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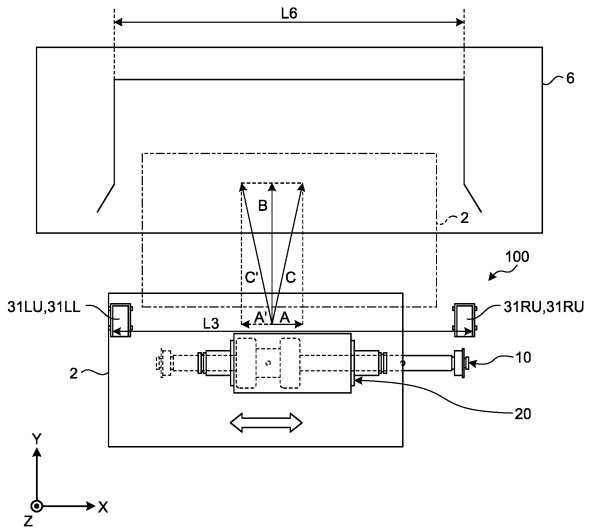
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(54) PAPER SHEET TRANSPORTING DEVICE, PAPER SHEET HANDLING DEVICE, AND PAPER SHEET TRANSPORTING METHOD

(57) A banknote conveying apparatus (100) includes rollers (12L, 12R), a roller (22), and a conveying path (7a). The roller (22), having a fixed position in a width direction of the conveying path (7a) where a banknote (2) is conveyed, rotates in response to rotation of the rollers (12L, 12R) while holding the banknote (2) sandwiched between the rollers (12L, 12R) and the roller (22), so as to convey the banknote (2) with the rollers (12L, 12R) from upstream to downstream on the conveying path (7a). When conveying the banknote (2) from upstream to downstream on the conveying path (7a), the rollers (12L, 12R) move in the width direction of the conveying path (7a) while holding the banknote (2) sandwiched between the rollers (12L, 12R) and the rollers (12L, 12R) so as to move the banknote (2) to a center in the width direction on the conveying path (7a) .

FIG.5



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Description

[Technical Field]

[0001] The present invention relates to a paper sheet conveying apparatus, a paper sheet handling apparatus, and a paper sheet conveying method.

[Background Art]

[0002] For example, a banknote handling apparatus, such as an automated teller machine (ATM), a cash dispenser (CD), and a teller cash recycler (TCR), includes a storage unit for storing a banknote deposited. In the banknote handling apparatus, the banknote deposited passes through a distinguishing unit that distinguishes true/false or the like of the banknote, and the banknote is stored in the storage unit that is classified into types of currencies. The banknote deposited in the banknote handling apparatus is typically stored in the storage unit of the same specification according to the types of currencies even when the banknote varies in size according to the types of currencies.

[0003] Here, for example, when a banknote smaller in size than the storage unit is stored and accumulated inside the storage unit, a gap is created between the banknotes accumulated and an inner wall of the storage unit. In some cases, some of the banknotes hang down or fall into the gap, causing the banknotes to be stored out of order in the storage unit. Then, the banknotes stored out of order in the storage unit causes unstable condition for dispensing of the banknotes when the banknotes are withdrawn from the storage unit. For this reason, types of currencies for withdrawal are limited by, for example, excluding the banknotes smaller in size for deposit only.

[0004] In order to prevent the banknotes smaller in size from being stored out of order, a countermeasure is proposed to align an inner size of the storage unit with the size of the banknote. For example, an inner width of the storage unit may be aligned with a width of the banknote that is smaller than a width of a conveying path for the banknote. However, when the banknotes smaller in size are conveyed at an end of the conveying path and about to be stored into the storage unit, some of the banknotes may be stuck against an input area of the storage unit, causing jamming. Under these circumstances, proposed is a related technique that corrects a conveyed position of each of the banknotes in a width direction of the conveying path so as to convey the banknote at a center on the conveying path.

[Citation List]

[Patent Citation]

[0005] Patent Document 1: Japanese Laid-open Patent Publication No. 2016-172619

[Summary of Invention]

[Technical Problem]

[0006] However, in the related technique described above, the conveying path for the banknote is formed by a pair of upper and lower rollers. The pair of upper and lower rollers is previously slid by an out-of-position amount that the banknote conveyed on the conveying path has from the center in the width direction of the conveying path. When the pair of upper and lower rollers sandwiches the banknote therebetween at the slide position, the pair of upper and lower rollers moves the banknote to the center of the conveying path while holding the banknote sandwiched therebetween. Furthermore, in the related technique, the pair of upper and lower rollers is arranged in plural rows along the conveying direction to form the conveying path. Then, the banknote is handed from one pair to another pair of upper and lower rollers to be moved to the center on the conveyance path. With this configuration, in the related technique, when correcting the conveyed position of the banknote in the width direction on the conveying path, a speed of conveying the banknote may be reduced. Such a problem is not limited to a banknote handling apparatus but may similarly arise in an apparatus that handles paper sheets.

[0007] In view of the respects described above, an object of the present disclosure technique is to provide a paper sheet conveying apparatus, a paper sheet handling apparatus, and a paper sheet conveying method, each configured to correct the position of the banknote conveyed on the conveying path in the width direction of the conveying path, for example, without reducing the speed of conveying the banknote.

[Solution to Problem]

[0008] In an example of the disclosed technique, a paper sheet conveying apparatus includes: a driving roller and a

follower roller. The driving roller is configured to rotate about a driving roller shaft in response to a rotational force transmitted from a driving source. The follower roller is configured to have a fixed position in a width direction of a conveying path where a paper sheet is conveyed, and rotate about a follower roller shaft in response to rotation of the driving roller while holding the paper sheet sandwiched between the follower roller and the driving roller so as to convey the paper sheet with the driving roller from upstream to downstream on the conveying path. When conveying the paper sheet from upstream to downstream on the conveying path, the driving roller moves in the width direction of the conveying path while holding the paper sheet sandwiched between the driving roller and the driving roller so as to move the paper sheet to a center in the width direction on the conveying path.

[Advantageous Effects of Invention]

[0009] According to an example of the disclosed technique, it is possible to correct a position of a banknote conveyed on a conveying path in a width direction of the conveying path without reducing a speed of conveying the banknote.

[Brief Description of Drawings]

[0010]

FIG. 1 is a schematic diagram illustrating an example entire side view of a banknote handling apparatus including a banknote conveying apparatus according to a first embodiment.
FIG. 2 is a perspective view illustrating an example of a schematic configuration of the banknote conveying apparatus according to the first embodiment.
FIG. 3 is a plan view illustrating an example of a moving range of rollers in a driving roller unit in the banknote conveying apparatus according to the first embodiment.
FIG. 4 is a plan view illustrating an example of the moving range of the rollers in the driving roller unit in the banknote conveying apparatus according to the first embodiment.
FIG. 5 is a plan view illustrating a schematic example of a centering process in the banknote conveying apparatus according to the first embodiment.
FIG. 6 is a plan view illustrating a schematic example of a failure of the centering process in the banknote conveying apparatus according to the first embodiment.
FIG. 7 is a perspective view illustrating an example of the banknote conveying apparatus according to the first embodiment.
FIG. 8 is a perspective view illustrating an example of the banknote conveying apparatus according to the first embodiment.
FIG. 9 is a flowchart illustrating an example of the centering process in the banknote conveying apparatus according to the first embodiment.
FIG. 10 is a schematic diagram illustrating an outline of an example in which the centering process is not performed in the banknote conveying apparatus according to the first embodiment.
FIG. 11 is a schematic diagram illustrating an outline of an example in which the centering process is performed in the banknote conveying apparatus according to the first embodiment.
FIG. 12 is a schematic diagram illustrating an outline of an example in which the centering process is performed in the banknote conveying apparatus according to the first embodiment.
FIG. 13 is a schematic diagram illustrating an outline of an example in which the centering process is performed in the banknote conveying apparatus according to the first embodiment.
FIG. 14 is a schematic diagram illustrating an outline of an example in which the centering process is performed in the banknote conveying apparatus according to the first embodiment.
FIG. 15 is a schematic diagram illustrating an outline of an example in which the centering process is in an error state in the banknote conveying apparatus according to the first embodiment.
FIG. 16 is a perspective view illustrating a schematic example of a banknote conveying apparatus according to a second embodiment.
FIG. 17 is a perspective view illustrating a schematic example of a banknote conveying apparatus according to a third embodiment.

[Embodiments for Carrying Out the Invention]

[0011] Hereinafter, an embodiment of a paper sheet conveying apparatus, a paper sheet handling apparatus, and a paper sheet conveying method, each according to the present disclosure technique, will be described in detail based on the drawings. Note that the paper sheet conveying apparatus, the paper sheet handling apparatus, and the paper

sheet conveying method, each according to the present disclosure technique, are not limited to the embodiment described below. The respective elements described in each embodiment and modification below may be combined appropriately as long as no conflict arises.

[0012] In each embodiment below, a banknote is used as an example of a paper sheet, but a paper sheet is not limited thereto. Examples of the paper sheet include valuable securities such as bill, check, a gift ticket, various corporation securities, and stock certificate.

First Embodiment

[Configuration of Banknote Handling Apparatus]

[0013] FIG. 1 is a schematic diagram illustrating an example entire side view of a banknote handling apparatus including a banknote conveying apparatus according to a first embodiment. As illustrated in FIG. 1, a banknote handling apparatus 1 according to the embodiment includes a deposit/withdrawal unit 3 for depositing and withdrawing a banknote 2, and a distinguishing unit 4 for distinguishing true/false or the like of the banknote 2 deposited in the deposit/withdrawal unit 3. The banknote handling apparatus 1 also includes a temporary accommodating unit 5 and a plurality of storage units 6. The temporary accommodating unit 5 takes in the banknote 2 conveyed from the distinguishing unit 4 and temporarily accommodates the banknote 2. Each of the plurality of storage units 6 stores the banknote 2 fed from the temporary accommodating unit 5.

[0014] Additionally, the banknote handling apparatus 1 includes a conveying mechanism 7 for conveying the banknote 2. The conveying mechanism 7 includes a conveying path 7a that conveys the banknote 2 between the deposit/withdrawal unit 3, the distinguishing unit 4, the temporary accommodating unit 5, and the storage units 6. The banknote handling apparatus 1 includes a banknote conveying apparatus 100 that is positioned between the distinguishing unit 4, the temporary accommodating unit 5, and the storage units 6. As with the conveying mechanism 7, the banknote conveying apparatus 100 includes the conveying path 7a, into which the banknote 2 is conveyed from the distinguishing unit 4. The banknote conveying apparatus 100 corrects a position of the banknote 2 in an orthogonal direction to a conveying direction on the conveying path 7a. Further, the banknote handling apparatus 1 includes a control unit 8 that controls each of the deposit/withdrawal unit 3, the distinguishing unit 4, the temporary accommodating unit 5, the storage units 6, the conveying mechanism 7, and the banknote conveying apparatus 100.

[0015] In a description of each embodiment below, an orthogonal coordinate system (X, Y, Z) is used as illustrated in FIG. 1 and subsequent drawings. The orthogonal coordinate system (X, Y, Z) has a Z-axis where a vertical height direction of the banknote handling apparatus 1 is referred to as a positive direction. The orthogonal coordinate system (X, Y, Z) has a Y-axis that extends from the deposit/withdrawal unit 3 toward the temporary accommodating unit 5 in the banknote handling apparatus 1 as a positive direction and that extends vertically to the Z-axis. The orthogonal coordinate system (X, Y, Z) also has an X-axis that creates a three-dimensional right-handed (positive-oriented) orthogonal coordinate system together with the Y-axis and the Z-axis. However, the orthogonal coordinate system (X, Y, Z) illustrated in each embodiment below merely indicates a relative direction and positional relationship. The orthogonal coordinate system (X, Y, Z) merely indicates the relative positional relationship or direction such as vertical, horizontal, upward, downward, leftward, or rightward.

[Outline of Banknote Conveying Apparatus According to First Embodiment]

(Schematic Configuration of Banknote Conveying Apparatus)

[0016] FIG. 2 is a perspective view illustrating an example of a schematic configuration of the banknote conveying apparatus according to the first embodiment. FIG. 2 illustrates a schematic configuration of the banknote conveying apparatus 100 according to the first embodiment, and an illustration of the configuration is omitted as appropriate.

[0017] As illustrated in FIG. 2, the banknote conveying apparatus 100 includes a driving roller unit 10, a follower roller unit 20, a pair of check sensors 31LU and 31LL, a pair of check sensors 31RU and 31RL, a pair of position detector sensors 32LU and 32LL, and a pair of position detector sensors 32RU and 32RL. The check sensors 31LU, 31LL, 31RU, and 31RL as well as the position detector sensors 32LU, 32LL, 32RU, and 32RL are each fixed at a predetermined position.

[0018] The driving roller unit 10 includes a shaft 11, a roller 12L, and a roller 12R. The shaft 11 is pivotally supported by a moving base station 40 in parallel to the X-axis, as will be described later (see FIG. 7). Each of the rollers 12L and 12R is a conveying roller in the driving roller unit. The rollers 12L and 12R are identical rollers, each rotating about the shaft 11 and having an equal diameter. The rollers 12L and 12R, being spaced with a gap (D1 illustrated in FIG. 2) from each other, are axially attached to the shaft 11 and rotate as the shaft 11 rotates. The portion between the roller 12L and the roller 12R is smaller in diameter than each of the rollers 12L and 12R.

[0019] The rollers 12L and 12R are axially attached to the shaft 11 that moves horizontally in response to the moving

base station 40 moving horizontally in positive and negative X-axis directions (hereinafter, will be referred to simply as "horizontally move" or "horizontal movement"). Accordingly, the rollers 12L and 12R horizontally move in response to the shaft 11, while maintaining a mutual positional relationship between the roller 12L and the roller 12R.

[0020] The follower roller unit 20 includes a shaft 21 and a roller 22. The roller 22 is a tension roller in the follower roller unit. The roller 22 rotates about the shaft 21 and has a rotating diameter equal to the rollers 12L and 12R that both rotate about the shaft 11.

[0021] The roller 22 is axially attached to the shaft 21 in a way that a roller face of the roller 22 is positioned opposite a roller face of each of the rollers 12L and 12R. The roller 22 thus rotates as the rollers 12L and 12R rotate. The roller 22 is fixed to a frame (not illustrated) so as to be restricted in parallel movement in any direction and be only allowed to rotate about the shaft 21. The banknote 2 conveyed on the conveying path 7a as a plane parallel to X-Y plane (see FIG. 1) passes a nip section that is formed between the rollers 12L, 12R, and the roller 22.

[0022] When the banknote 2 is positioned in the nip section, the rollers 12L, 12R, and the roller 22 sandwich the banknote 2 therebetween from upper and lower sides in the Z-axis direction. Then, the roller 12L, 12R, and the roller 22 rotate to convey the banknote 2 in the positive Y-axis direction. In this state, the roller 12L, 12R, and the roller 22 convey the banknote 2, and when needed, the rollers 12L and 12R concurrently move horizontally to perform a centering process in which the banknote 2 is horizontally moved to a center in a width direction on the conveying path 7a.

[0023] In other words, the banknote 2 sandwiched between the roller 12L, the roller 12R, and the roller 22 is conveyed on the conveying path 7a by friction with the rollers 12L and 12R that horizontally move, while concurrently having its conveyed position corrected to the center in the width direction of the conveying path 7a. This configuration corrects the position of the banknote 2 conveyed out of the center in the X-axis direction on the conveying path 7a, so that the banknote 2 is positioned closer to the center in the X-axis direction on the conveying path 7a.

