(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 089 654 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
16.11.2022 Bulletin 2022/46

(21) Application number: **20912567.3**

(22) Date of filing: **06.01.2020**

(51) International Patent Classification (IPC):
G07D 11/12 *(2019.01)* ***B65H 1/14*** *(2006.01)*
B65H 31/18 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B65H 1/14; B65H 31/18; G07D 11/12

(86) International application number:
PCT/JP2020/000090

(87) International publication number:
WO 2021/140549 (15.07.2021 Gazette 2021/28)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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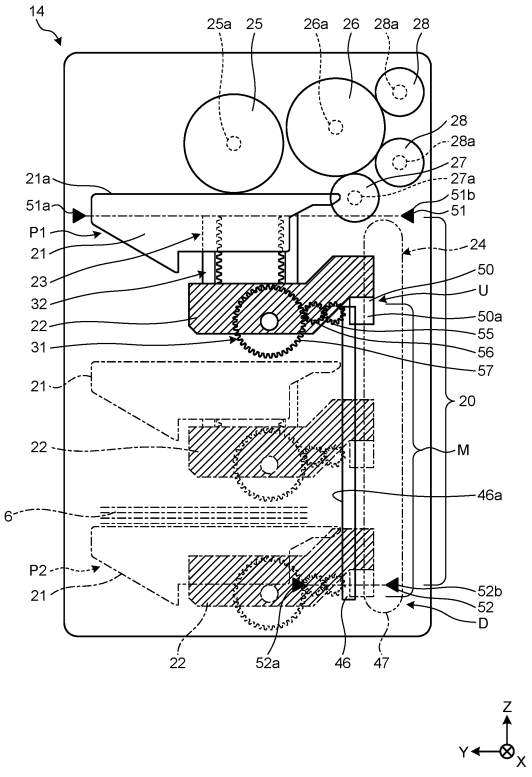
(54) **PAPER SHEET STORAGE DEVICE**

(57) A paper sheet storage device (14) includes a storage space (20) in which paper sheets (6) are stored; a placement table (21) that is provided in the storage space (20) and on which the paper sheets (6) are accumulated and placed; a support base (22) that supports the placement table (21); a first up-down mechanism (23) that causes the placement table (21) to rise and lower to an up position (P1) and a down position (P2) with respect to the support base (22); and a second up-down mechanism (24) that causes the support base (22) to rise and lower in the storage space (20). The first up-down mechanism (23) includes a rack unit (32) that is provided on the placement table (21) and a pinion unit that causes the rack unit (32) to move.

FIG.2



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Description

Technical Field

[0001] The present invention relates to a paper sheet storage device.

Background

[0002] A banknote handling apparatus, such as an automated teller machine (ATM), includes a banknote storage device that stores banknotes that are put in. As this type of banknote storage device, one whose placement table, on which banknotes are accumulated and placed, is raised and lowered by an up-down mechanism in a storage space, in which banknotes are stored, is known.

[0003] In the banknote storage device, the placement table gradually lowers as banknotes are stored in the storage space and, when the placement table moves to a bottom surface that is a lower end of the storage space, the banknotes, which are stored in the storage space, are full. A pickup roller, a carrying roller, and a separation roller, etc., for taking or putting banknotes out of or into the storage space are provided.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Laid-open Patent Publication No. 2012-53637

Summary of Invention

Technical Problem

[0005] In the above-described banknote storage device, in order to increase the amount of banknotes that can be stored in the storage space, it is considered to form the placement table in a small thickness occupying in a direction in which banknotes are stored in the storage space, that is, a direction in which the placement table rises or lowers. In the case where the thickness of the placement table is reduced, the level of a placement surface of the placement table lowers in association with the reduction of the thickness of the placement table and therefore, when the placement table is moved by the up-down mechanism to the top position, it is unable to cause the pickup roller, which sends the banknotes on the placement table, to make contact with the banknotes on the placemen surface. In the case where the level (the top position), to which the placement table can be caused to rise by the up-down mechanism, is extended upward in order to cause the pickup roller to make contact with the banknotes on the placement surface, the up-down mechanism collides with the carrying roller. In the case where the position of the up-down mechanism is changed in order to avoid interference between the up-down mechanism and the carrying roller, etc., there is a problem that the space, occupied by the up-down mechanism around the placement table, increases and therefore an increase in the whole size of the device is caused.

[0006] The disclosed technique was made in view of the above-described circumstances, and an object of the technique is to provide a leaf storage device that enables an increase in the amount of paper sheets to be stored without increasing the whole size of the paper sheet storage device.

Solution to Problem

[0007] One aspect of a paper sheet storage device disclosed in the present application includes: a storage space in which paper sheets are stored; a placement table that is provided in the storage space and on which the paper sheets are accumulated and placed; a support base that supports the placement table; a first up-down mechanism that causes the placement table to rise and lower to an up position and a down position with respect to the support base; and a second up-down mechanism that causes the support base to rise and lower in the storage space, wherein the first up-down mechanism includes a rack unit that is provided on the placement table and a pinion unit that causes the rack unit to move.

Advantageous Effects of Invention

[0008] According to a mode of a paper sheet storage device disclosed by the present application, it is possible to increase the amount of paper sheets to be stored without increasing the whole size of the paper sheet storage device.

