case where the width size of the sheet does not correspond to the positions of the side edge regulation plates **511** and **512** will be described. FIG. **8** is a schematic diagram illustrating the posture of the sheet in the case where the side edge regulation plates of the present embodiment are located at positions not corresponding to the width size of the sheet.

[0049] For example, when a user places the sheet S on the manual sheet feed tray **236**, sometimes, the user starts feeding the sheet (starts the job) without moving the side edge regulation plates **511** and **512** to align with the side edges of the sheet S, and thereby starts feeding the sheet with a gap D existing between the sheet S and the side edge regulation plates **511** and **512**. Alternatively, for example, assume that, when the user placed the sheet S on the manual sheet feed tray **236**, the side edge regulation plates **511** and **512** were moved to come into contact with the side edges of the sheet S. However, sometimes, the side edge regulation plates **511** and **512** are moved by such as being touched by the user after having started feeding the sheet, and the gap D is created between the sheet S and the side edge regulation plates **511** and **512**. When the air blows from the sides of the sheet bundle by the air-blow portions **511**A and **512**A as described above with the gap D existing as described above, the levitated sheet S**1** moves a distance corresponding to the gap D, and the posture of the sheet S**1** is disrupted. That is, with respect to the sheet feed direction Y, positions of the leading edge and a trailing edge of the sheet S**1** in the width direction X deviate, and the sheet S**1** is inclined at an angle θ with respect to the sheet feed direction Y. When starting feeding the sheet S**1** that is inclined as described above, the sheet S**1** becomes skewed without undergoing correction, which leads to a problem that can cause a sheet jam. Therefore, in the present embodiment, as described below, an air-blow stop determination process is performed in sheet feed control.

Sheet Feed Control and Air-Blow Stop Determination Process

[0050] Next, using FIGS. **9** and **10**, the sheet feed control and the air-blow stop determination process performed during the sheet feed control of the present embodiment will be described. FIG. **9** is a flowchart illustrating the sheet feed control in a separation mode of the present embodiment. FIG. **10** is a flowchart illustrating the air-blow stop determination process of the present embodiment.

[0051] To be noted, the sheet feed control illustrated in FIG. **9** performs the feeding of the sheet S placed on the manual sheet feed tray **236** in the separation mode in which the air-blow operation is performed. That is, in the image forming apparatus **201**, it is possible to perform the feeding of the sheet in a normal mode in which the sheet feed is performed without the air-blow onto the sheet S placed on the manual sheet feed tray **236**. However, since the normal mode is a mode in which the air-blow operation is simply not performed, descriptions of the normal mode will be omitted, and, hereinafter, the separation mode will be described. To be noted, the normal mode is suitable for feeding the sheet, such as regular paper and thin paper, which has normal (standard) or coarse surface properties and equal to or less than a normal thickness. Further, the separation mode is suitable for feeding the sheet, such as the coated paper, with the surface properties that are finer or smoother than the normal (standard), and with thickness surpassing the normal.

[0052] Upon receiving a start command for a job, for example, the printing of a predetermined number (for example, 15 sheets) of sheets of the coated paper from either the operation unit **730** or the external computer, not shown, the control unit **100** starts the sheet feed control that is executed as the separation mode illustrated in FIG. **9** (STEP S**1**). Then, the control unit **100** first obtains the width size of the sheet S placed on the manual sheet feed tray **236** (STEP S**2**). In the present embodiment, the value of the sheet width volume sensor **405** at the start of the job is stored in the RAM **103** as the width size at the start of the job. That is, the positions of the side edge regulation plates **511** and **512** detected by the sheet width volume sensor **405** prior to starting the air-blow operation are referred to as the width size of the sheet at the start of the job. To be noted, in the present embodiment, the width size of the sheet is detected from the value of the sheet width volume sensor **405**. However, it is acceptable to obtain the width size of the sheet from sheet size information which the user inputs through, for example, the operation unit **730** or the external computer.

[0053] Next, the control unit **100** drives the fan motors **511**M and **512**M (refer to FIG. **2**) of the air-blow portions **511**A and **512**A, and starts the air-blow operation to blow the air onto the sides of the sheet bundle (STEP S**3**). Thereby, several to several dozens of the sheet S located in the upper part of the sheet bundle are levitated by being separated, and are brought into a state in which the levitation of the sheet S is regulated by the hold-down plates **511***c* and **512***c* (refer to FIG. **4**), so that the adhesion force between the separated sheets is reduced.