[0024] When friction coefficient for outer circumferential face of each of the rollers 12L and 12R is indicated by $\mu 12$ and friction coefficient for outer circumferential face of the roller 22 is indicated by $\mu 22$, the friction coefficient above is expressed as $\mu 12 > \mu 22$. Accordingly, in the centering process for the banknote 2, the friction force that the rollers 12L and 12R exert against the banknote 2 contributes more than the friction force that the roller 22 exerts against the banknote 2.

[0025] Each of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL is, for example, a two optical axis photoelectric sensor. Each of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL is a set of a light emitting section and a light receiving section. Each of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL is disposed in a direction substantially orthogonal to the conveying direction, being spaced from each other with a gap through which the banknote 2 to be stored in the storage unit 6 passes without having its horizontal width blocking between the two optical axes. Each of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL is disposed downstream of the driving roller unit 10 and the follower roller unit 20 (i.e., closer to the storage unit 6) on the conveying path 7a.

[0026] Hereinafter, a state in which an area between the two optical axes is blocked in each of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL will be referred to simply as a "blocked sensor" state. Similarly, a state in which light transmits between the two optical axes in each of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL will be referred to simply as a "light-transmitting sensor" state.

[0027] When both of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL are in the "light-transmitting sensor" state (i.e., light transmits between the light emitting section and the light receiving section), the banknote conveying apparatus 100 determines that the banknote 2 is not positioned out of the center toward the positive or negative X-axis direction on the conveying path 7a and is thus conveyed at the center on the conveying path 7a. Accordingly, when the banknote 2 is stored in the storage unit 6, the banknote 2 does not hit a banknote input area of the storage unit 6.

[0028] In other words, when the banknote conveying apparatus 100 determines, based on the detection result of the check sensors 31LU to 31RL, that the banknote 2 is conveyed at the center on the conveying path 7a, the banknote conveying apparatus 100 does not perform the centering process for the banknote 2. Then, the banknote 2 is conveyed maintaining the current conveyed position on the conveying path 7a to be stored in the storage unit 6.

[0029] When the banknote conveying apparatus 100 performing the centering process for the banknote determines, based on the detection result of the check sensors 31LU to 31RL, that the banknote 2 is conveyed at the center on the conveying path 7a, the banknote conveying apparatus 100 terminates execution of the centering process for the banknote 2. Then, the banknote 2 is conveyed maintaining the conveyed position defined at the moment of termination of the execution on the conveying path 7a.

[0030] On the other hand, when one of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL is in the "blocked sensor" state (i.e., the banknote 2 blocks the area between the light emitting section and the light receiving section), the banknote conveying apparatus 100 determines that the banknote 2 is conveyed out of the center toward the positive or negative X-axis direction on the conveying path 7a. Accordingly, when the banknote 2 comes to the banknote input area to be stored in the storage unit 6, the banknote 2 hits the banknote input area of the

storage unit 6.

[0031] When the banknote conveying apparatus 100 determines, based on the detection result of the check sensors 31LU to 31RL, that the banknote 2 is conveyed out of the center in the positive or negative X-axis direction on the conveying path 7a, the banknote conveying apparatus 100 performs the centering process for the banknote 2. In other words, the banknote 2 is conveyed on the conveying path 7a, while concurrently having its conveyed position corrected to the center in the width direction of the conveying path 7a.

[0032] As long as the banknote conveying apparatus 100 determines, based on the detection result of the check sensors 31LU to 31RL, that the banknote 2 is conveyed out of the center toward the positive or negative X-axis direction on the conveying path 7a, the banknote conveying apparatus 100 continues to perform the centering process for the banknote 2. In other words, the banknote 2 is conveyed on the conveying path 7a, while concurrently and continually having its conveyed position corrected to the center in the width direction of the conveying path 7a.

[0033] As has been described above, the banknote conveying apparatus 100 detects, based on the check sensors 31LU to 31RL, whether or not the banknote 2 is conveyed out of the center toward the positive or negative X-axis direction on the conveying path 7a, while concurrently conveying and executing the centering process for the banknote 2 on the conveying path 7a.

[0034] Each of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL is, for example, a photoelectric sensor. Each of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL is a set of a light emitting section and a light receiving section. Each of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL is disposed upstream of the driving roller unit 10 and the follower roller unit 20 (i.e., closer to the distinguishing unit 4) on the conveying path 7a. A distance between the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL is indicated by L3 (see FIG. 5).

[0035] When both of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL are in the "blocked sensor" state (i.e., the banknote 2 blocks an area between the light emitting section and the light receiving section), the banknote conveying apparatus 100 determines that the banknote 2 is not positioned out of the center toward the positive or negative X-axis direction and is thus conveyed at the center on the conveying path 7a. In this case, the banknote conveying apparatus 100 does not perform the centering process for the banknote 2 and conveys the banknote 2 maintaining the current position on the conveying path 7a.

[0036] On the other hand, when one of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL is in the "blocked sensor" state (i.e., the banknote 2 blocks the area between the light emitting section and the light receiving section), the banknote conveying apparatus 100 determines that the banknote 2 is conveyed out of the center toward the positive or negative X-axis direction on the conveying path 7a. When the banknote conveying apparatus 100 determines, based on the detection result of the position detector sensors 32LU to 32RL, that the banknote 2 is conveyed out of the center toward the positive or negative X-axis direction on the conveying path 7a, the banknote conveying apparatus 100 performs a preparation for the centering process for the banknote 2. In other words, the banknote conveying apparatus 100, when needed, moves the rollers 12L and 12R in the driving roller unit 10 from the current position in the X-axis direction to a first home position or a second home position as will be described later.

[0037] When the centering process is performed, the positions of the rollers 12L and 12R in the X-axis direction are changed. Then, when the centering process terminates, the rollers 12L and 12R stop to remain at positions in the X-axis direction that are defined at the moment of termination of the centering process.

[0038] For example, when the banknote conveying apparatus 100 determines, based on the detection result of the position detector sensors 32LU to 32RL, that the banknote 2 is conveyed out of the center toward the positive (negative) X-axis direction on the conveying path 7a, the banknote conveying apparatus 100 performs the following process. That is to say, when the rollers 12L and 12R are not currently located in a limit position in the positive (negative) X-axis direction, the banknote conveying apparatus 100 moves the rollers 12L and 12R to the limit position in the positive (negative) X-axis direction. The limit position in the negative X-axis direction indicates the first home position to be described later. The limit position in the positive X-axis direction indicates the second home position to be described later.

(Moving Range of Rollers 12L and 12R)

[0039] Each of FIG. 3 and FIG. 4 is a plan view illustrating an example of the moving range of the rollers in the driving roller unit in the banknote conveying apparatus according to the first embodiment. The moving range of the rollers 12L and 12R in the driving roller unit 10 that horizontally move is equal to a range within which the face of each of the rollers 12L and 12R remains positioned opposite the face of the roller 22 in the follower roller unit 20.

[0040] Specifically, as illustrated in FIG. 3, the roller 12L has an end portion in the negative X-axis direction that aligns in the Z-axis direction with an end portion of the roller 22 in the negative X-axis direction. The aligned position is the first home position that represents the moving range limit of the rollers 12L and 12R in the negative X-axis direction. The

first home position as the moving range limit of the driving roller unit 10 in the negative X-axis direction also represents a home position of the rollers 12L and 12R.

[0041] Additionally, as illustrated in FIG. 4, the roller 12L has an end portion in the positive X-axis direction that aligns in the Z-axis direction with an end portion of the roller 22 in the positive X-axis direction. The aligned position is the second home position that represents the moving range limit of the rollers 12L and 12R in the positive X-axis direction. The second home position as the moving range limit of the driving roller unit 10 in the positive X-axis direction also represents another home position of the rollers 12L and 12R.

[0042] The driving roller unit 10 horizontally moves in the positive and negative X-axis directions between the first home position and the second home position. In other words, the rollers 12L and 12R move within the range between the first home position and the second home position in the width direction of the conveying path 7a (X-axis direction) where the roller face of each of the rollers 12L and 12R is positioned opposite the roller face of the roller 22 in a vertical direction of the conveying path 7a (i.e., in a positive Z-axis direction). Here, the moving range of the rollers 12L and 12R corresponds to a length range of the roller 22 in the width direction of the conveying path 7a (X-axis direction).

[0043] Further, the predetermined range, within which the rollers 12L and 12R horizontally move, is included within a length range of the conveying path 7a of the banknote 2 in the width direction of the conveying path 7a, even when the banknote 2 conveyed on the conveying path 7a is located at any position in width direction of the conveying path 7a. With this configuration, the banknote 2 conveyed on the conveying path 7a is caught by the nip section formed between the rollers 12L, 12R, and the roller 22, even when the banknote is positioned out of the center toward anywhere in the width direction on the conveying path 7a. Then, the centering process is performed to correct the position of the banknote 2 to the center on the conveying path 7a.

[0044] Before moving in the width direction of the conveying path 7a and concurrently holding the banknote 2 sandwiched between the rollers 12L, 12R, and the roller 22, the rollers 12L and 12R previously move to the limit position closer to where the banknote 2 is conveyed out of the center in the width direction on the conveying path 7a (i.e., the first home position or the second home position). Then, the rollers 12L and 12R move from the limit position as a starting point to move within the predetermined range so as to move the banknote 2 to the center in the width direction on the conveying path 7a. This configuration causes the rollers 12L and 12R to maximize the horizontally movable range to perform the centering process for the banknote 2.

(Outline of Centering Process)

[0045] FIG. 5 is a plan view illustrating a schematic example of the centering process in the banknote conveying apparatus according to the first embodiment. The distance L3 between the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31RL is equal to L6 as a width of the banknote input area of the storage unit 6 in the X-direction. For example, as illustrated in FIG. 5, the banknote 2 has its end portion causing the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state that requests the centering process, and thus, the centering process is performed.

[0046] Then, for example, the driving roller unit 10 moves in a direction A as the positive X-axis direction and in parallel to the X-axis by a first predetermined amount, while concurrently conveying the banknote 2 with the follower roller unit 20 in a direction B as the positive Y-axis direction by a second predetermined amount. With this configuration, the banknote 2 is subjected to the centering process based on the moving amount and direction expressed by A + B = C (where each of A and B is used as a vector). As a result, the banknote 2 has its conveyed position corrected in the X-axis direction so as to be located at a position not to hit the banknote input area of the storage unit 6. Subsequently, the banknote 2 is stored in the storage unit 6 without hitting the banknote input area of the storage unit 6.

[0047] When the banknote 2 has its end portion causing the pair of check sensors 31RU and 31RL to be in the "blocked sensor" state that requests the centering process, the driving roller unit 10 moves in a direction A' as opposite to the direction A and in parallel to the X-axis by the first predetermined amount, while concurrently conveying the banknote 2 with the follower roller unit 20 in the direction B by the second predetermined amount. With this configuration, the banknote 2 is subjected to the centering process based on the moving amount and direction expressed by A' + B = C' (where each of A' and B is used as a vector).

(Failure of Centering Process)

[0048] FIG. 6 is a plan view illustrating a schematic example of a failure of the centering process in the banknote conveying apparatus according to the first embodiment. For example, as illustrated in FIG. 6, the banknote 2 has its end portion causing the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state that requests the centering process, and thus, the centering process is performed. Then, for example, the banknote 2 is subjected to the centering process, in which the driving roller unit 10 moves in the positive X-axis direction while concurrently conveying the banknote 2 with the follower roller unit 20 in the positive Y-axis direction.

[0049] However, even when the driving roller unit 10 reaches the second home position in the positive X-axis direction, the banknote 2 still has its end portion causing the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state. The banknote 2 is not moved further in the positive X-direction and is thus not further subjected to the centering process. In this state, the centering process ends in failure. In this case, the banknote 2 is not recycled but is, for example, accommodated in a collection unit (not illustrated) or in a rejection unit (not illustrated), each including a banknote input area wider than the banknote input area of the storage unit 6, or returned to the depositor.

(Detail for Banknote Conveying Apparatus According to First Embodiment)

[0050] Each of FIG. 7 and FIG. 8 is a perspective view illustrating an example of the banknote conveying apparatus according to the first embodiment. In a description of each of FIGS. 7 and 8, a description of each configuration previously described will be omitted.

[0051] The banknote conveying apparatus 100 according to the first embodiment includes the moving base station 40, a conveying path connection port 50, a home position sensor 60, a horizontal-movement driving mechanism 70, a conveyance-driving mechanism 80, and a housing 100a in addition to the configuration illustrated in FIG. 1.

[0052] The housing 100a accommodates the driving roller unit 10, the follower roller unit 20, the check sensors 31LU, 31LL, 31RU, and 31RL, the position detector sensors 32LU, 32LL, 32RU, and 32RL, the moving base station 40, the home position sensor 60, the horizontal-movement driving mechanism 70, and the conveyance-driving mechanism 80.

[0053] In the housing 100a, each of the horizontal-movement driving mechanism 70 and the conveyance-driving mechanism 80 is accommodated at a fixed position and remains fixed regardless of the horizontal movement of the moving base station 40.

[0054] The driving roller unit 10 further includes a gear 13 formed around an outer circumference of the shaft 11. The shaft 11 acts as a rotational shaft of the gear 13. In the driving roller unit 10, the shaft 11, the roller 12L and the roller 12R each rotate as the gear 13 rotates. The gear 13 has a width L13 in the X-axis direction. The width L13 is equal to or greater than the maximum moving amount in horizontal movement of the moving base station 40 including the rollers 12L and 12R.

[0055] The moving base station 40 includes a pivotal support 41L, a pivotal support 41R, a moving guide hole 42L, a moving guide hole 42R, a guide pin 43L, a guide pin 43R, a sensor shield 44, and a rack 45. Each of the pivotal supports 41L and 41R pivotally supports the shaft 11 so that the shaft 11 rotates about its rotational center parallel to the X-axis. The moving guide holes 42L and 42R are holes through which the guide pins 43L and 43R are respectively inserted.

[0056] Each of the moving guide holes 42L and 42R has, for example, an oval shape extending by a predetermined length in the X-axis direction. Each of the guide pins 43L and 43R is located at a fixed position in the housing 100a. The guide pins 43L and 43R are respectively inserted through the moving guide holes 42L and 42R, so as to allow the moving base station 40 to move only horizontally and to restrict variation in the horizontal moving amount of the moving base station 40.

[0057] The sensor shield 44 is a member attached to extend in a negative Y-axis direction from a part of an edge of the moving base station 40, the edge closer to where the moving guide holes 42L and 42R are located. The sensor shield 44 shields the home position sensor 60 (to be described later) so as to detect at which one of the first home position and the second home position the rollers 12L and 12R, moving horizontally in the positive and negative X-axis directions along with the moving base station 40, are positioned.

[0058] The rack 45 is attached to the moving base station 40 on a side opposite to the sensor shield 44, as will be described later with reference to FIG. 8. The rack 45 constitutes a rack and pinion together with a pinion 72b to be described later with reference to FIG. 8. When the pinion 72b rotates, the rotation is transmitted to the rack 45 that is tooth-engaged with the pinion 72b, causing the rotation of the pinion 72b to be converted to the horizontal movement of the moving base station 40.

[0059] The conveying path connection port 50 connects the conveying path 7a inside the housing 100a with the conveying path 7a extending out of the housing 100a to the upstream and downstream sides in the banknote conveying apparatus 100 (see FIG. 1). On the conveying path 7a inside the housing 100a, the banknote 2 passes through the nip section formed between the rollers 12L, 12R, and the roller 22.