Brief Description of Drawings

[0009]

FIG. 1 is a schematic diagram illustrating a banknote handling apparatus according to an embodiment.

FIG. 2 is a schematic diagram illustrating a banknote storage device according to the embodiment.

FIG. 3 is a perspective view illustrating a state in which a first up-down mechanism of the banknote storage device according to the embodiment causes a stage to rise to an up position.

FIG. 4 is a perspective view illustrating a state in which the first up-down mechanism of the banknote storage device according to the embodiment causes the stage to lower to a down position.

FIG. 5 is a plane view illustrating a support base and the first up-down mechanism that are arranged in an area of projection of the stage in the banknote storage device of the embodiment.

FIG. 6 is a plane view for describing the first up-down mechanism of the banknote storage device of the embodiment.

FIG. 7 is a cross-sectional view for describing the first up-down mechanism of the banknote storage device of the embodiment.

FIG. 8 is a cross-sectional view of a main part for describing an operation in which the first up-down mechanism of the embodiment causes the stage to rise from the down position.

FIG. 9 is a cross-sectional view of the main part for describing an operation in which the first up-down mechanism of the embodiment causes the stage to lower from the up position.

FIG. 10 is a schematic diagram for describing a banknote storage device of a reference example. Embodiments for Carrying out the Invention

[0010] An embodiment of a paper sheet storage device, disclosed by the present application, will be described in detail below with reference to the drawings. Note that the following embodiment does not limit the paper sheet storage device disclosed by the present application.

Embodiment

Configuration of Banknote Handling apparatus

[0011] FIG. 1 is a schematic diagram illustrating a banknote handling apparatus according to an embodiment. As illustrated in FIG. 1, a banknote handling apparatus 1 of the embodiment includes an in/out unit 11 via which banknotes 6 are put in and taken out; a discrimination unit 12, which discriminates the banknotes 6 that are conveyed from the in/out unit 11; a plurality of temporarily holding units 13, which temporarily store the banknotes 6 that are conveyed from the discrimination unit 12; and a plurality of storage units 14, which store the banknotes 6 that are conveyed from each of the temporarily holding units 13.

[0012] The banknote handling apparatus 1 further includes a conveying mechanism 15, which conveys the banknotes 3 along a conveying path 15a among the units 11, 12, 13 and 14; and a controller 16, which controls each of the units 11, 12, 13 and 14. Although not illustrated in the drawing, the conveying mechanism 15 includes a conveying belt and a plurality of rollers that form the conveying path 15a along which the banknotes 6 are conveyed, and the conveying belt and the rollers are arranged such that the conveying belt and the rollers connect the in/out unit 11, the discrimination unit 12, each of the temporarily holding units 13, and each of the storage units 14. The conveying mechanism 15 is configured to be capable of bidirectional conveying in which the banknote 6 are carried in and out of each of the storage units 14. The controller 16 is electrically connected to each of the discrimination unit 12, each of the temporarily holding units 13, each of the storage units 14, and the conveying mechanism 15.

[0013] As illustrated in FIG. 1, the storage unit 14 that is installed in the banknote handling apparatus 1 corresponds to a banknote storage device of the embodiment. The storage unit 14 will be put into the banknote storage device 14 and will be described below. For convenience of description, a width direction of the banknote handling apparatus 1 viewed from the side of the in/out unit 11 in FIG. 1, is referred to as an X-direction, a front-back direction of the banknote handling apparatus 1, is referred to as a Y-direction, and an top-bottom direction of the banknote handling apparatus 1, is referred to as a Z-direction. As in FIG. 1, each of the X, Y and Z directions is presented in the drawings after FIG. 1, too. In the present embodiment, the banknotes 6 are used as an example of paper sheets, paper sheets are not limited to the banknotes 6. Paper sheets include securities, such as a promissory note, a check, a coupon, various instruments, and a share.

Configuration of Banknote Storage Device

[0014] FIG. 2 is a schematic diagram illustrating the banknote storage device 14 of the embodiment. FIG. 3 is a perspective view illustrating a state in which a first up-down mechanism of the banknote storage device according to the embodiment causes a stage to rise to an up position. FIG. 4 is a perspective view illustrating a state in which the first up-down mechanism of the banknote storage device according to the embodiment causes the stage to lower to a down position.

[0015] As illustrated in FIG. 2 and FIG. 3, the banknote storage device 14 includes a storage space 20 in which the banknotes 6 are stored, and a stage 21 that is provided in the storage space 20 and that serves as a placement table on which the banknotes 6 are accumulated and placed. The banknote storage device 14 further includes a support base 22 that supports the stage 21, a first up-down mechanism 23 that causes the stage 21 to rise and lower with respect to the support base 22 to an up position P1 and a down position P2 in the Z-direction; a second up-down mechanism 24 that causes the support base 22 to rise and lower in the Z-direction in the storage space 20; and a drive force transmission mechanism 31 that transmits a drive force to the first up-down mechanism in association with an up-down operation of the second up-down mechanism 24 on the support base 22.