[0054] Next, the control unit **100** performs the air-blow stop determination process, that is, the control unit **100** determines whether or not to stop the air-blow operation (STEP S**4**). That is, as described in detail below, the control unit **100** determines whether or not there is a possibility that the sheet S is inclined due to the creation of the gap D (refer to FIG. **5**) between the sheet S placed on the manual sheet feed tray **236** and the side edge regulation plates **511** and **512**. In a case where there is a possibility for the sheet S to be inclined, the control unit **100** stops the air-blow operation. Here, it is presumed that the air-blow operation is not stopped, and the description will proceed on that basis.

[0055] When proceeding to STEP S**5**, the control unit **100** waits until a predetermined time, for example, approximately 10 seconds has passed (STEP S**5**: No). That is, the predetermined time is set based on the duration of the time required for the fan motors **511**M and **512**M to start rotation from a standstill and attain a desired number of rotation (rotational speed), and a time required for stabilizing the levitation of the sheet S is included in the predetermined time. Then, when the predetermined time has passed (STEP S**5**: Yes), a feeding operation of the sheet S is started (STEP S**6**). To be noted, this start of the feeding operation refers to the feeding of the sheet S by the rotation of the pickup roller **501** (refer to FIG. **3**) rotated by the drive of the feed motor **520** with the pickup roller **501** coming into contact with the uppermost sheet S in the sheet bundle. Thereafter, in a case where the sheet S has been fed in multiples, the separation is performed in the separation unit formed by the feed roller **502** and the retard roller **503**, and, when a passage of the uppermost sheet S through the sheet feed sensor **505** has been detected, the feeding operation of a single sheet is completed.

[0056] When the feeding operation is started (STEP S**6**), again the air-blow stop determination process is performed (STEP S**7**), and the control unit **100** judges whether or not the feeding of, for example, 15 sheets, which is the required number of sheets, has been completed (STEP S**8**). For example, in a case where the feeding of the 15 sheets of the sheet S has not been completed (STEP S**8**: No), the feeding operation is continued while repeating the air-blow stop determination process throughout the duration. Then, upon the completion of the feeding of, for example, the 15 sheets, which is the required number of sheets (STEP S**8**: Yes), the control unit **100** stops the air-blow operation (STEP S**9**), and, with that, ends the sheet feed control.

[0057] Next, details of the air-blow stop determination process mentioned above (STEPS S**4** and S**7**) will be described. As illustrated in FIG. **10**, the control unit **100** first determines whether or not the air-blow is in progress (STEP S**11**), and, in a case where the air-blow is not in progress (STEP S**11**: No), directly ends the air-blow stop determination process. Further, in a case where the air-blow is in progress (STEP S**11**: Yes), a current value of the sheet width volume sensor is stored in the RAM **103** as the width size during the job. Then, the control unit **100** determines whether or not the width size at the start of the job is different from the width size during the job (STEP S**13**). In a case of no change, that is, a case where the width size is the same and has not changed (STEP S**13**: No), the control unit **100** directly ends the air-blow stop determination process.

[0058] On the other hand, in a case where the width size at the start of the job is different from the width size during the job (STEP S**13**: Yes), the gap D (refer to FIG. **8**) is created between the sheet S placed on the manual sheet feed tray **236** and the side edge regulation plates **511** and **512**, and there is a possibility that the sheet S may be inclined as described above. In particular, in a case where the width size at the start of the job was set to the value of the sheet width volume sensor **405**, there is a possibility that the user may have moved the side edge regulation plates **511** and **512** after starting the job. Therefore, the control unit **100** stops the air-blow operation with respect to the sheet S (STEP S**9**) by stopping the fan motors **511**M and **512**M (refer to FIG. **2**) described above, and ends the air-blow stop determination process.

[0059] Therefore, in the sheet feed control in the present embodiment, before the predetermined time has passed after the start of the air-blow operation (STEP S**5**: No), the control unit **100** recognizes that the positions of the side edge regulation plates **511** and **512** detected by the sheet width volume sensor **405** have been moved. Then, since it becomes identical to the case where the positions of the side edge regulation plates **511** and **512** do not correspond to the width size of the sheet at the start of the job (the positions of the side edge regulation plates **511** and **512** at the start of the job) (STEP S**13** at STEP S**4**: Yes), the air-blow operation is stopped (STEP S**14**). Therefore, in a case where, for example, the user has moved to increase spacing between the side edge regulation plates **511** and **512**, during the predetermined time in which the job is started and a preparation for starting the feeding of the sheet S is in progress, it is possible to stop the air-blow operation before starting the feeding of the sheet S. Thereby, at the time of feeding the sheets S subsequent to the feed of a first sheet, it is possible to reduce the disruption of the posture of the sheet S caused by the air-blow, and it is possible to reduce the skew of the sheet and the sheet jam.