[0060] The home position sensor 60 includes a first sensor 61L and a second sensor 61R. The first sensor 61L and the second sensor 61R are disposed with a distance from each other, the distance corresponding to a horizontal movement amount allowed for the moving base station 40, in other words, an allowable moving amount when the rollers 12L and 12R horizontally move between the first home position and the second home position. Each of the first sensor 61L and the second sensor 61R is, for example, a photoelectric sensor.

[0061] Each of the first sensor 61L and the second sensor 61R, having a pair of a light emitting section and a light receiving section, is, for example, a sensor of U-shape facing upward in the positive Z-axis direction. When the moving base station 40 horizontally moves in the negative X-axis direction, causing the sensor shield 44 to shield the first sensor 61L, the rollers 12L and 12R are positioned at the first home position. When the moving base station 40 horizontally

moves in the positive X-axis direction, causing the sensor shield 44 to shield the second sensor 61R, the rollers 12L and 12R are positioned at the second home position.

[0062] Each of the first sensor 61L and the second sensor 61R is not limited to the one illustrated in the drawings, but may be any sensor or in any shape as long as being a position detector sensor.

[0063] The horizontal-movement driving mechanism 70 and the conveyance-driving mechanism 80 will be described with reference to FIG. 8. FIG. 8 is a perspective view of the banknote conveying apparatus 100, taken on arrow S in FIG. 7.

[0064] The horizontal-movement driving mechanism 70 is a mechanism that causes the moving base station 40 including the rollers 12L and 12R to horizontally move. The horizontal-movement driving mechanism 70 includes a driving pulley 71, a follower pulley 72a, the pinion 72b, and a driving transmission belt 73.

[0065] The driving pulley 71 acts as a pulley for inputting driving rotation. The driving pulley 71 is connected to a driving source (not illustrated) and rotates in response to the driving rotation input from the driving source. The control unit 8 (see FIG. 1) controls an operation of the driving source (not illustrated).

[0066] The follower pulley 72a acts as a pulley for rotating in response to the rotation of the driving pulley 71. The rotation of the driving pulley 71 is transmitted to the follower pulley 72a via the driving transmission belt 73 that is wound around the driving pulley 71 and wound around the follower pulley 72a. The pinion 72b is fixed to the follower pulley 72a and thus rotates as the follower pulley 72a rotates. While omitted in the illustration in FIG. 8, the pinion 72b includes gear teeth formed on its outer circumferential face.

[0067] As previously described, the pinion 72b constitutes the rack and pinion together with the rack 45 provided on the moving base station 40. The driving pulley 71 rotates, and the rotation is transmitted via a driving transmission belt 73 to the follower pulley 72a. As the follower pulley 72a rotates, the pinion 72b rotates. When the pinion 72b rotates, the rotation is transmitted to the rack 45 tooth-engaged with the pinion 72b, causing the rotation of the pinion 72b to be converted to the horizontal movement of the moving base station 40. As a result, the moving base station 40 including the rollers 12L and 12R horizontally moves.

[0068] Here, the rotation of the driving pulley 71 is transmitted to the follower pulley 72a via the driving transmission belt 73 (friction transmission), but the transmission manner is not limited thereto. Instead of these pulleys, a gear or a chain may be used to transmit the rotation. Additionally, here, the rotation of the pinion 72b is transmitted, and converted via the rack and pinion to the horizontal movement of the moving base station 40, but the conversion manner is not limited thereto. The rotation may be converted to the horizontal movement via a friction transmission medium.

[0069] The conveyance-driving mechanism 80 normally operates to convey the banknote 2 from upstream to downstream on the conveying path 7a (in the positive Y-axis direction) whether or not the banknote 2 is horizontally moved. The conveyance-driving mechanism 80 includes a driving pulley 81, a follower pulley 82a, a follower gear 82b, a driving transmission gear 83, and a driving transmission belt 84.

[0070] The driving pulley 81 acts as a pulley for inputting driving rotation. The driving pulley 81 is connected to the driving source (not illustrated) and rotates in response to the driving rotation input from the driving source. The control unit 8 (see FIG. 1) controls the operation of the driving source (not illustrated).

[0071] The follower pulley 82a rotates in response to the rotation of the driving pulley 81. The rotation of the driving pulley 81 is transmitted to the follower pulley 82a via the driving transmission belt 84 that is wound around the driving pulley 81 and wound around the follower pulley 82a. The follower gear 82b is fixed to the follower pulley 82a and thus rotates as the follower pulley 82a rotates. When the follower gear 82b rotates, the driving transmission gear 83 rotates and transmits the rotation of the follower gear 82b to the gear 13 of the driving roller unit 10.

[0072] The rotation is transmitted from the follower gear 82b to the driving transmission gear 83 by way of gear transmission. Further, the rotation is transmitted from the driving transmission gear 83 to the gear 13 of the driving roller unit 10 by way of gear transmission.

[0073] Here, the rotation of the driving pulley 81 is transmitted to the follower pulley 82a via the driving transmission belt 73 (friction transmission), but the transmission manner is not limited thereto. Instead of these pulleys, a gear or a chain may be used to transmit the rotation. Additionally, here, the rotation is transmitted from the follower gear 82b to the driving transmission gear 83 by way of gear transmission, but the transmission manner is not limited thereto. The rotation may be transmitted via a friction transmission medium instead of these gears. Further, the rotation is transmitted from the driving transmission gear 83 to the gear 13 of the driving roller unit 10 by way of gear transmission, but the transmission manner is not limited thereto. The rotation may be transmitted via a friction transmission medium instead of these gears.

[Centering Process According to First Embodiment]

[0074] FIG. 9 is a flowchart illustrating an example of the centering process in the banknote conveying apparatus according to the first embodiment. The control unit 8 in the banknote handling apparatus 1 executes the centering process according to the first embodiment at each moment that the banknote 2 passes through the position detector sensors 32LU, 32LL, 32RU, and 32RL.

[0075] First, in Step S11, the control unit 8 determines whether both of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL detect the "blocked sensor" state or detect the "light-transmitting sensor" state. When the control unit 8 determines that both of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL detect the "blocked sensor" state (Step S11: Yes), the control unit 8 moves on to Step S26. On the other hand, when the control unit 8 determines that one of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL detects the "blocked sensor" state (Step S11: No), the control unit 8 moves on to Step S12.

[0076] In Step S12, the control unit 8 determines whether or not one of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU and 32RL detects the "blocked sensor" state. When the control unit 8 determines that the pair of position detector sensors 32RU and 32RL detects the blocked sensor" state (Step S12: Yes; blocked on the right side), the control unit 8 moves on to Step S18. On the other hand, when the control unit 8 determines that the pair of position detector sensors 32LU and 32LL detects the "blocked sensor" state (Step S12: No; blocked on the left side), the control unit 8 moves on to Step S13.

[0077] In Step S13, the control unit 8 starts the horizontal movement of the rollers 12L and 12R in a left direction (the negative X-axis direction). Next, in Step S14, the control unit 8 detects that the horizontal movement of the rollers 12L and 12R in the left direction (negative X-axis direction) causes the first sensor 61L to be in the "blocked sensor" state. In this state, the rollers 12L and 12R are positioned at the first home position.

[0078] Next, in Step S15, the control unit 8 detects that the banknote 2 conveyed from upstream to downstream on the conveying path 7a causes the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state. In Step S16, the control unit 8 starts the horizontal movement of the rollers 12L and 12R together with the banknote 2 from the first home position in a right direction (the positive X-axis direction) so as to start the centering process for the banknote 2.

[0079] In Step S17, the control unit 8 continues the horizontal movement of the rollers 12L and 12R from the first home position in the right direction (positive X-axis direction) until the pair of check sensors 31LU and 31LL becomes in the "light-transmitting sensor" state. When Step S17 completes, the control unit 8 moves on to Step S23.

[0080] On the other hand, in Step S18, the control unit 8 starts the horizontal movement of the rollers 12L and 12R in the right direction (positive X-axis direction). Next, in Step S19, the control unit 8 detects that the horizontal movement of the rollers 12L and 12R in the right direction (positive X-axis direction) causes the second sensor 61R to be in the "blocked sensor" state. In this state, the rollers 12L and 12R are positioned at a second position (the second home position).

[0081] Next, in Step S20, the control unit 8 detects that the banknote 2 conveyed from upstream to downstream on the conveying path 7a causes the pair of check sensors 31RU and 31RL to be in the "blocked sensor" state. In Step S21, the control unit 8 starts the horizontal movement of the rollers 12L and 12R together with the banknote 2 from the second position (first home position) in the left direction (negative X-axis direction) so as to start the centering process for the banknote 2.

[0082] In Step S22, the control unit 8 continues the horizontal movement of the rollers 12L and 12R from the second position (second home position) in the left direction (negative X-axis direction) until the pair of check sensors 31RU and 31RL becomes in the "light-transmitting sensor" state. When Step S22 completes, the control unit 8 moves on to Step S23.

[0083] In Step S23, the control unit 8 determines whether or not each of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31LL has detected the "light-transmitting sensor" state within a specified length of time. When the control unit 8 determines that each of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31LL has detected the "light-transmitting sensor" state within the specified length of time (Step S23: Yes), the control unit 8 moves on to Step S26. On the other hand, when the control unit 8 determines that one of the pair of check sensors 31LU and 31LL and the pair of check sensors 31RU and 31LL has not detected the "light-transmitting sensor" state within the specified length of time (Step S23: No), the control unit 8 moves on to Step S24.

[0084] In Step S24, the control unit 8 determines that the centering process has failed, and thus stores the banknote 2 in the collection unit (not illustrated) or returns the banknote 2 to the depositor. After Step S24, in Step S25, the control unit 8 returns to Step S11 to execute the process of Step S11 and subsequent steps for each subsequent banknote that is conveyed as the banknote 2.

[0085] On the other hand, in Step S26, the control unit 8 determines that the banknote 2 does not request the centering process, and thus stores the banknote 2 in the storage unit 6 to recycle the banknote 2 (use the banknote 2 stored in the storage unit 6 for cash withdrawal). When Step S26 completes, the control unit 8 moves on to Step S25.

(Outline of Case in which Centering Process is not performed)

[0086] FIG. 10 is a schematic diagram illustrating an outline of an example in which the centering process is not performed in the banknote conveying apparatus according to the first embodiment. In a case illustrated in FIG. 10, the banknote 2 conveyed on the conveying path 7a is smaller in width in the X-axis direction than the storage unit 6 (width: L6), and each of the pair of position detector sensors 32LU and 32LL and the pair of position detector sensors 32RU

and 32RL is in the "light-transmitting sensor" state. Accordingly, the centering process for the banknote 2 is not performed. This case corresponds to the case in which the determination in Step S11 in FIG. 9 is Yes. Note that, as illustrated in FIGS. 10 to 15, the conveying path 7a is equal in width in the X-axis direction to the banknote input area of the collection unit (not illustrated).

(Outline of Case in which Centering is Performed)

[0087] Each of FIGS. 11 to 14 is a schematic diagram illustrating an outline of an example in which the centering process is performed in the banknote conveying apparatus according to the first embodiment. FIG. 15 is a schematic diagram illustrating an outline of an example in which the centering process is in an error state in the banknote conveying apparatus according to the first embodiment. In a case illustrated in FIG. 11, the banknote 2 conveyed on the conveying path 7a has its left end portion (an end portion in the negative X-axis direction) causing the pair of position detector sensors 32LU and 32LL to be in the "blocked sensor" state. Accordingly, the centering process for the banknote 2 is performed. This case corresponds to the case in which the determination in Step S12 in FIG. 9 is No. Similarly, when the banknote 2 conveyed on the conveying path 7a has its right end portion (an end portion in the positive X-axis direction) causing the pair of position detector sensors 32RU and 32RL to be in the "blocked sensor" state, the centering process for the banknote 2 is performed.

[0088] In a case illustrated in FIG. 12, the banknote 2 conveyed on the conveying path 7a (as illustrated in FIG. 11) has its left end portion (the end portion in the negative X-axis direction) causing the pair of position detector sensors 32LU and 32LL to be in the "blocked sensor" state. Thus, in order to execute the centering process for the banknote 2, the control unit 8 moves the rollers 12L and 12R in the left direction (negative X-axis direction) until the first sensor 61L becomes in the "blocked sensor" state. This case corresponds to Step S13 and Step S14 in FIG. 9. Similarly, when the banknote 2 conveyed on the conveying path 7a has its right end portion (the end portion in the positive X-axis direction) causing the pair of position detector sensors 32RU and 32RL to be in the "blocked sensor" state, in order to execute the centering process for the banknote 2, the control unit 8 moves the rollers 12L and 12R in the right direction (positive X-axis direction) until the second sensor 61R becomes in the "blocked sensor" state. (This case corresponds to Step S18 and Step S19 in FIG. 9.)

[0089] FIG. 13 illustrates a state in which the banknote 2 is further conveyed on the conveying path 7a from the state in the case of FIG. 12 and in which the banknote 2 has its left end portion (the end portion in the negative X-axis direction) causing the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state. This moment corresponds to the timing of starting the centering process for the banknote 2 (corresponds to Step S15 in FIG. 9). Similarly, when the banknote 2 is further conveyed on the conveying path 7a from the state, in which the banknote 2 conveyed on the conveying path 7a has its right end portion (the end portion in the positive X-axis direction) causing the pair of position detector sensors 32RU and 32RL to be in the "blocked sensor" state, and then has its right end portion (the end portion in the positive X-axis direction) causing the pair of check sensors 31RU and 31RL to be in the "blocked sensor" state, the moment corresponds to the timing of starting the centering process for the banknote 2 (corresponds to Step S20 in FIG. 9).

[0090] FIG. 14 illustrates a state in which the banknote 2 is further conveyed on the conveying path 7a while being centered from the state in the case of FIG. 13, and in which the banknote 2 has its left end portion (the end portion in the negative X-axis direction) causing the pair of check sensors 31LU and 31LL to be in the "light-transmitting sensor" state. This moment corresponds to the timing of completing the centering process for the banknote 2 (corresponds to Step S16 and Step S17 in FIG. 9). Similarly, when the banknote 2 is further conveyed on the conveying path 7a from the state, in which the banknote 2 conveyed on the conveying path 7a has its right end portion (the end portion in the positive X-axis direction) causing the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state, and then has its right end portion (the end portion in the positive X-axis direction) causing the pair of check sensors 31LU and 31LL to be in the "light-transmitting sensor" state, the moment corresponds to the timing of completing the centering process for the banknote 2 (corresponds to Step S21 and Step S22 in FIG. 9) .

[0091] FIG. 15 illustrates a state in which the banknote 2 is further conveyed on the conveying path 7a while being centered from the state in the case of FIG. 13, and in which the banknote 2 still has its left end portion (the end portion in the negative X-axis direction) causing the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state even after the specified length of time. This state indicates that the centering process for the banknote 2 ends in failure (corresponding to Step S23: No in FIG. 9). Similarly, when the banknote 2 is further conveyed on the conveying path 7a from the state, in which the banknote 2 conveyed on the conveying path 7a has its right end portion (the end portion in the positive X-axis direction) causing the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state, but even after the specified length of time, the banknote 2 still has its right end portion (the end portion in the positive X-axis direction) causing the pair of check sensors 31LU and 31LL to be in the "blocked sensor" state, the state indicates that the centering process for the banknote 2 ends in failure (corresponding to Step S23: No in FIG. 9).