[0016] The stage 21 has a placement surface 21a on which the banknotes 3 are placed and which moves parallelly to the up position P1 and the down position P2 with the placement surface 21a being in a horizontal posture parallel to an X-Y plane. As illustrated in FIG. 4, when the stage 21 lowers to the down position P2, the stage 21 is mounted on the support base 22. The placement surface 21a of the stage 21 moves in the horizontal posture in the top-bottom direction (the Z-direction) between an upper end and a lower end in the storage space 20. On the placement surface 21a of the stage 21, as illustrated in FIG. 3, the banknotes 6 are placed with their

long side being oriented along the X-direction. The stage 21 is provided with a rack unit 32 that the first up-down mechanism 23 includes and that is described below.

[0017] As illustrated in FIG. 2, a conveying roller group including a pickup roller 25, a carrying roller (feed roller) 26, a separation roller 27, an acceleration roller 28, etc., is provided above the storage space 20. Using the conveying roller group, the banknote storage device 14 carries the banknote 6 into the storage space 20 and carries the banknote 6 out of the storage space 20. Details of the conveying roller group will be described below.

[0018] As for the posture of the banknote storage device 14, the X and Y directions are not limited to the horizontal direction, and the Z direction is not limited to the top-bottom direction. In the embodiment, the side, on which the banknote 6 is taken or put out of or in the storage space 20, is referred to as a front side of the banknote storage device 14, and the opposite side to the front side, is referred to as a back side of the banknote storage device 14.

Area of Projection of Stage

[0019] FIG. 5 is a plane view illustrating the support base 22 and the first up-down mechanism 23 that are arranged in an area S of projection of the stage 21 in the banknote storage device 14 of the embodiment. FIG. 5 presents a plane orthogonal to the up-down direction (the Z-direction) in which the second up-down mechanism 24 causes the support base 22 to rise and lower.

[0020] As illustrated in FIG. 5, the support base 22 and the first up-down mechanism 23 are arranged in an area S of projection, obtained by projecting the stage 21 on the X-Y plane orthogonal to the up-down direction (the Z-direction) in which the second up-down mechanism 24 causes the support base 22 to rise and lower. Accordingly, the outer size of the support base 22 is formed smaller than the outer size of the stage 21 and is formed in a size within the area S of projection of the stage 21.

[0021] As described above, when the stage 21, on which the banknotes 6 are placed, lowers along the Z-direction between the upper end and the lower end of the storage space 20, because the support base 22 and the first up-down mechanism 23 are arranged in the area S of projection of the stage 21, it is possible to avoid an increase in the size of the banknote storage device 14 because of the support base 22 and the first up-down mechanism 23.

Configuration of First Up-down Mechanism

[0022] FIG. 6 is a plane view for describing the first up-down mechanism 23 of the banknote storage device 14 of the embodiment. FIG. 7 is a cross-sectional view for describing the first up-down mechanism 23 of the banknote storage device 14 of the embodiment. FIG. 7 is a cross section taken along the A-A line in FIG. 6.

[0023] As illustrated in FIG. 6 and FIG. 7, the first up-down mechanism 23 is arranged on each of both sides of the stage 21 in the X-direction. Each of the first up-down mechanism 23 includes a rack unit 32, with which the stage 21 is provided, and a pinion unit 33 that causes the rack unit 32 to move.

[0024] The rack unit 32 includes a first rack 32a and a second rack 32b in a pair that are provided oppositely with the pinion unit 33 being interposed in between. The first rack 32a and the second rack 32b are provided under the stage 21 such that the first rack 32a and the second rack 32b are extended along the Z-direction in which the stage 21 rises and lowers. As illustrated in FIG. 7, the rack unit 32 is arranged movably in an opening 22a of the support base 22 in the Z-direction with respect to the support base 22.

[0025] The pinion unit 33 includes a first pinion 33a and a second pinion 33b in a pair that are engaged with the first rack 32a and the second rack 32b in a pair, respectively. The first pinion 33a and the second pinion 33b in a pair are provided in an engaged manner and rotate in synchronization with each other. The first pinion 33a and the second pinion 33b are rotatably supported respectively on support shafts 33c with which the support base 22 is provided. The first pinion 33a is engaged with a drive gear 58 that the drive force transmission mechanism 31 includes and that will be described below, and a drive force is transmitted by the drive gear 58 to the first pinion 33a. As described above, the first up-down mechanism 23 includes the first rack 32a and the second rack 32b in a pair, and the first pinion 33a and the second pinion 33b in a pair that are engaged with each other, and thus the up-down operation on the stage 21 is stabilized, and reliability of the up-down operation is increased, and the first up-down mechanism 23 is configured compactly.

[0026] The drive force associated with the up-down operation of the second up-down mechanism 24 is transmitted to the first up-down mechanism 23 via the drive force transmission mechanism 31 to be described below, and therefore the first up-down mechanism 23 causes the stage 21 to rise and lower with respect to the support base 22 simultaneously with the up-down operation in which the second up-down mechanism 24 causes the support base 22 to rise and lower. In other words, in the banknote storage device 14, the second up-down mechanism 24 causes the support base 22 to rise and lower in the Z-direction at a constant up-down speed while the first up-down mechanism 23 causes the stage 21 to rise and lower in the Z-direction at a constant up-down speed.

[0027] As described above, the first up-down mechanism 23 and the second up-down mechanism 24 operate simultaneously, which makes it possible to stabilize the up-down operation on the stage 21 in the storage space 20. For example, after lowering of the support base 22 caused by the second up-down mechanism 24 completes, compared to the case where the first up-down mechanism 23 and the second up-down mechanism 24 operate independently such that lowering of the stage 21

caused by the first up-down mechanism 23 starts, the up-down operation on the stage 21 is stabilized, the banknotes 6 are accumulated on the stage 21, and reliability of a carrying operation is increased.