[0060] Further, in the sheet feed control in the present embodiment, when, after the start of the feeding operation of the sheet S (STEP S**6**), the positions of the side edge regulation plates **511** and **512**, detected by the sheet width volume sensor **405**, have been moved, the control unit **100** recognizes that the positions of the size edge regulation plates **511** and **512** are different from the width size of the sheet at the start of the job (the positions of the side edge regulation plates **511** and **512** at the start of the job) (STEP S**13** at STEP S**7**: Yes), and, then, the air-blow operation is stopped (STEP S**14**). Therefore, for example, in a case where the user has moved to increase the spacing of the side edge regulation plates **511** and **512** during the feeding of the sheet S after the start of feeding the sheet, it is possible to stop the air-blow operation even during the feeding of the sheet S. Thereby, after having detected the movements of the side edge regulation plates **511** and **512**, when feeding subsequent sheets, it is possible to reduce the disruption of the posture of the sheet S caused by the air-blow, and it is possible to reduce the skew of the sheet and the sheet jam.

Summary of Present Embodiment

[0061] As described above, according to the sheet feed control of the present embodiment, the separation mode to feed the sheet while performing the air-blow is executed. During the execution of this separation mode, in the case where the positions of the side edge regulation plates **511** and **512** regulating the position of the sheet in the width direction are moved by, for example, such as the operation of the user, it is possible to stop the air-blow operation, and it is possible to reduce the skew of the sheet and the sheet jam.

Possibilities of Other Embodiments

[0062] In the present embodiment described above, it is mainly described that the width size of the sheet placed on the manual sheet feed tray **236** is detected by the sheet width volume sensor **405** at the start of job (prior to starting the

air-blow operation), and the value of the sheet width volume sensor **405** is referred to as the width size at the start of job. However, it is not limited to this, and it is acceptable that the width size at the start of the job is set from the sheet size information input through the operation unit **730** and the external computer. In this case, before starting the air-blow operation, it is possible to determine that the width size of the sheet detected by the sheet width volume sensor **405** at the start of the job is different from the sheet size information. Therefore, it is also possible to determine the stoppage (interruption) of the air-blow operation before starting the air-blow operation.

[0063] Further, in the present embodiment, the sheet width volume sensor **405** is described as an example that detects the positions of the side edge regulation plates **511** and **512** in the width direction. However, it is not limited to this, and, for example, any type of device such as position sensors or encoders that can detect the positions of the side edge regulation plates **511** and **512** in the width direction can be used.

[0064] Further, in the present embodiment, as a case where the width size during the job is different from the width size at the start of the job, a case where the spacing between the side edge regulation plates **511** and **512** is increased to be larger than the width size of the sheet S is described. However, it is not limited to this, and the spacing between the side edge regulation plates **511** and **512** can be decreased to be less than the width size of the sheet S. That is, in a case where the positions of the side edge regulation plates **511** and **512** are decreased to be less than the width size of the sheet S, since it is conceivable that the sheet S curves in the width direction so as to be curled at the side edges of the sheet, similarly, the position of the sheet in the width direction is not accurately regulated by the side edge regulation plates **511** and **512**. Therefore, similarly, there is the risk that the posture of the sheet may be disrupted by the air-blow operation.

[0065] Further, in the present embodiment, the positions of the side edge regulation plates **511** and **512** are detected by the sheet width volume sensor **405**, and those positions are converted into the width size of the sheet placed on the manual sheet feed tray **236**. However, it is not limited to this, and it is acceptable to configure the air-blow stop determination process such that, by simply comparing the positions of the side edge regulation plates **511** and **512** at the start of the job with the positions of the side edge regulation plates **511** and **512** during the job, in a case where these positions are different, the air-blow operation is stopped. Further, in this context, the positions of the side edge regulation plates **511** and **512** are equivalent to the AD value of the sheet width volume sensor **405**. Therefore, by simply comparing the AD value at the start of the job with the AD value during the job, it is acceptable to configure the air-blow stop determination process such that the air-blow operation is stopped in a case where these values are different.

[0066] Further, in the present embodiment, the image forming apparatus **201** includes such as the control unit **100** and the manual sheet feed portion **235**. However, it is not limited to this, and it is acceptable to configure the sheet feeding apparatus, such as the sheet feed deck **800**, to include the control unit and the like. Further, the image forming apparatus is not limited to the image forming apparatus **201** of the present embodiment, and it is acceptable that the image forming apparatus refers to image forming systems including sheet feed decks.