[0092] According to the first embodiment described above, the banknote conveying apparatus 100, having the driving

roller unit 10 and the follower roller unit 20 as a pair, monitors via the check sensors 31LU to 31RL whether or not the banknote 2 is conveyed out of the center on the conveying path 7a, and concurrently performs the centering process by only moving the rollers 12L and 12R horizontally. Thus, according to the first embodiment, with the simple configuration and the simple process, it is possible to perform the centering process for banknote 2 efficiently without reducing speed of conveying the banknote 2. According to the first embodiment, it is also possible to prevent the banknote 2 from being stored out of order in the storage unit 6 or from jamming against the input area of the storage unit 6. Further, according to the first embodiment, when the banknote 2 smaller in size is withdrawn from the storage unit 6, the process is performed in a more stable manner.

[Modification of First Embodiment]

(1) Movement of Rollers 12L and 12R to Home Positions

[0093] In the first embodiment, when the rollers 12L and 12R are not positioned in the limit position in the negative (positive) X-axis direction before the centering process for the banknote 2 on the conveying path 7a takes place, the control unit 8 moves the rollers 12L and 12R to the limit position in the negative (positive) X-axis direction, i.e., the first home position (second home position). However, the present disclosure is not limited thereto. Even when the rollers 12L and 12R are not positioned in the limit position in the negative (positive) X-axis direction before the centering process for the banknote 2 takes place, the control unit 8 may determine, based on the detection of the position detector sensors 32LU to 32RL, that the out-of-position amount, which the banknote 2 has from the center of the conveying path 7a, is to be resolved (the banknote 2 is to be centered) only by moving the rollers 12L and 12R horizontally from the current position. In this case, the rollers 12L and 12R may be moved horizontally from the current position without being moved to the limit position. With this configuration, the process of moving the rollers 12L and 12R to each of the home positions may be omitted, thereby resulting in further higher efficiency and higher speed in the centering process.

(2) Location of Banknote Conveying Apparatus 100

[0094] In the first embodiment, the banknote conveying apparatus 100 is disposed downstream of the distinguishing unit 4 as well as upstream of the temporary accommodating unit 5 on the conveying path 7a. However, the present disclosure is not limited thereto. The banknote conveying apparatus 100 may be disposed at any location from downstream of the distinguishing unit 4 to the storage units 6 on the conveying path 7a.

(3) Rollers 12L and 12R

[0095] In the first embodiment, the two rollers 12L and 12R, being spaced with a predetermined gap from each other, are axially attached to the shaft 11. However, the present disclosure is not limited thereto. Three or more rollers may be spaced with a predetermined gap from one another and axially attached to the shaft 11.

(4) Sensors

[0096] In the first embodiment, each of the following sensors is described as a photoelectric sensor: the check sensors 31LU, 31LL, 31RU, and 31RL, the position detector sensors 32LU, 32LL, 32RU, and 32RL, and the sensors of the home position sensor 60. However, the present disclosure is not limited thereto. These sensors may be other type of sensors, such as an infrared sensor.

(5) Provided Configuration of Banknote Conveying Apparatus 100

[0097] In the first embodiment, the banknote conveying apparatus 100 is included in the banknote handling apparatus 1 as a configuration unit of the banknote handling apparatus 1. However, the present disclosure is not limited thereto. The banknote conveying apparatus 100 may be provided as a unit that is detachable from the banknote handling apparatus 1.

Second Embodiment

[Outline of Banknote Conveying Apparatus According to Second Embodiment]

[0098] FIG. 16 is a perspective view illustrating a schematic example of a banknote conveying apparatus according to a second embodiment. In a banknote conveying apparatus 100A according to the second embodiment, the check

sensors 31LU, 31LL, 31RU, and 31RL are omitted as compared with the banknote conveying apparatus 100 according to the second embodiment.

[0099] The banknote conveying apparatus 100A according to the second embodiment has a control unit 8A. The distinguishing unit 4 distinguishes the banknote 2, and based on the result, the control unit 8A determines at which position in the X-axis direction on the conveying path 7a the banknote 2 is being conveyed. Based on the position determined, the control unit 8A calculates the horizontal movement amount of the rollers 12L and 12R in the centering process for the banknote 2. Then, the control unit 8A horizontally moves the rollers 12L and 12R by the calculated movement amount to perform the centering process for the banknote 2.

[0100] According to the second embodiment, the check sensors 31LU to 31RL are omitted, and the distinguishing result on the banknote 2 by the distinguishing unit 4 is instead used to calculate the horizontal movement amount of the rollers 12L and 12R in the centering process for the banknote 2. Thus, according to the second embodiment, with the further simplified configuration and the further simplified process, the centering process for banknote 2 may be efficiently performed.

Third Embodiment

[Outline of Banknote Conveying Apparatus According to Third Embodiment]

[0101] FIG. 17 is a perspective view illustrating a schematic example of a banknote conveying apparatus according to a third embodiment. In a banknote conveying apparatus 100B according to the third embodiment, the position detector sensors 32LU, 32LL, 32RU, and 32RL are omitted as compared with the banknote conveying apparatus 100A according to the second embodiment.

[0102] The banknote conveying apparatus 100B according to the third embodiment has a control unit 8B. The distinguishing unit 4 distinguishes the banknote 2, and based on the result, the control unit 8B determines at which position in the X-axis direction on the conveying path 7a the banknote 2 is being conveyed. Based on the position determined, the control unit 8A calculates the horizontal movement amount of the rollers 12L and 12R in the centering process for the banknote 2. Then, the control unit 8A horizontally moves the rollers 12L and 12R by the calculated movement amount to perform the centering process for the banknote 2.

[0103] Based on the distinguishing result on the banknote 2 by the distinguishing unit 4, the control unit 8B determines at which position in the X-axis direction on the conveying path 7a the banknote 2 is being conveyed. Further, based on the position determined, the control unit 8B horizontally moves the rollers 12L and 12R to the first home position or the second home position before performing the centering process for the banknote 2.

[0104] According to the third embodiment, the position detector sensors 32LU and 32LL, and the position detector sensors 32RU and 32RL are also omitted, and the distinguishing result on the banknote 2 by the distinguishing unit 4 is instead used for the preliminary movement of the rollers 12L and 12R to the first home position or the second home position. Thus, according to the third embodiment, with the further simplified configuration and the further simplified process, the centering process for banknote 2 may be efficiently performed.

[0105] Each of the configurations of the units exemplified in each of the foregoing embodiments may be changed or omitted without departing from the technical scope of a paper sheet conveying apparatus, a paper sheet handling apparatus, and a paper sheet conveying method, each according to the disclosed technique. In addition, each of the embodiments is mere exemplification, and starting with a mode described in the field of the disclosure of the invention, other modes on which various modifications and improvements are performed based on the knowledge of the one skilled in the art are included in the disclosed technique.

[Explanation of Reference]

[0106]

1	BANKNOTE HANDLING APPARATUS
2	BANKNOTE
3	DEPOSIT/WITHDRAWAL UNIT
4	DISTINGUISHING UNIT
5	TEMPORARY ACCOMMODATING UNIT
6	STORAGE UNIT
7	CONVEYING MECHANISM
7a	CONVEYING PATH
8, 8A, 8B	CONTROL UNIT
10	DRIVING ROLLER UNIT

11	SHAFT
12L, 12R	ROLLER
13	GEAR
20	FOLLOWER ROLLER UNIT
21	SHAFT
22	ROLLER
31LU, 31LL, 31RU, 31RL	CHECK SENSOR
32LU, 32LL, 32RU, 32RL	POSITION DETECTOR SENSOR
40	MOVING BASE STATION
41L, 41R	PIVOTAL SUPPORT
42L, 42R	MOVING GUIDE HOLE
43L, 43R	GUIDE PIN
44	SENSOR SHIELD
45	RACK
50	CONVEYING PATH CONNECTION PORT
60	HOME POSITION SENSOR
61L	FIRST SENSOR
61R	SECOND SENSOR
70	HORIZONTAL-MOVEMENT DRIVING MECHANISM
71	DRIVING PULLEY
72a	FOLLOWER PULLEY
72b	PINION
73	DRIVING TRANSMISSION BELT
80	CONVEYANCE-DRIVING MECHANISM
81	DRIVING PULLEY
82a	FOLLOWER PULLEY
82b	FOLLOWER GEAR
83	DRIVING TRANSMISSION GEAR
84	DRIVING TRANSMISSION BELT
100, 100A, 100B	BANKNOTE CONVEYING APPARATUS
100a	HOUSING

Claims

1. A paper sheet conveying apparatus comprising:

a driving roller configured to rotate about a driving roller shaft in response to a rotational force transmitted from a driving source; and

a follower roller configured to have a fixed position in a width direction of a conveying path where a paper sheet is conveyed, and rotate about a follower roller shaft in response to rotation of the driving roller while holding the paper sheet sandwiched between the follower roller and the driving roller so as to convey the paper sheet with the driving roller from upstream to downstream on the conveying path, wherein

when conveying the paper sheet from upstream to downstream on the conveying path, the driving roller moves in the width direction of the conveying path while holding the paper sheet sandwiched between the driving roller and the driving roller so as to move the paper sheet to a center in the width direction on the conveying path.

2. The paper sheet conveying apparatus according to claim 1, wherein the driving roller includes a plurality of rollers that are axially attached to the driving roller shaft and are spaced with a predetermined gap from each other on the driving roller shaft.

3. The paper sheet conveying apparatus according to claim 1, wherein the driving roller moves within a predetermined range in the width direction of the conveying path, the predetermined range within which a face of the driving roller is positioned opposite a face of the follower roller.

4. The paper sheet conveying apparatus according to claim 3, wherein the predetermined range in the width direction of the conveying path is included within a length range of the paper sheet in the width direction of the conveying path, even when the paper sheet conveyed on the conveying path is located at any position in the width direction

of the conveying path.

5. The paper sheet conveying apparatus according to claim 3, wherein before holding the paper sheet sandwiched between the driving roller and the driving roller and concurrently moving in the width direction of the conveying path, the driving roller previously moves to a limit position of the predetermined range closer to where the paper sheet conveyed on the conveying path is positioned out of the center in the width direction of the conveying path, and when moving the paper sheet to the center in the width direction on the conveying path, the driving roller moves from the limit position as a starting point to move within the predetermined range.

6. The paper sheet conveying apparatus according to claim 1, further including
a detector unit configured to detect that the paper sheet conveyed on the conveying path is positioned out of the center in the width direction of the conveying path, wherein
the driving roller moves in the width direction of the conveying path while holding the paper sheet sandwiched between the driving roller and the driving roller until the detector unit detects that the paper sheet conveyed on the conveying path, having been detected to be positioned out of the center in the width direction of the conveying path, is no longer conveyed out of the center in the width direction on the conveying path.

7. A paper sheet handling apparatus comprising:

the paper sheet conveying apparatus according to any one of claims 1 to 6;
an input/output unit configured to be used to put in or take out a paper sheet;
a distinguishing unit configured to distinguish the paper sheet put in from the input/output unit;
a storage unit configured to store the paper sheet;
a conveying mechanism including a conveying path configured to mutually connect the input/output unit, the distinguishing unit, the paper sheet conveying apparatus, and the storage unit with one another to convey the paper sheet in dual directions; and
a control unit configured to control the paper sheet conveying apparatus and the conveying mechanism.

8. A paper sheet conveying method performed by a paper sheet conveying apparatus,
the paper sheet conveying method comprising:

when a driving roller configured to rotate about a driving roller shaft in response to a rotational force transmitted from a driving source conveys a paper sheet from upstream to downstream on a conveying path, where the paper sheet is conveyed, while holding the paper sheet sandwiched between the driving roller and a follower roller that has a fixed position in a width direction of the conveying path and rotates about a follower roller shaft in response to rotation of the driving roller,
holding the paper sheet, by the driving roller, sandwiched between the driving roller and the driving roller; and conveying the paper sheet concurrently, by the driving roller, to the width direction on the conveying path so as to move the paper sheet to a center in the width direction on the conveying path.