[0028] Furthermore, the first up-down mechanism 23 is configured to cause the stage 21 to move from the up position P1 to the down position P2 before the support base 22, which is lowered by the second up-down mechanism 24, reaches the lower end D of the up-down area M. In other words, the down operation on the stage 21 with respect to the support base 22 completes before the support base 22 reaches the lower end D of the up-down area M, and the up-down operation on the stage 21 in the storage space 20 is stabilized, and reliability of the up-down operation is increased.

[0029] In other words, in the first up-down mechanism 23, when the support base 22 reaches the upper end U of the up-down area M, rising of the stage 21 with respect to the support base 22 completes. Thus, when the support base 22 starts lowering from the upper end U of the up-down area M, the stage 21 simultaneously starts lowering with respect to the support base 22 from the up position P1 and, after the stage 21 lowers to the down position P2, the support base 22 reaches the lower and D of the up-down area M.

[0030] As described above, in the first up-down mechanism 23, because lowering of the stage 21 completes before the support base 22 reaches the lower end D of the up-down area M, transmission of the drive force by the drive force transmission mechanism 31 continues in association with lowering of the support base 22. For this reason, in the drive force transmission mechanism 31, using a torque limiter 59 to be described below blocks transmission of the drive force, which is transmitted by the drive force transmission mechanism 31 in association with lowering of the support base 22, to the first pinion 33a of the pinion unit 33. For this reason, in the structure in which the support base 22 continues lowering after the stage 21 moves to the down position P2, the rack unit 32 and the pinion unit 33 of the first up-down mechanism 23 are prevented from being damaged.

Up-down Operation of First Up-down Mechanism

[0031] FIG. 8 is a cross-sectional view of a main part for describing the operation in which the first up-down mechanism 23 of the embodiment causes the stage 21 to rise from the down position P2. FIG. 9 is a cross-sectional view of the main part for describing the operation in which the first up-down mechanism 23 of the embodiment causes the stage 21 to lower from the up position P1.

[0032] As illustrated in FIG. 8, in the first up-down mechanism 23, the first pinion 33a is rotated counterclockwise by the drive gear 58 of the drive force transmission mechanism 31, thereby causing the first rack 32a to rise. At that time, the first pinion 33a is rotated counterclockwise and accordingly the second pinion 33b is rotated clockwise in synchronization with the first pinion 33a, so that the second rack 32b is caused to rise. As described above, in the first up-down mechanism 23, the first pinion 33a and the second pinion 33b that rotate in synchronization with each other cause the first rack 32a and the second rack 32b to rise, thereby causing the rack unit 32 to rise with respect to the support base 22 and causing the stage 21 to rise from the down position P2.

[0033] As illustrated in FIG. 9, in the first up-down mechanism 23, the first pinion 33a is rotated clockwise by the drive gear 58 of the drive force transmission mechanism 31, thereby causing the first rack 32a to lower. At that time, the first pinion 33a is rotated clockwise and accordingly the second pinion 33b is rotated counterclockwise in synchronization with the first pinion 33a, so that the second rack 32b is caused to lower. As described above, in the first up-down mechanism 23, the first pinion 33a and the second pinion 33b that rotate in synchronization with each other cause the first rack 32a and the second rack 32b to lower, thereby causing the rack unit 32 to lower with respect to the support base 22 and causing the stage 21 to lower from the up position P1.

Configuration of Second Up-down Mechanism

[0034] As illustrated in FIG. 2, the second up-down mechanism 24 includes up-down guide members 46 in a pair that guide the support base 22 movably along the up-down direction (the Z-direction), and a drive belt 47 that causes the support base 22 to move in the up-down direction (the Z-direction). The second up-down mechanism 24 further includes a pulley (not illustrated in the drawing) around which the drive belt 47 is put; a base support member 49 (refer to FIG. 6) that is connected to the support base 22; and a fixation member 50 that fixes the base support member 49 to the drive belt 47.

[0035] The up-down guide members 46 in a pair are arranged on both sides of the support base 22 in the X-direction. A rack 46a for driving the drive force transmission mechanism 31 is formed over the up-down area M (refer to FIG. 2) of the support base 22 along the Z-direction and also serves as a rack member for transmitting the drive force to the first up-down mechanism. The drive belt 47 is arranged along the Z-direction, and the stage 21 is connected to part of the drive belt 47 in a length direction via the fixation member 50 and the base support member 49. As illustrated in FIG. 2, a detection piece 50a, whose position is detected by a lower end sensor 52 to be described below, is formed in the fixation member 50. Driving the second up-down mechanism 24 is controlled by the controller 16 of the banknote handling apparatus 1 described above.

[0036] As illustrated in FIG. 2, the drive belt 47 of the second up-down mechanism 24 is arranged on the side of the carrying roller 26 with respect the support base 22 in the Y-direction, that is, the side on which the banknotes 6 are carried by the carrying roller 26 and the separation roller 27 from the stage 21. As described above, in the

banknote storage device 14, the drive belt 47 is arranged in a free space caused under the space for arranging the support structure of the conveying roller group, such as the carrying roller 26 and the separation roller 27, which makes it possible to arrange the second up-down mechanism 24 compactly and reduces the size of the banknote storage device 14.