[0067] Further, in the present embodiment, it is possible to selectively execute both the separation mode and the normal mode. However, it is not limited to this, and it is acceptable that it is possible to execute only the separation mode.

[0068] Further, in the present embodiment, the sheet size information may be input by performing an input operation through the operation unit **730**. However, it is acceptable to input the sheet size information through such as, for example, the external computer via an interface. In this case, the interface becomes an input unit.

Other Embodiments

[0069] Embodiment(s) of the present invention can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programs) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

[0070] While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

[0071] This application claims the benefit of Japanese Patent Application No. 2023-031339, filed Mar. 1, 2023, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A sheet feeding apparatus comprising:

a supporting portion configured to support a plurality of sheets that have been manually set;

a sheet feeding unit configured to feed the sheets supported by the supporting portion;

a side edge regulation plate configured to move in a width direction perpendicular to a feed direction, the side edge regulation plate being configured to regulate a

position of the sheets supported by the supporting portion in the width direction;

a separation unit configured to separate the sheets by blowing air onto the plurality of sheets supported by the supporting portion;

a regulation plate position detection unit configured to detect a position of the side edge regulation plates in the width direction; and

a control unit configured to execute a separation mode so as to perform an air-blow operation by the separation unit in feeding the sheets by the sheet feeding unit,

wherein, in the separation mode,

in a case where the position of the side edge regulation plate detected by the regulation plate position detection unit does not correspond to size of the sheets supported by the supporting portion in the width direction, the control unit is configured to stop the air-blow operation.

2. The sheet feeding apparatus according to claim **1**,

wherein, in the separation mode,

in a case where the position of the side edge regulation plate detected by the regulation plate position detection unit differs from a position of the side edge regulation plate detected by the regulation plate position detection unit prior to starting the air-blow operation, the control unit is configured to stop the air-blow operation.

3. The sheet feeding apparatus according to claim **2**,

wherein, in the separation mode,

the control unit is configured to start a feeding operation by the sheet feeding unit after a predetermined time has passed subsequent to starting the air-blow operation by the separation unit, and

wherein, in the separation mode, in a case where, before the predetermined time has passed subsequent to starting the air-blow operation, the position of the side edge regulation plate, detected by the regulation plate position detection unit, has been moved so that the position of the side edge regulation plate does not correspond to the size of the sheet in the width direction, the control unit is configured to stop the air-blow operation.

4. The sheet feeding apparatus according to claim **2**,

wherein, in the separation mode,

the control unit is configured to start a feeding operation by the sheet feeding unit after a predetermined time has passed subsequent to starting the air-blow operation by the separation unit, and

wherein, in the separation mode, in a case where, after starting the feeding operation, the position of the side edge regulation plate, detected by the regulation plate position detection unit, has been moved so that the position of the side edge regulation plates does not correspond the size of the sheet in the width direction, the control unit is configured to stop the air-blow operation.

5. The sheet feeding apparatus according to claim **1**,

further comprising an input unit through which size information of the sheet supported by the supporting portion is input,

wherein the control unit

is configured to obtain the size of the sheets supported by the supporting portion in the width direction from the size information of the sheet input through the input unit.

6. The sheet feeding apparatus according to claim **1**,

wherein the separation unit includes a fan and a duct configured to blow the air onto sides of the sheets by guiding the air blown from the fan to pass through an interior of the side edge regulation plate.

7. A sheet feeding apparatus comprising:

a supporting portion configured to support a plurality of sheets that have been manually set;

a sheet feeding unit configured to feed the sheets supported by the supporting portion;

a side edge regulation plate configured to move in a width direction perpendicular to a feed direction, the side edge regulation plate being configured to regulate a position of the sheets supported by the supporting portion in the width direction;

a separation unit configured to separate the sheets by blowing air onto the plurality of sheets that are supported by the supporting portion;

a regulation plate position detection unit configured to detect a position of the side edge regulation plate in the width direction; and

a control unit configured to execute a separation mode so as to perform an air-blow operation by the separation unit in feeding the sheets by the sheet feeding unit,

wherein, in the separation mode,

in a case where a position of the side edge regulation plate, detected by the regulation plate position detection unit, subsequent to starting the air-blow operation differs from a position of the side edge regulation plate, detected by the regulation plate position detection unit, prior to starting the air-blow operation, the control unit is configured to stop the air-blow operation.

8. An image forming apparatus comprising:

the sheet feeding apparatus according to claim **1**; and

an image forming unit configured to form an image on the sheet fed by the sheet feeding apparatus.

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