FIG.1

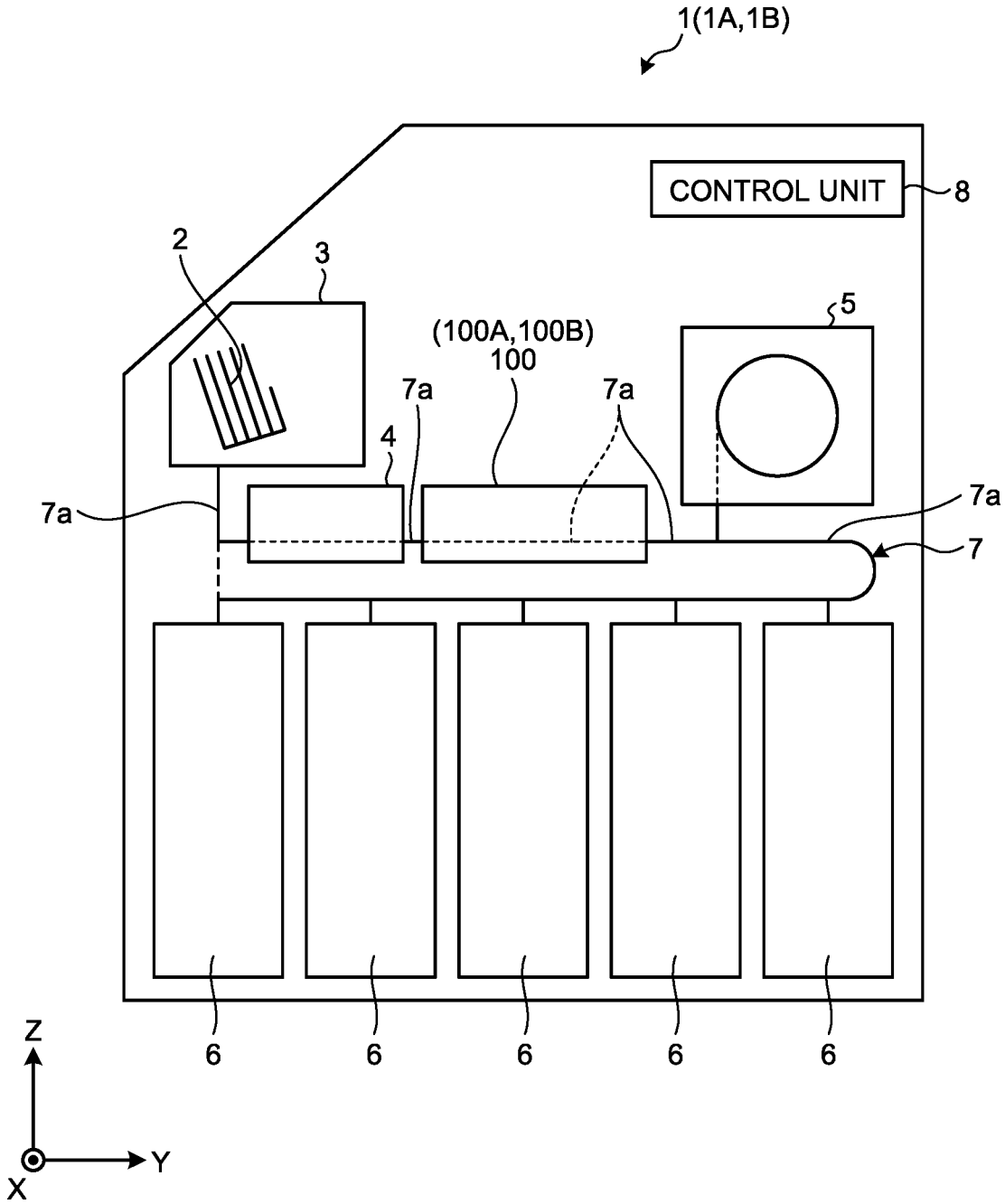


FIG.2

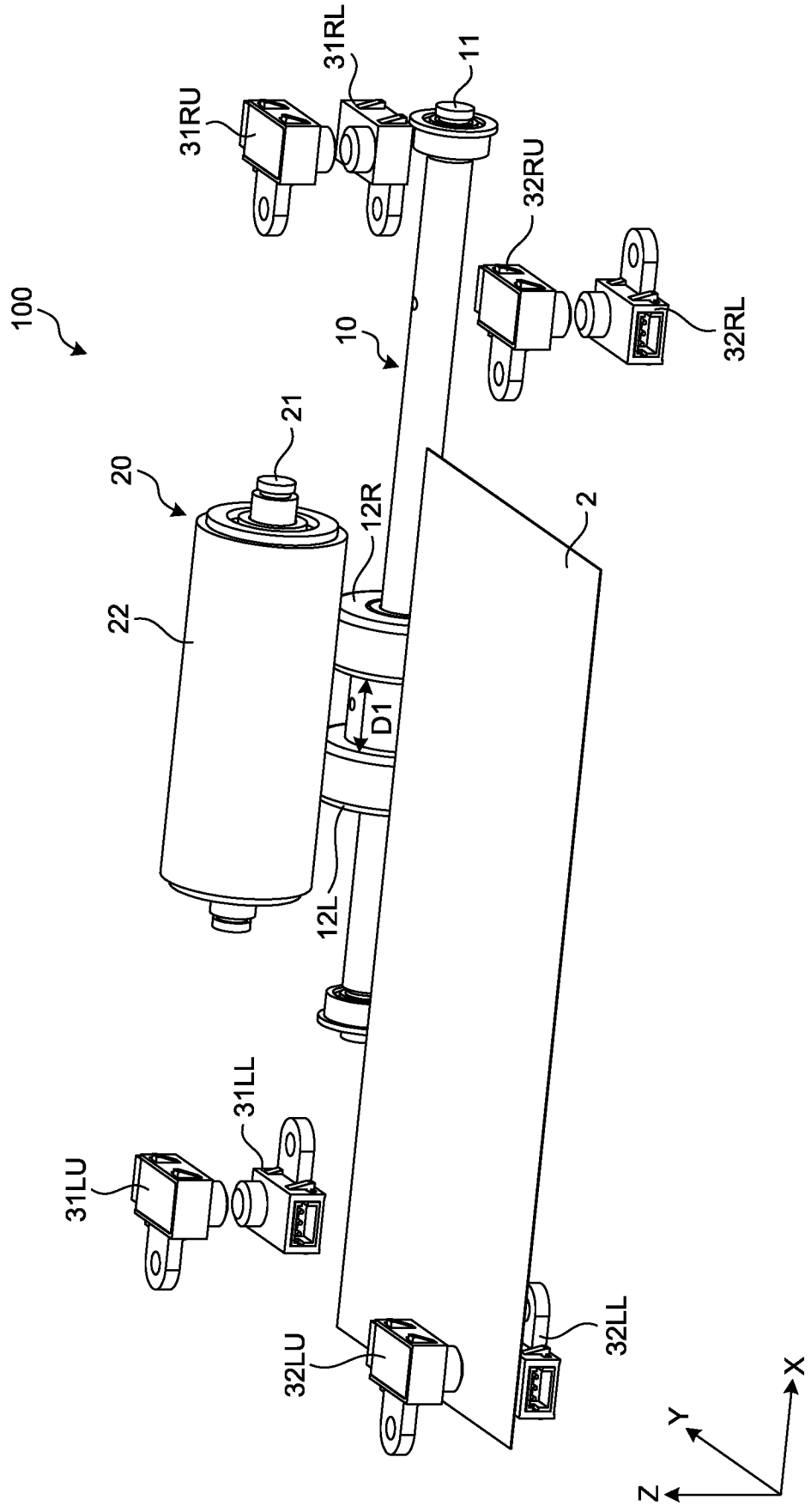

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10
11
20
21
22
2
12R
12L
D1
31RU
31RL
32RU
32RL
31LU
31LL
32LU
32LL
X
Y
Z