[0037] As illustrated in FIG. 2, each of an upper end sensor 51 that detects an upper end of the banknotes 6 that are accumulated on the stage 21 and the lower end sensor 52 that detects that the stage 21 on which the banknotes 6 are accumulated lowers to the lower end of the storage space 20, is provided in the storage space 20 of the banknote storage device 14.

[0038] The upper end sensor 51 is arranged at the upper end of the storage space 20, and includes a light emitter 51a that emits detection light and a light receiver 51b that receives detection light that is emitted by the light emitter 51a. The lower end sensor 52 is arranged at the lower end of the storage space 20, and includes a light emitter 52a that emits detection light and a light receiver 52b that receives the detection light that is emitted by the light emitter 52a. The upper end sensor 51 and the lower end sensor 52 are electrically connected to the controller 16, and the controller 16 controls the second up-down mechanism 24 based on respective results of detection by the upper end sensor 51 and the lower end sensor 52.

[0039] In the upper end sensor 51, the detection light is blocked by the upper end of the banknotes 6 on the stage 21 (the banknote 6 positioned at the top), and thus the controller 16 detects that the banknotes 6, placed on the stage 21, reaches the upper end. When the upper end sensor 51 senses the banknote 6 on the stage 21, the controller 16 controls the second up-down mechanism 24 to cause the stage to lower by a given height. In the lower end sensor 52, the detection light is blocked by the detection piece 50a of the fixation member 50 that is connected to the stage 21, and thus the controller 16 detects that the stage 21 is lowered together with the support base 22 to the lower end of the storage space 20. When the lower end sensor 52 senses lowering of the stage 21, the controller 16 determines that the storage space 20 is full of the banknotes 6, and stops driving the second up-down mechanism 24 and the conveying roller group.

Configuration of Drive Force Transmission Mechanism

[0040] As illustrated in FIGS. 2, 6 and 7, the drive force transmission mechanism 31 includes the up-down guide member 46 that is provided over the up-down area M of the support base 22 and that serves as the rack member, a first transmission gear 55 that is rotated by the rack 46a of the up-down guide member 46, a second transmission gear 56, a third transmission gear 57, and the drive gear 58 that drives the first pinion 33a of the first up-down mechanism 23.

[0041] The first transmission gear 55 is engaged with the rack 46a of the up-down guide member 46, and is provided rotatably on the base support member 49 (refer to FIG. 6) via a spindle 55a. The second transmission gear 56 includes a large-diameter gear part 56a that is engaged with the first transmission gear 55, and a small-diameter gear part 56b that is engaged with the third transmission gear 57, and the second transmission gear 56 is provided rotatably on the support base 22 via a rotation shaft 56c. The second transmission gear 56 that is arranged on the left in FIG. 6, is engaged with only the first transmission gear 55, and causes the rotation shaft 56c to rotate. The third transmission gear 57 is provided rotatably on the support base 22 via a rotation shaft 57a. The drive gear 58 is provided on the rotation shaft 57a of the third transmission gear 57, and the drive gear 58 is rotated in association with rotation of the third transmission gear 57. The drive gear 58 is engaged with the first pinion 33a of the first up-down mechanism 23.

[0042] The drive force transmission mechanism 31 includes the torque limiter 59 that blocks the drive force that is transmitted to the pinion unit 33. The torque limiter 59 is provided on the rotation shaft 57a of the third transmission gear 57, and is arranged near the third transmission gear 57. As described above, in the drive force transmission mechanism 31, when the second up-down mechanism 24 causes the support base 22 to lower in the state in which the stage 21 moves to the down position P2, transmission of the drive force to the first pinion 33a of the pinion unit 33 by the third transmission gear 57 and the drive gear 58, is blocked in association with lowering of the support base 22. For this reason, the rack unit 32 and the pinion unit 33 of the first up-down mechanism 23 are prevented from being damaged in the structure in which the support base 22 continues lowering after the stage 21 moves to the down position P2.

[0043] Note that the stage 21 may be controlled such that rising to the up position P1 completes before the support base 22 reaches the upper end U of the up-down area M. In this case, a configuration in which, in association with the rise of the support base 22 after the reach by the stage 21 to the up position P1, the drive force transmitted by the drive force transmission mechanism 31 is blocked by the torque limiter 59 may be taken.

[0044] As illustrated in FIG. 5, the third transmission gear 57, the drive gear 58, and the torque limiter 59 of the drive force transmission mechanism 31 are arranged in the projection area S of the stage 21, excluding part of the third transmission gear 57.

[0045] In the embodiment, the up-down guide member 46 of the second up-down mechanism 24 also serves as the rack member of the drive force transmission mechanism 31, which simplifies the drive force transmission mechanism 31. Not limited to this structure, the drive force transmission mechanism 31 may include a rack member (not illustrated in the drawing) independent of the up-down guide member 46.