FIG.3

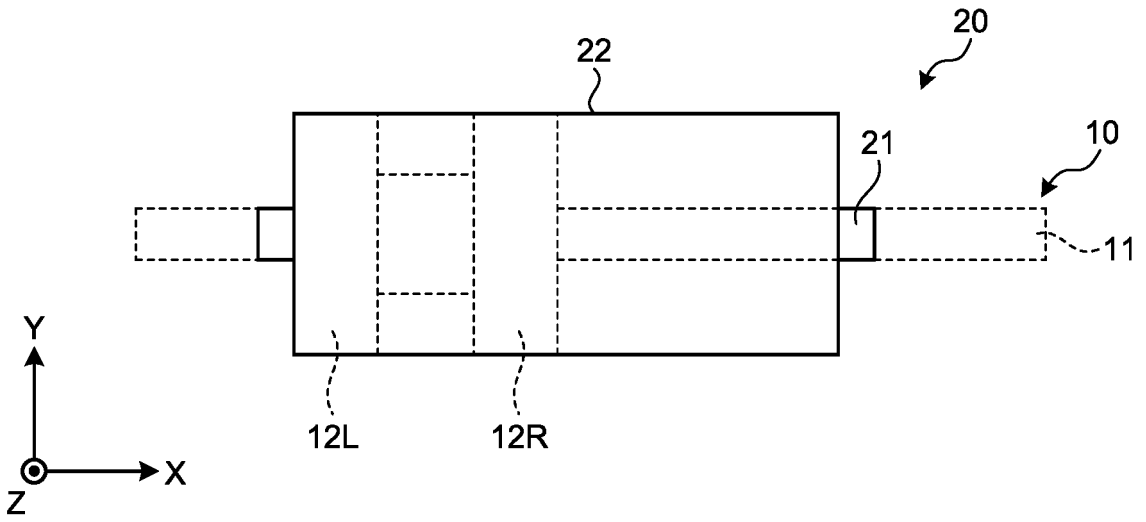


FIG.4

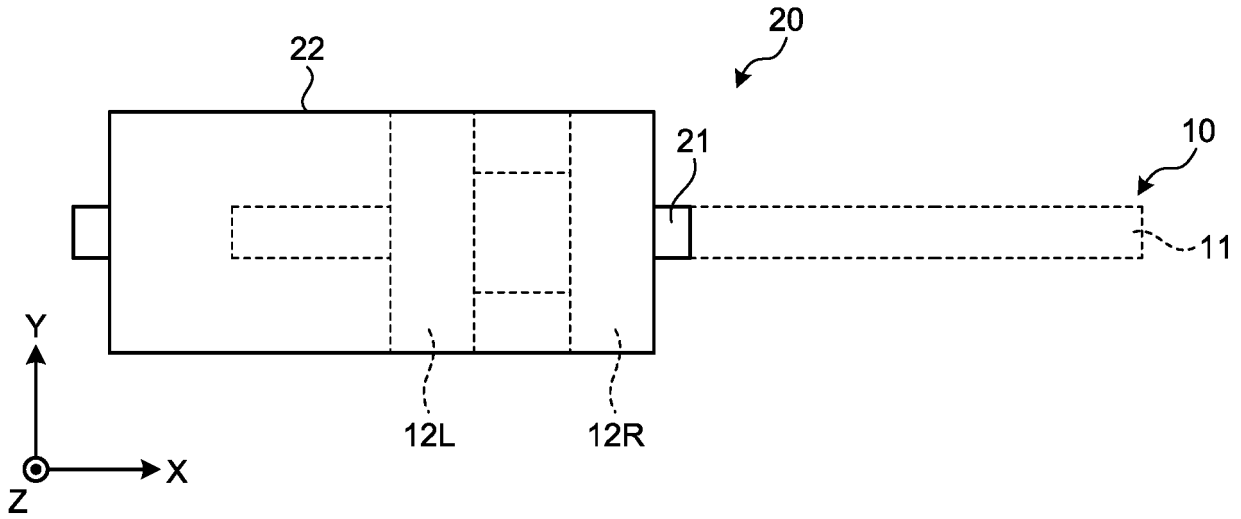


FIG.5

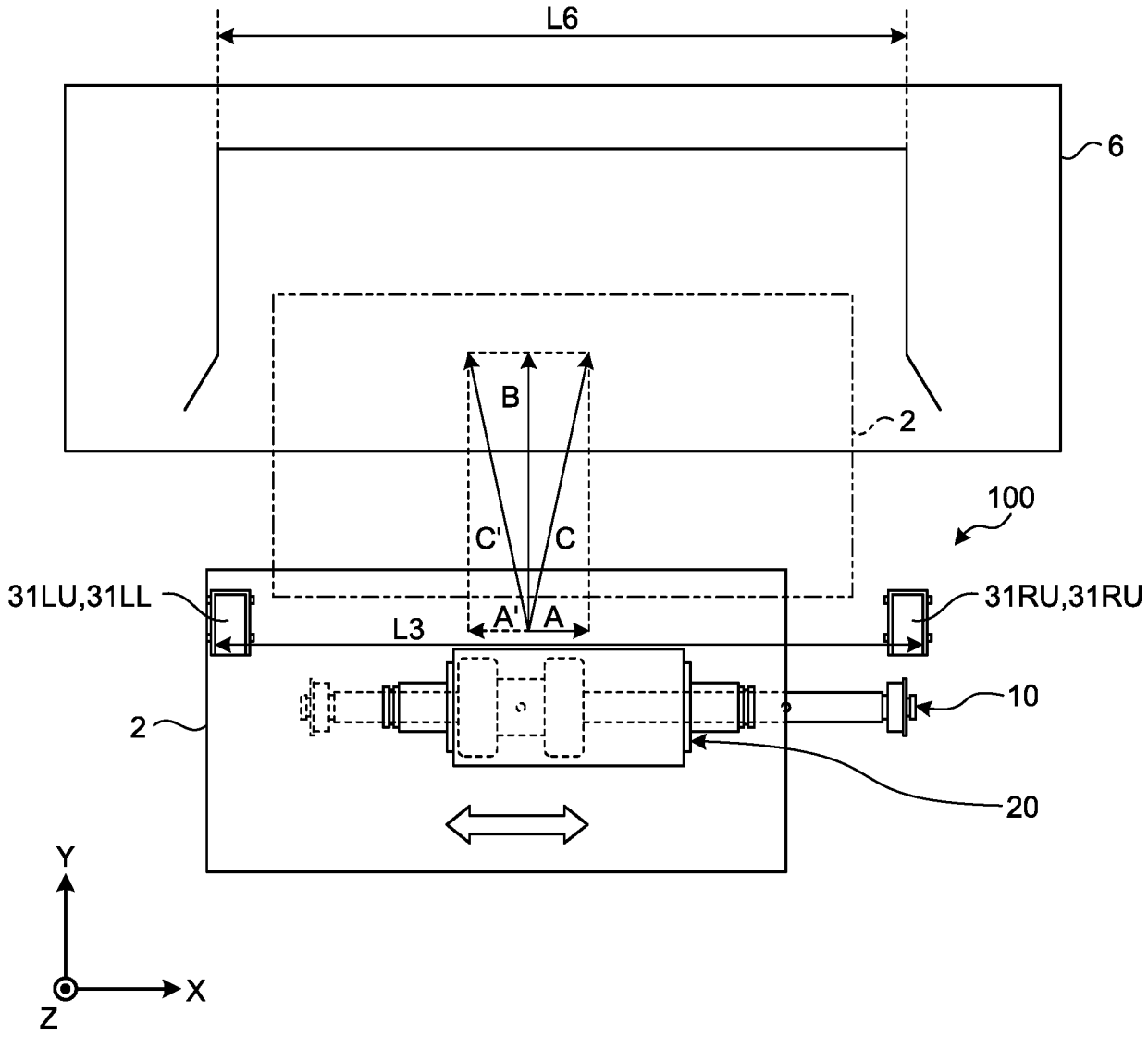


FIG.6

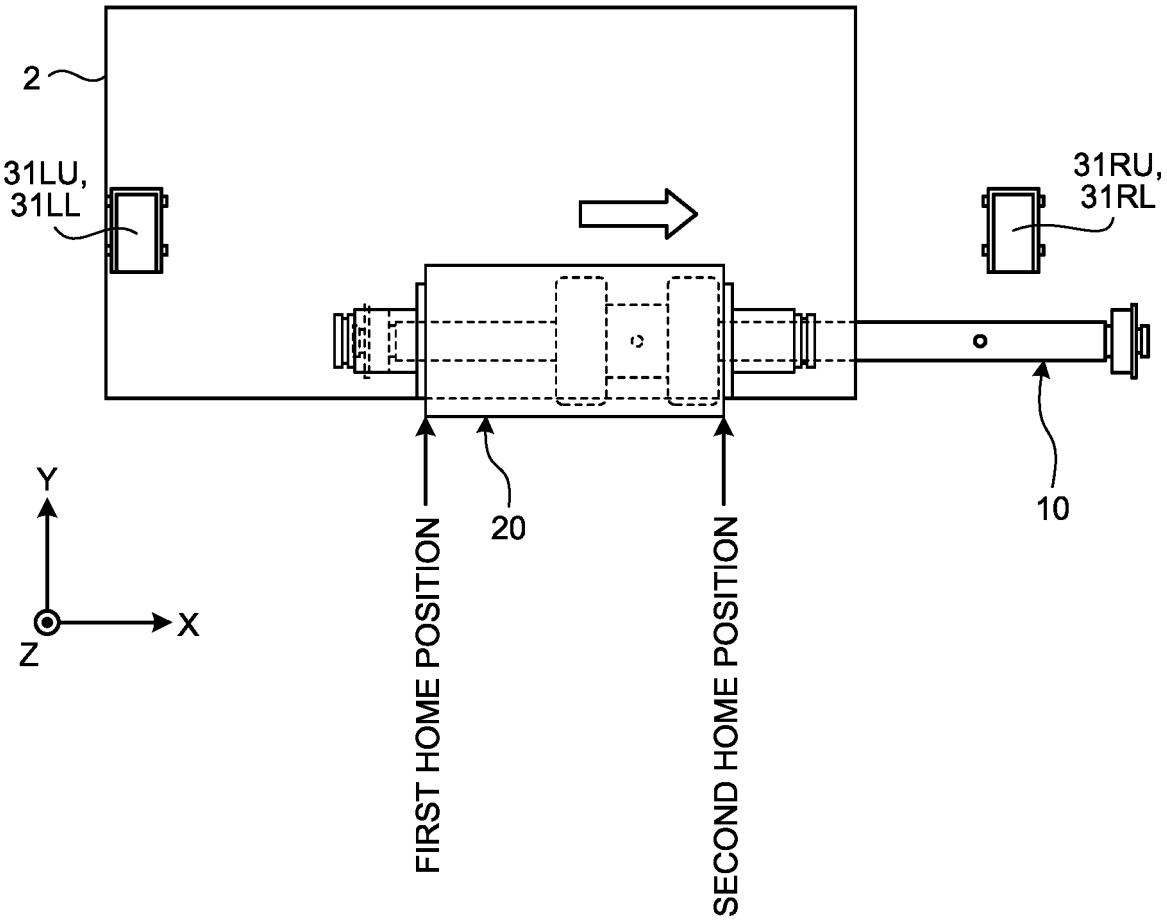

2
31LU,
31LL
31RU,
31RL
Y
X
Z
FIRST HOME POSITION
20
SECOND HOME POSITION
10

FIG.7

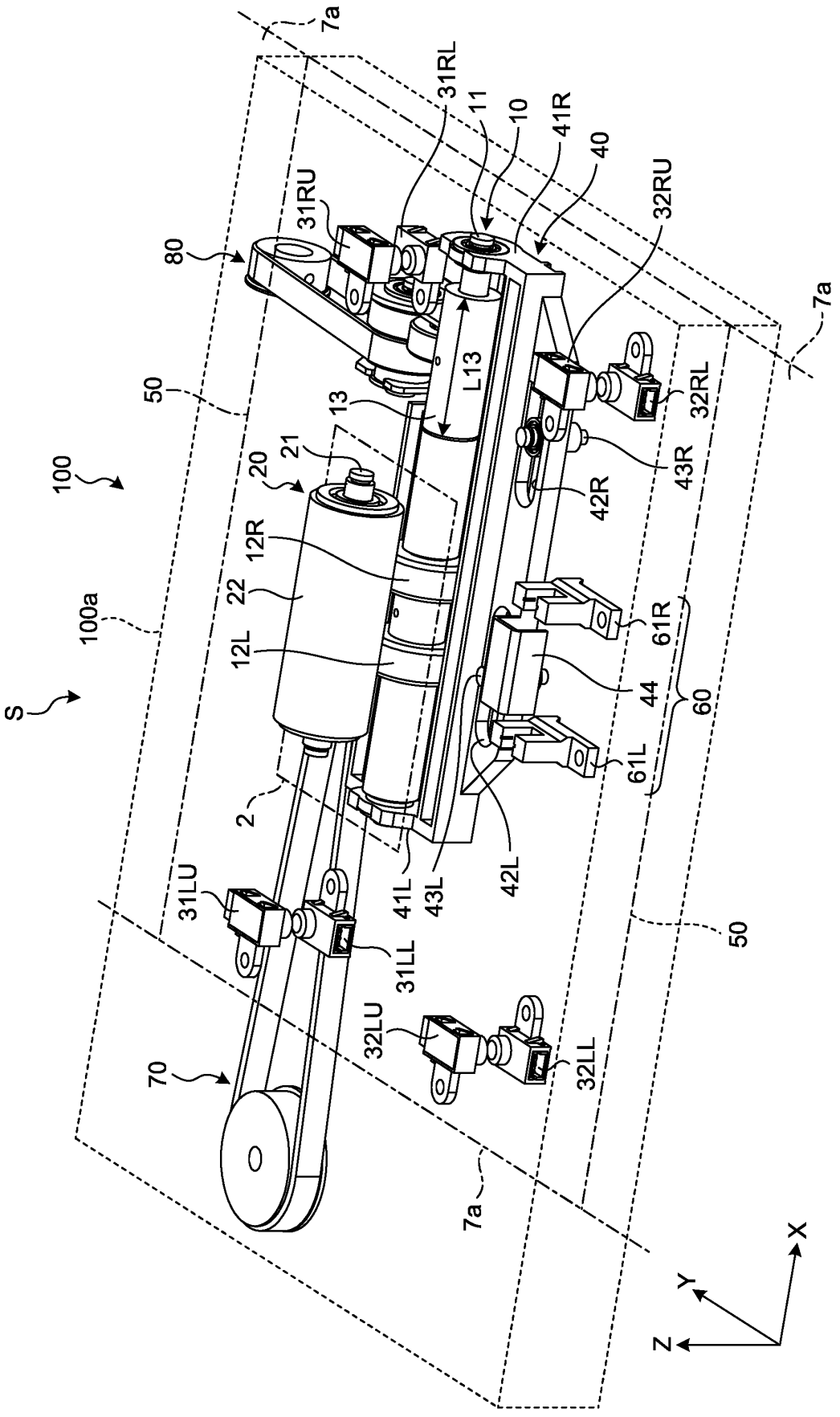

7a
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10
41R
40
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80
50
13
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20
43R
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12R
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100a
61R
12L
44
60
S
61L
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31LL
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32LU
32LL
70
7a
X
Y
Z

FIG.8

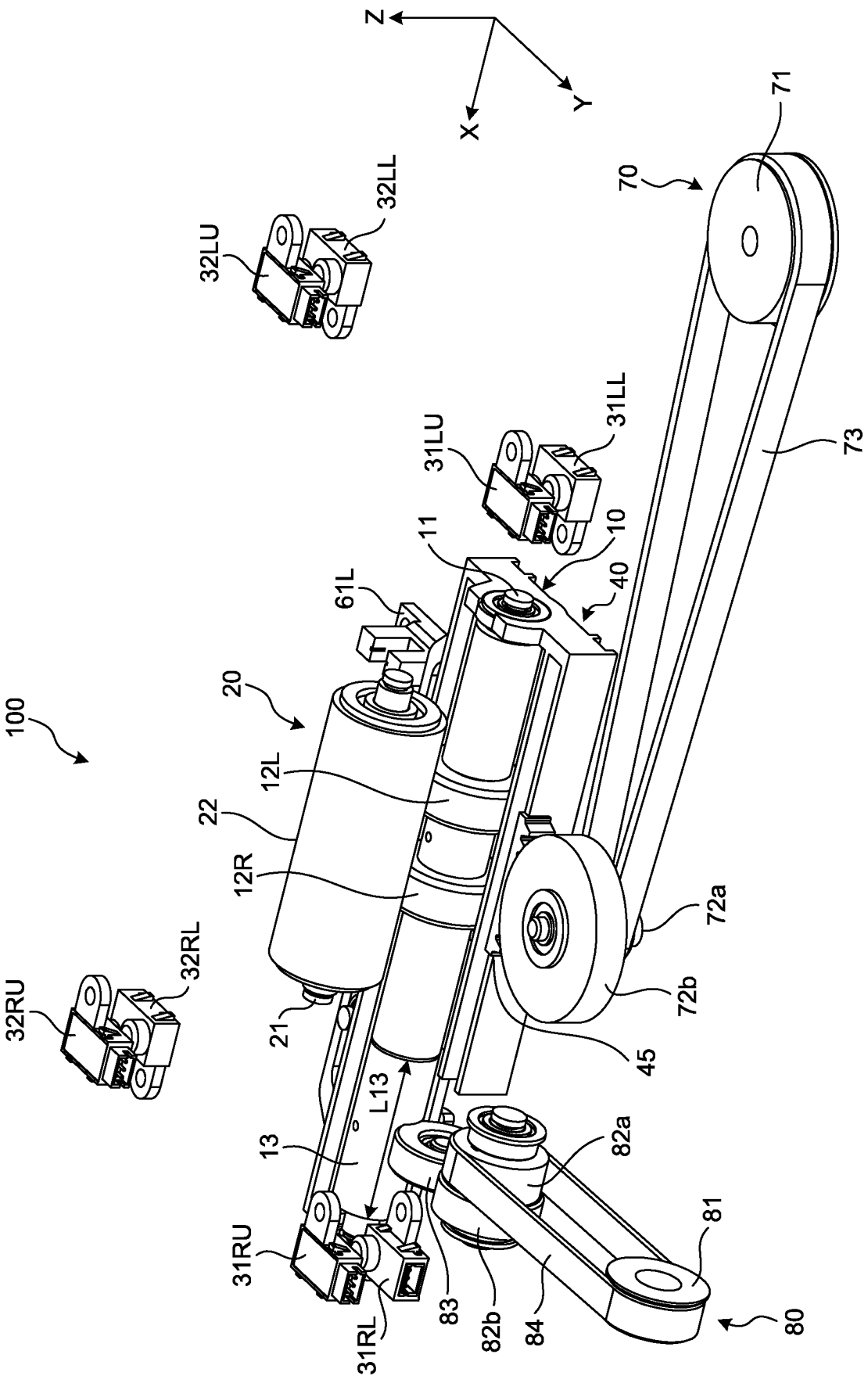

Z
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X
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20
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22
12R
21
13
L13
61L
11
10
40
31LU
31LL
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73
72a
72b
45

FIG.9

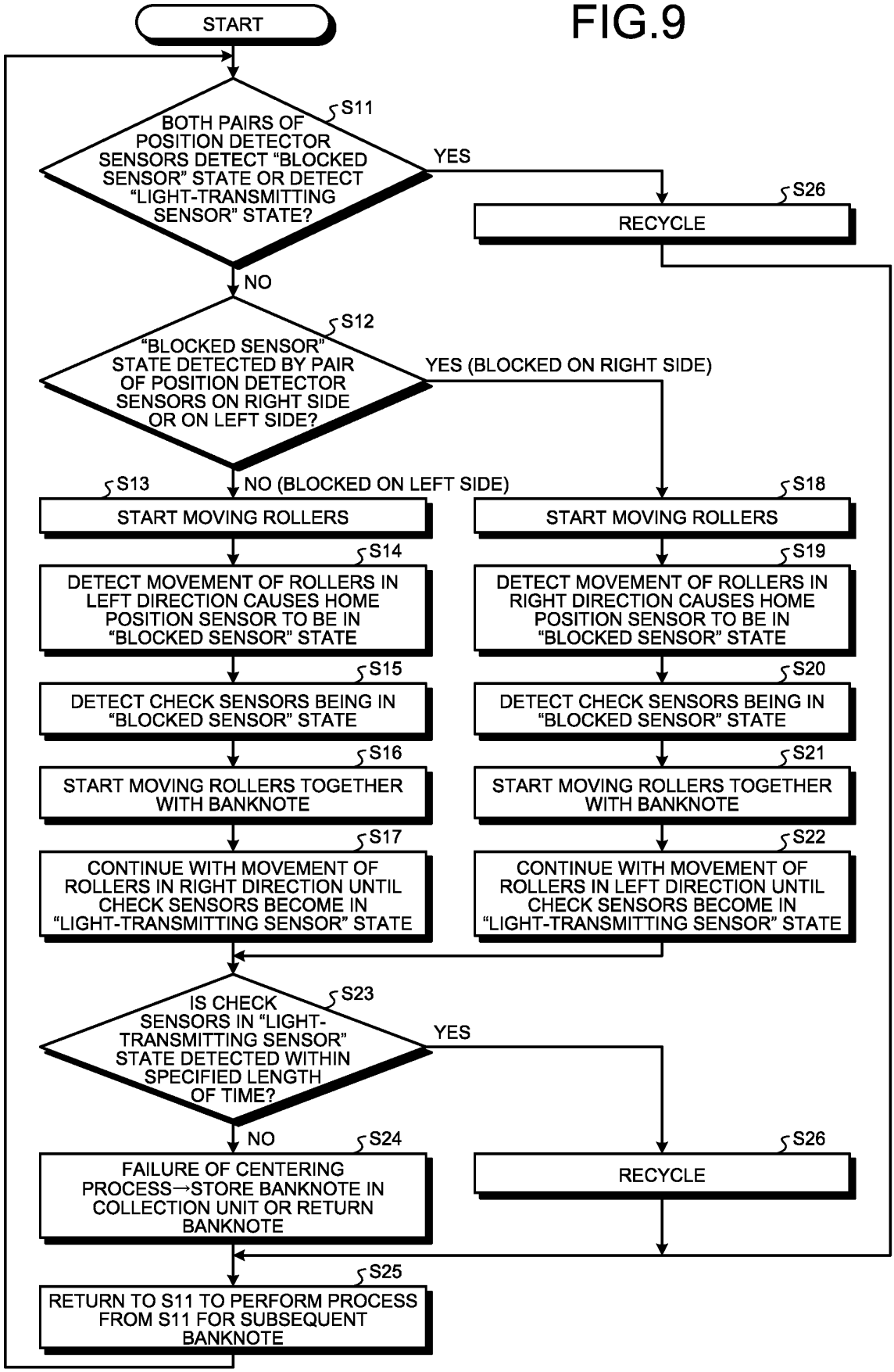

START
S11
BOTH PAIRS OF POSITION DETECTOR SENSORS DETECT "BLOCKED SENSOR" STATE OR DETECT "LIGHT-TRANSMITTING SENSOR" STATE?
YES
S26
RECYCLE
NO
S12
"BLOCKED SENSOR" STATE DETECTED BY PAIR OF POSITION DETECTOR SENSORS ON RIGHT SIDE OR ON LEFT SIDE?
YES (BLOCKED ON RIGHT SIDE)
NO (BLOCKED ON LEFT SIDE)
S13
START MOVING ROLLERS
S14
DETECT MOVEMENT OF ROLLERS IN LEFT DIRECTION CAUSES HOME POSITION SENSOR TO BE IN "BLOCKED SENSOR" STATE
S15
DETECT CHECK SENSORS BEING IN "BLOCKED SENSOR" STATE
S16
START MOVING ROLLERS TOGETHER WITH BANKNOTE
S17
CONTINUE WITH MOVEMENT OF ROLLERS IN RIGHT DIRECTION UNTIL CHECK SENSORS BECOME IN "LIGHT-TRANSMITTING SENSOR" STATE
S18
START MOVING ROLLERS
S19
DETECT MOVEMENT OF ROLLERS IN RIGHT DIRECTION CAUSES HOME POSITION SENSOR TO BE IN "BLOCKED SENSOR" STATE
S20
DETECT CHECK SENSORS BEING IN "BLOCKED SENSOR" STATE
S21
START MOVING ROLLERS TOGETHER WITH BANKNOTE
S22
CONTINUE WITH MOVEMENT OF ROLLERS IN LEFT DIRECTION UNTIL CHECK SENSORS BECOME IN "LIGHT-TRANSMITTING SENSOR" STATE
S23
IS CHECK SENSORS IN "LIGHT-TRANSMITTING SENSOR" STATE DETECTED WITHIN SPECIFIED LENGTH OF TIME?
YES
NO
S24
FAILURE OF CENTERING PROCESS→STORE BANKNOTE IN COLLECTION UNIT OR RETURN BANKNOTE
S26
RECYCLE
S25
RETURN TO S11 TO PERFORM PROCESS FROM S11 FOR SUBSEQUENT BANKNOTE

FIG.10

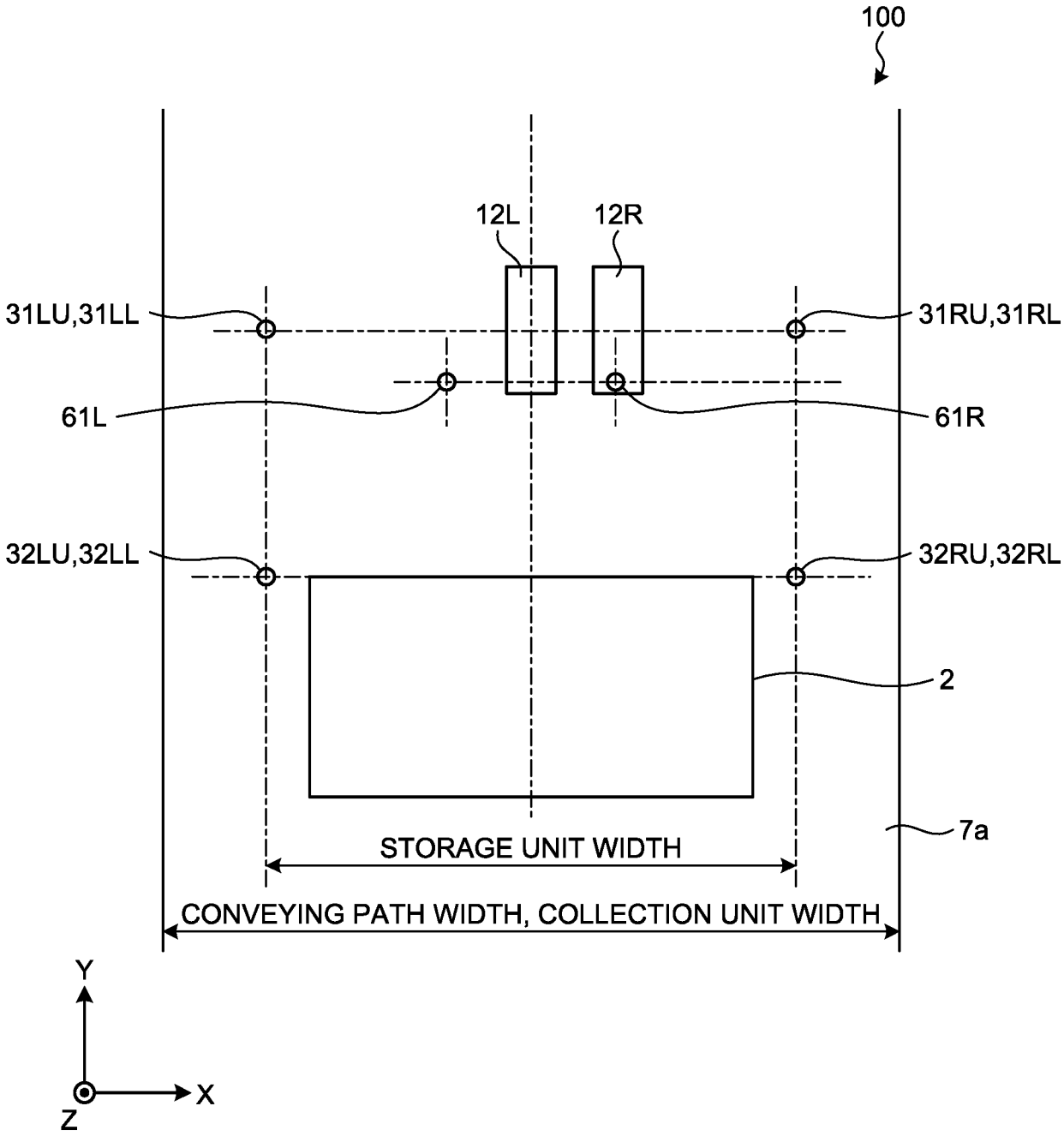

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12R
31LU,31LL
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61L
61R
32LU,32LL
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2
7a
STORAGE UNIT WIDTH
CONVEYING PATH WIDTH, COLLECTION UNIT WIDTH
Y
X
Z

FIG.11

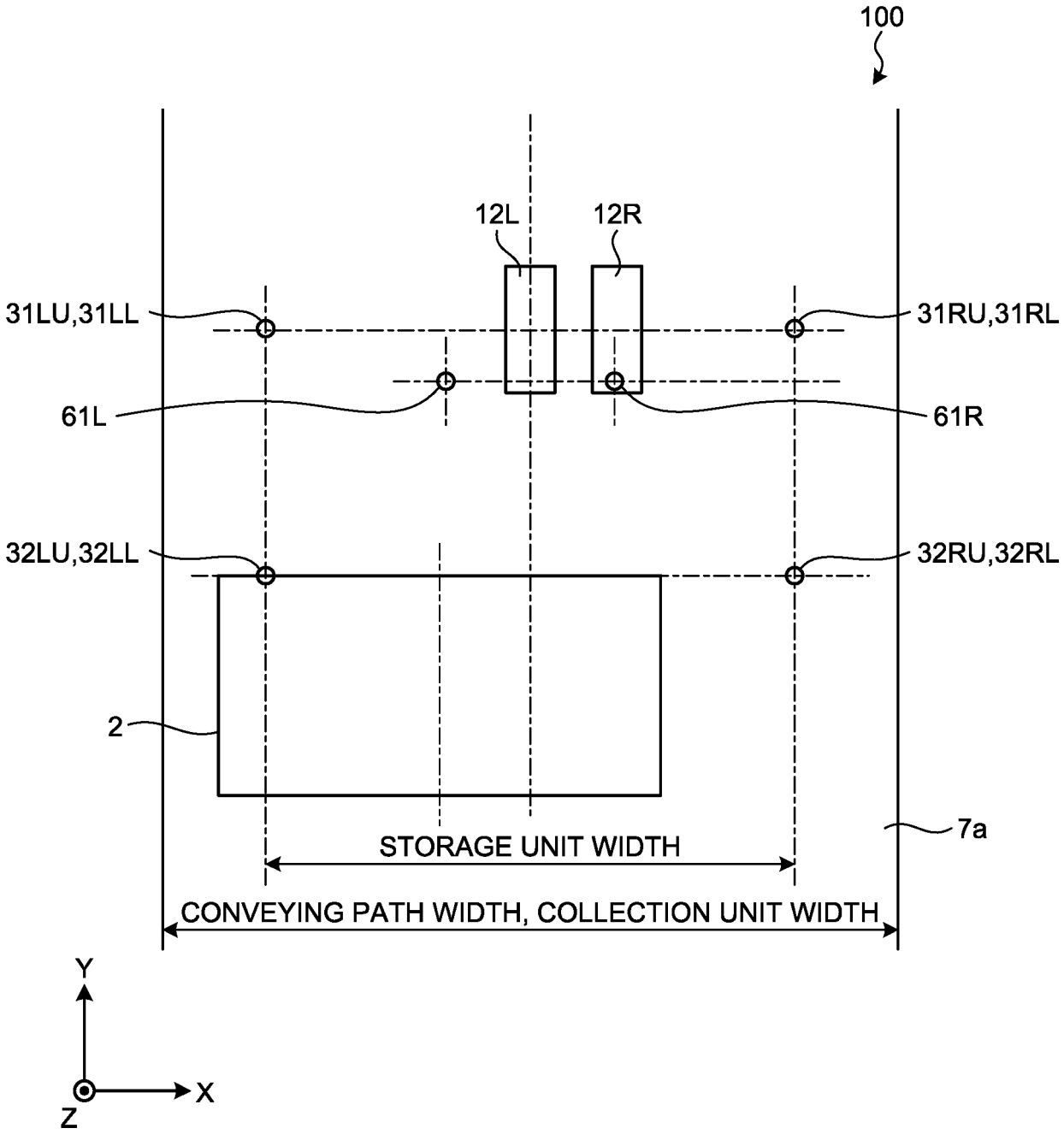

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12R
31LU,31LL
31RU,31RL
61L
61R
32LU,32LL
32RU,32RL
2
7a
STORAGE UNIT WIDTH
CONVEYING PATH WIDTH, COLLECTION UNIT WIDTH
Y
X
Z

FIG.12

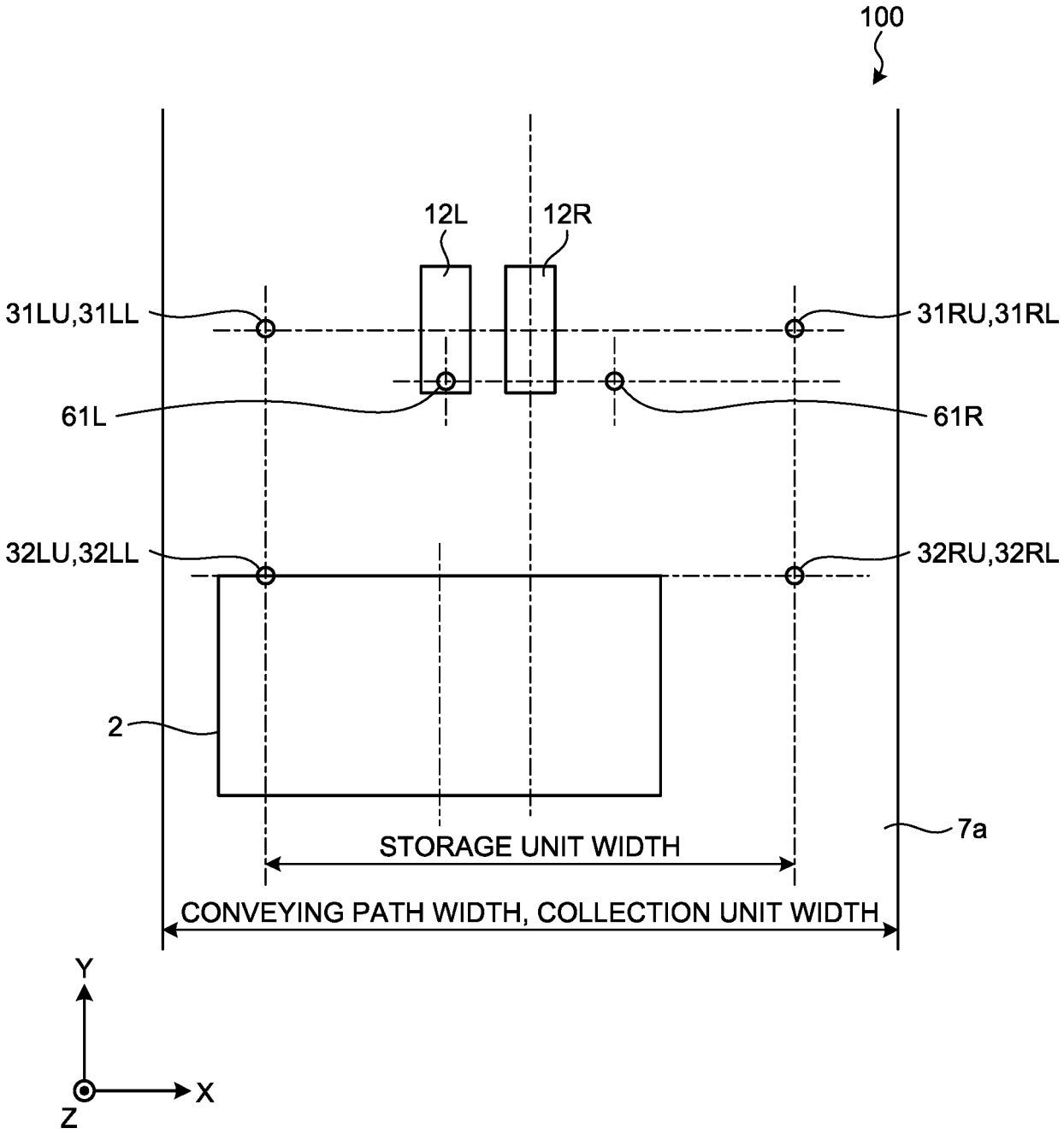

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61L
61R
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2
7a
STORAGE UNIT WIDTH
CONVEYING PATH WIDTH, COLLECTION UNIT WIDTH
Y
X
Z

FIG.13

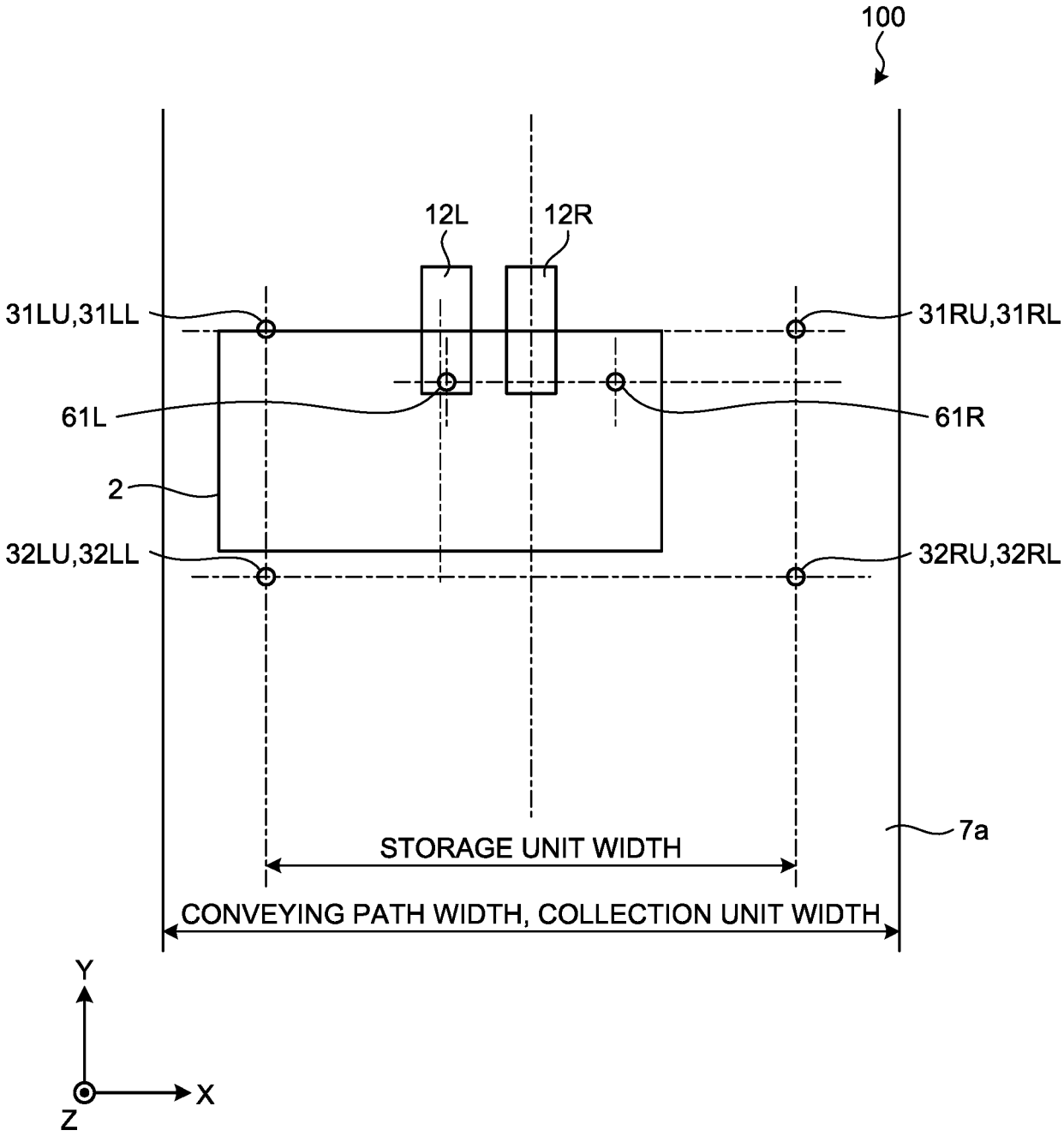

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61R
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32LU,32LL
32RU,32RL
7a
STORAGE UNIT WIDTH
CONVEYING PATH WIDTH, COLLECTION UNIT WIDTH
Y
X
Z