Operation of Drive Force Transmission Mechanism

[0046] In the above-described drive force transmission mechanism 31, when the support base 22 is raised and lowed by the second up-down mechanism 24, the first transmission gear 55 is rotated by the rack 46a of the up-down guide member 46. The first transmission gear 55 is rotated, accordingly the second transmission gear 56 is rotated, and accordingly the third transmission gear 57 is rotated by the second transmission gear 56. The third transmission gear 57 rotates and accordingly the drive gear 58 is rotated together with rotation of the rotation shaft 57a. The drive gear 58 is rotated and accordingly the first pinion 33a is rotated. As described above, the drive force transmission mechanism 31 transmits the drive force to the pinion unit 33 via the rack 46a, the first transmission gear 55, the second transmission gear 56, the third transmission gear 57 and the drive gear 58.

Configuration of Conveying Roller Group

[0047] As illustrated in FIG. 2, the conveying roller group including the pickup roller 25, which sends out the banknote 6 on the stage 21, the carrying roller 26 and the separation roller 27, which separate the banknotes 6 that are sent by the pickup roller 25 one by one and carries the banknote 6, and the acceleration roller 28, which increases the rate of conveying banknotes that are carried from the carrying roller 26, is arranged above the storage space 20.

[0048] The pickup roller 25 is supported on a rotation shaft 25a and is arranged in a position opposed to the placement surface 21a of the stage 21. The carrying roller 26 is supported on a rotation shaft 26a and is arranged on the side of one end of the stage 21 in the Y-direction. The separation roller 27 is supported on a rotation shaft 27a and is arranged under the carrying roller 26. An idler roller (not illustrated in the drawing) is rotatably supported on the rotation shaft 26a of the carrying roller 26, and the idler roller is arranged adjacently to the carrying roller 26. A guide roller (not illustrated in the drawing) is provided on the rotation shaft 26a of the carrying roller 26 with an interval between the guide roller and the carrying roller 26. A plurality of acceleration rollers 28 are arranged near the carrying roller 26 along the direction in which the banknote 6 is conveyed. Each of the acceleration rollers 28 is supported on the rotation shaft 28a. The pickup roller 25, the carrying roller 26, the acceleration roller 28 and the guide roller are driven by the drive mechanism not illustrated in the drawing to rotate.

Operation of Storing Banknotes

[0049] In the banknote storage device 14 configured as described above, when the banknotes 6 are not stored in the storage space 20, the stage 21 is positioned near the upper end of the storage space 20, that is, near the pickup roller 25. At that time, the stage 21 is in a state of being raised by the first up-down mechanism 23 to the up position P1. The banknotes 6 are carried by the conveying roller group, which includes the carrying roller 26, etc., into the storage space 20 and, with accumulating of the banknotes 6 on the stage 21, the second up-down mechanism 24 causes the stage 21 to intermittently lower together with the support base 22 based on a result of detection by the upper end sensor 51. The second up-down mechanism 24 causes the stage 21 to gradually lower in association with an increase of the banknotes 6 that are accumulated on the stage 21.

[0050] Simultaneously with the operation in which the second up-down mechanism 24 causes the support base 22 to lower, the first up-down mechanism 23 causes the stage 21 to gradually lower from the up position P1 to the down position P2. In the banknote storage device 14, with an increase of the banknotes 6 accumulated on the stage 21, the first up-down mechanism 23 causes the stage 21 to lower to the down position P3 while the second up-down mechanism 24 causes the support base 22 to lower.

[0051] When the support base 22, which is lowered by the second up-down mechanism 24, lowers to a given position near the lower end D of the up-down area M, the stage 21, which is lowered by the first up-down mechanism 23, moves to the down position P2, and lowering of the stage 21 stops. Subsequently, with an increase of the banknotes 6 accumulated on the stage 21, the second up-down mechanism 24 causes the support base 22 and the stage 21 to lower in a state where the stage 21 lowers to the down position P2. When the second up-down mechanism 24 causes the support base 22 to move to the lower end D of the up-down area M, the lower end sensor 52 detects the detection piece 50a of the support base 22, and thus lowering of the stage 21 and the support base 22 stops.

[0052] As described above, the second up-down mechanism 24 causes the support base 22 to lower, and the first up-down mechanism 23 causes the stage 21 to lower with respect to the support base 22, which enables further accumulating of the banknotes 6 on the stage 21 by the difference in height between the up position P1 and the down position P2.

[0053] When sending out the banknotes 6 that are accumulated on the stage 21 using the conveying roller group, contrary to the above-described operation of lowering the stage 21 and the support base 22, the second up-down mechanism 24 causes the stage 21 to rise from the lower end D of the up-down area M toward the upper end U. When the support base 22, which is raised by the second up-down mechanism 24, rises to a given position close to the lower end D of the up-down area M, the first up-down mechanism 23 causes the stage 21 to start rising from the down position P2 to the up position P1. Thereafter, in the banknote storage device 14, the second up-down mechanism 24 causes the support base 22 to rise, and the first up-down mechanism 23 causes the stage 21 to rise gradually toward the up position P1.

[0054] When he second up-down mechanism 24 causes the support base 22 to move to the upper end U of the up-down area M, the first up-down mechanism 23 causes the stage 21 to move to the up position P1 and, as illustrated in FIG. 2, the banknote 6 on the placement surface 21a of the stage 21 appropriately makes contact with the pickup roller 25, and is sent by the pickup roller 25 smoothly to the side of the carrying roller 26 and the separation roller 27.

Reference Example

[0055] The banknote storage device 14 of the embodiment will be described in comparison with a banknote storage device of a reference example that solves the problem of the present invention. FIG. 10 is a schematic diagram for describing the banknote storage device of the reference example. In the banknote storage device of the reference example, the structure of a first up-down mechanism of the reference example is different from the first up-down mechanism 23 of the banknote storage device 14 of the embodiment. In the reference example, the same components as those of the embodiment are denoted with the same reference numerals as those of the embodiment, and description thereof will be omitted.

[0056] As illustrated in FIG. 10, a banknote storage device 114 of the reference example includes a first up-down mechanism 123 including a link mechanism (not illustrated in the drawing) that supports the stage 21 such that the stage 21 can rise and lower with respect to the support base 22; rotation levers 134 in a pair that causes the first up-down mechanism 123 to operate; and a torsion spring 135 that applies a force to the rotation levers 134 to cause the stage 21 to rise to the up position P1.

[0057] The rotation levers 134 are arranged on both sides of the support base 22 in the X-direction, respectively, and a center part of the rotation lever 134 in a length direction is rotatably supported on the support base 22 via a rotation shaft 141. A roller 143 is rotatably provided at one end of the rotation lever 134, and the one end of the rotation lever 134 is connected to the stage 21 via the roller 143. A guide groove 145, along which the roller 143 at the one end of the rotation lever 134 moves, is formed in the stage 21 along the Y-direction. A roller 144 is rotatably provided at the other end of the rotation lever 134, and the roller 144 rotates along and on a guide surface 156 of an operation member 155 with which a bottom surface 20a on the side of the lower end of the storage space 20 is provided.

[0058] The torsion spring 135 is attached to the rotation shaft 141 that supports the center part of the rotation lever 134. An end of the torsion spring 135 is fixed to the support base 22, and the other end is fixed to the rotation lever 134. Accordingly, the torsion spring 135 applies a force such that the rotation lever 134 is caused to rotate around the rotation shaft 141. Accordingly, the state, in which the stage 21 is moved to the torsion spring 135, serves as an initial state.

[0059] In the first up-down mechanism 123 of the reference example, when the stage 21 moves close to the lower end of the storage space 20, the rotation lever 134 causes the stage 21 to move from the up position P1 to the bottom position P2. In the first up-down mechanism 123, when the stage 21 moves apart from the lower end of the storage space 20, the rotation lever 134 causes the stage 21 to move from the down position P2 to the up position P1.

[0060] In the banknote storage device 114 of the reference example, because the rotation lever 134 and the torsion spring 135 are used, there is a risk that the timing of the operation of causing the stage 21 to rise and lower with respect to the support base 22 is unstable. For example, the state, in which the banknotes 6 are accumulated on the stage 21, may vary due to the effect of crumples, folding, etc., of the banknotes 6 that are accumulated on the stage 21. In such a case, the weight applied to the stage 21 varies according to the accumulating state of the banknotes 6 accumulated on the stage 21 and, when the stage 21 separates from the lower end of the storage space 20, there is a risk that the rotation lever 134 does not rotate appropriately.

[0061] For example, in the case where rotation of the rotation lever 134 is insufficient when the stage 21 separates from the lower end of the storage space 20, the roller 144 of the rotation lever 134 separates from the operation members 155 at the lower end of the storage space 20 before the stage 21 moves to the up position P1, and there is a risk that the rotation lever 134 rotate suddenly when the support base 22 is raised by the second up-down mechanism 24. At that time, because the stage 21 suddenly moves to the up position P1, the banknotes 6 on the stage 21 are pressed strongly by the pickup roller 25, and the operation of carrying the banknote 6 is unstable.

[0062] In the banknote storage device 114 of the reference example, elasticity of the torsion spring 135 that causes the rotation lever 134 to rotate, has an effect on the operation in which the stage 21 moves from the down position P2 to the up position P1, and it is difficult to appropriately set the elastic force of the torsion spring 135, and the up-down operation on the stage 21 is unstable. In other words, when the elastic force of the torsion spring 135 is large, there is a risk that the stage 21 would not move appropriately to the down position P2. When the elastic force of the torsion spring 135 is small, there is a risk that the stage 21 would not move appropriately to the up position P1.

[0063] On the other hand, in the banknote storage device 14 of the embodiment, compared to the above-described reference example, the stage 21 is raised and lowered by the up-down operation using the first rack 32a of the rack unit 32 and the first pinion 33a, and the up-down operation using the second rack 32b and the second pinion 33b without using the torsion spring 135, which makes it possible stabilize the up-down operation and increase reliability of the operation of accumulating and

carrying the banknotes 6. Additionally, in the banknote storage device 14 of the embodiment, because the rack unit 32 and the pinion unit 33 support the stage 21 such that the stage 21 is able to rise and lower, it is unnecessary to install a complicated link mechanism like that in the reference example, which makes it possible to simplify the first up-down mechanism 23 and simplify the process of manufacturing the banknote storage device 14.