FIG.14

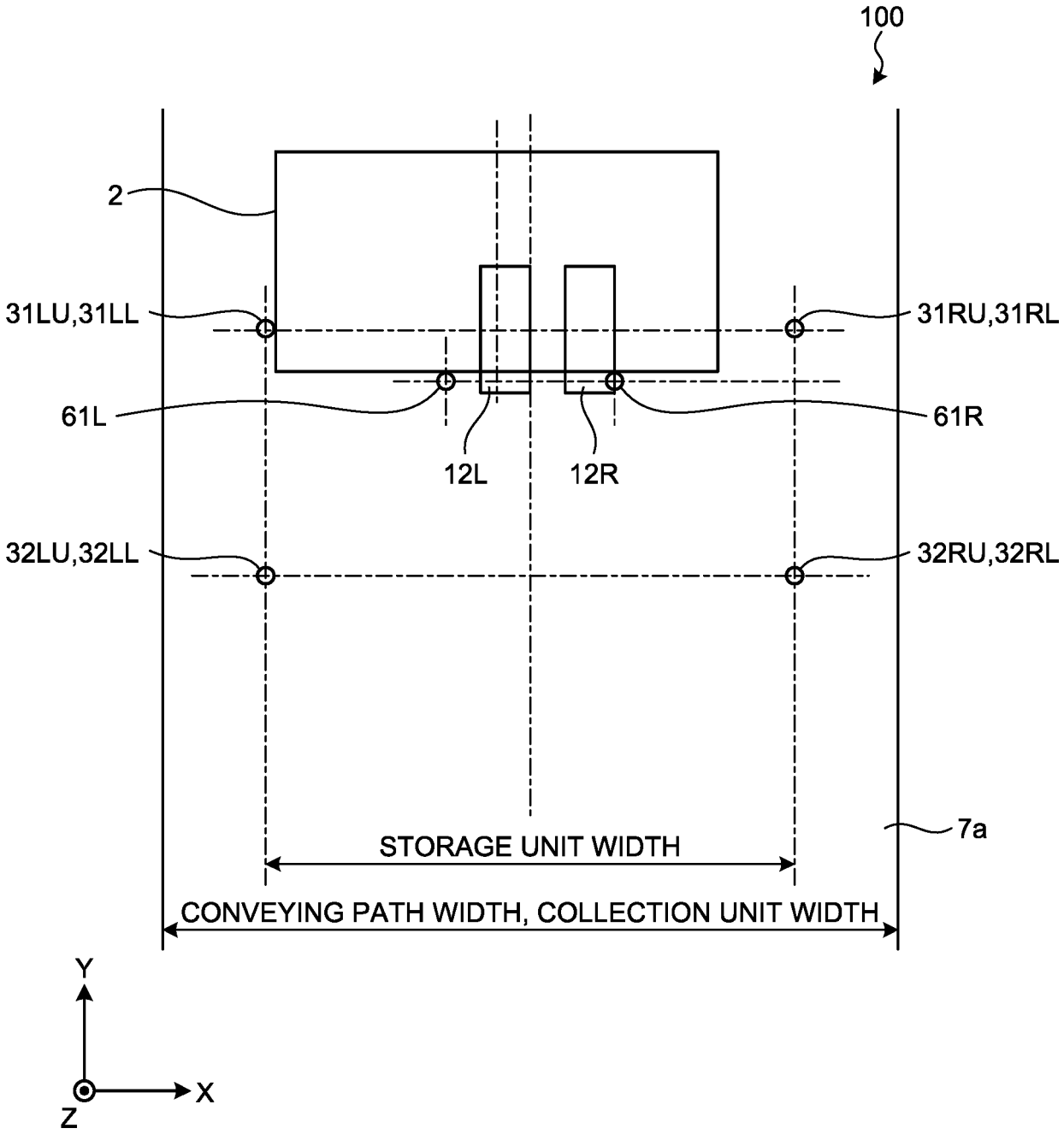

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7a
STORAGE UNIT WIDTH
CONVEYING PATH WIDTH, COLLECTION UNIT WIDTH
Y
X
Z

FIG.15

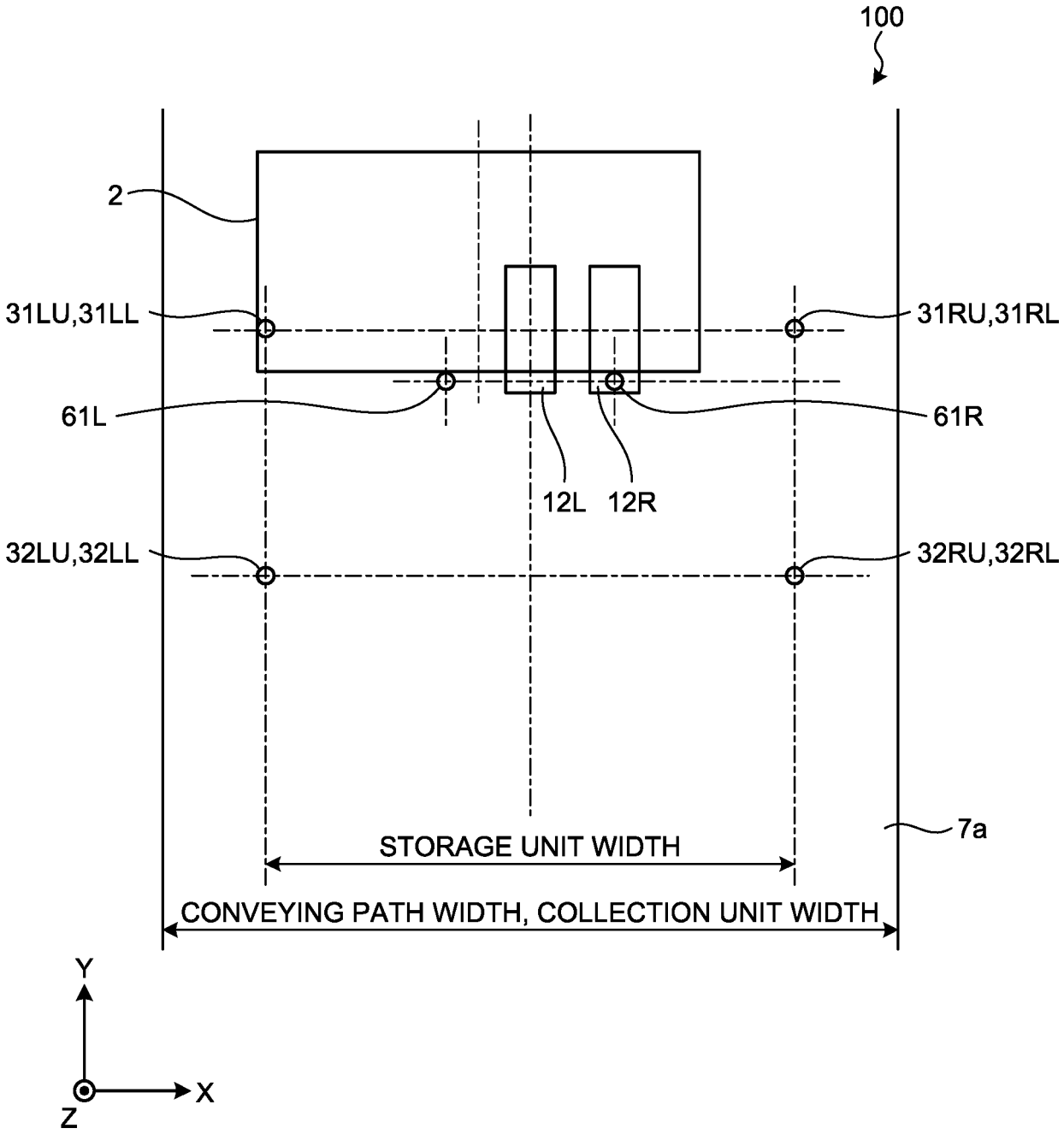

100
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61L
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12L
12R
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7a
STORAGE UNIT WIDTH
CONVEYING PATH WIDTH, COLLECTION UNIT WIDTH
Y
X
Z

FIG.16

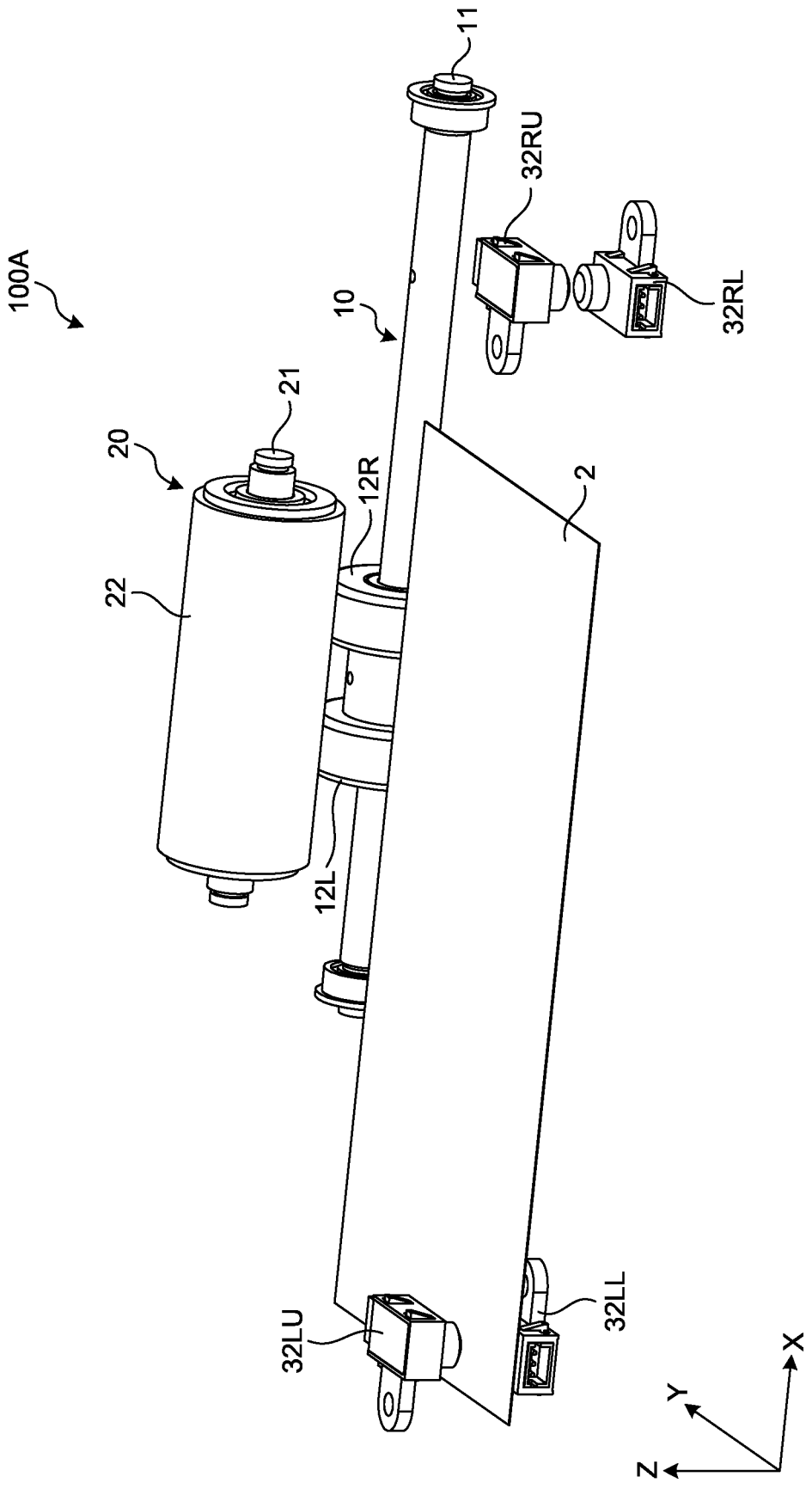
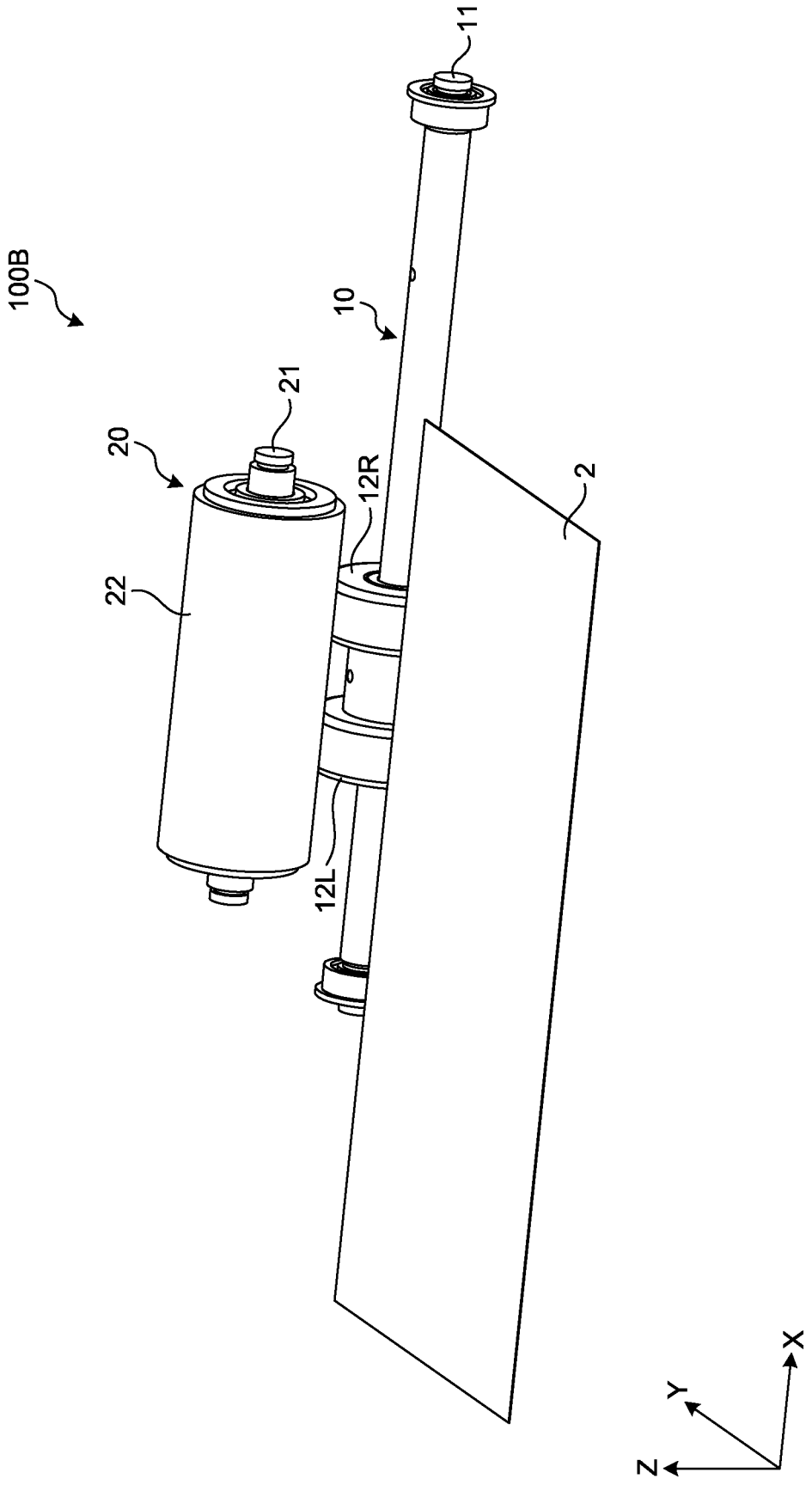


FIG.17



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/026562

A. CLASSIFICATION OF SUBJECT MATTER
B65H9/00(2006.01)i, *B65H5/06*(2006.01)i, *B65H7/10*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H9/00, B65H5/06, B65H7/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
B65H9/00, B65H5/06, B65H7/10

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2016-023062 A (Konica Minolta, Inc.), 08 February 2016 (08.02.2016), paragraphs [0072] to [0082], [0115]; fig. 5 & US 2016/0023858 A1 paragraphs [0096] to [0106], [0142]; fig. 5	1,3,4,8 2,5-7
X Y	JP 2014-114100 A (Ricoh Co., Ltd.), 26 June 2014 (26.06.2014), paragraphs [0002] to [0005] (Family: none)	1,8 2-7
Y	JP 2016-172619 A (Glory Ltd.), 29 September 2016 (29.09.2016), paragraphs [0054] to [0070]; fig. 6 to 8 & WO 2016/147838 A1	1-8

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 September 2017 (22.09.17)	03 October 2017 (03.10.17)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/026562

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2008-074620 A (Ricoh Co., Ltd.), 03 April 2008 (03.04.2008), paragraphs [0024] to [0026]; fig. 2 & US 2008/0054553 A1 paragraphs [0047] to [0052]; fig. 2A to 2C & EP 1892582 A1	6

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Patent documents cited in the description

- JP 2016172619 A **[0005]**