Effect of Embodiment

[0064] As described above, the banknote storage device 14 of the embodiment includes the first up-down mechanism 23 that causes the stage 21 to rise and lower to the up position P1 and the down position P2 with respect to the support base 22, and the second up-down mechanism that causes the support base 22 to rise and lower in the storage space 20, and the first up-down mechanism 23 includes the rack unit 32 that is provided on the stage 21, and the pinion unit 33 that causes the rack unit 32 to move. As described above, in the first up-down mechanism 23, because the stage 21 is raised and lowered using the rack unit 32 and the pinion unit 33, and thus the rack unit 32 and the pinion unit 33 also serve as the support structure that supports the stage 21 such that the stage 21 can rise and lower, it is possible to avoid the first up-down mechanism 23 from being complicated and increasing in size. Additionally, because the stage 21 is raised and lowered by the first up-down mechanism 23 with respect to the support base 22, it is possible to accumulate the banknotes 6 on the stage 21 according to the difference between the up position P1 and the down position P2 of the stage 21. Accordingly, it is possible to increase the amount of the banknotes 6 to be stored in the storage space 20 without increasing the whole size of the paper sheet storage device 14.

[0065] In the banknote storage device 14 of the embodiment, the support base 22 and the first up-down mechanism 23 are arranged in the projection area S obtained by projecting the stage 21 to the X-Y plane orthogonal to the up-down direction in which the second up-down mechanism 24 causes the support base 22 to rise and lower. This, compared to the structure in which the support base 22 and the first up-down mechanism 23 are arranged outside the space in which the stage 21 rises and lowers, the space, in which the support base 22 and the first up-down mechanism 23 are arranged, makes it possible to avoid the whole size of the banknote storage device 14 from increasing.

[0066] In the banknote storage device 14 of the embodiment, the first up-down mechanism 23 causes the stage 21 to rise and lower with respect to the support base 22 simultaneously with the up-down operation in which the second up-down mechanism 24 raises and lowers the support base 22. Accordingly, it is possible to stabilize the up-down operation on the stage 21 in the storage space 20. For example, compared to the case where each of the first up-down mechanism 23 and the second up-down mechanism 24 independently operates such that lowering of the stage 21 by the first up-down mechanism 23 starts after lowering of the support base 22 by the second up-down mechanism 24 completes, and the up-down operation on the stage 21 is stabilized, and reliability of the operation for accumulating the banknoted on the stage 21 and carrying the banknotes is increased.

[0067] In the first up-down mechanism 23 of the banknote storage device 14 of the embodiment, the rack unit 32 includes the first rack 32a and the second rack 32b in a pair that are provided oppositely to each other, the pinion unit 33 includes the first pinion 33a and the second pinion 33b in a pair that are engaged with the first rack 32a and the second rack 32b in a pair, respectively, and the first pinion 33a and the second pinion 33b are engaged with each other. This makes it possible to stabilize the up-down operation on the stage 21, and thus increase the reliability of the up-down operation, and configure the first up-down mechanism 23 compactly.

[0068] The banknote storage device 14 of the embodiment includes the drive force transmission mechanism 31 that transmits a drive force to the first up-down mechanism 23 using the up-down operation in which the second up-down mechanism 24 causes the support base 22 to rise and lower, and the drive force transmission mechanism 31 includes the up-down guide member 46 including the rack 46a that is provided along the up-down area M of the support base 22 and the first transmission gear 55 that is rotated by the rack 46a of the up-down guide member 46 and thus drives the pinion unit 33 of the first up-down mechanism 23 to cause the pinion unit 33 to rotate. This makes it possible to cause the first up-down mechanism 23 to drive using the up-down operation of the second up-down mechanism 24 without using an independent drive source or control for driving the first up-down mechanism 23 and simplify the banknote storage device 14.

[0069] In the banknote storage device 14 of the embodiment, the drive force transmission mechanism 31 includes the torque limiter 59, which blocks the drive force that is transmitted to the pinion unit 33, and the first up-down mechanism 23 causes the stage 21 to move from the up position P1 to the down position P2, before the support base 22, which is lowered by the second up-down mechanism 24, reaches the lower end D of the up-down area M. Accordingly, because the operation of causing the stage 21 to lower with respect to the support base 22 completes before the support base 22 reaches the lower end D of the up-down area M, the up-down operation on the stage 21 in the storage space 20 is stabilized, and reliability of the up-down operation is increased. It is also possible to, using the torque limiter 59, block transmission of the drive force that is transmitted by the drive force transmission mechanism 31 in association with lowering of the support base 22 after the stage 21 moves to the down position P2 to the pinion unit

33. Thus, when the support base 22 continues lowering after the stage 21 moves to the down position P2, it is possible to prevent the rack unit 32 and the pinion unit 33 of the first up-down mechanism 23 from being damaged.

Reference Signs List

[0070]

1	BANKNOTE HANDLING APPARATUS
6	BANKNOTE (PAPER SHEET)
14	BANKNOTE STORAGE DEVICE (PAPER SHEET STORAGE DEVICE)
20	STORAGE SPACE
21	STAGE (PLACEMENT TABLE)
22	SUPPORT BASE
23	FIRST UP-DOWN MECHANISM
24	SECOND UP-DOWN MECHANISM
31	DRIVE FORCE TRANSMISSION MECHANISM
32	RACK UNIT
32a	FIRST RACK (RACK)
32b	SECOND RACK (RACK)
33	PINION UNIT
33a	FIRST PINION (PINION)
33b	SECOND PINION (PINION)
46	UP-DOWN GUIDE MEMBER (RACK MEMBER)
46a	RACK
49	BASE SUPPORT MEMBER
55	FIRST TRANSMISSION GEAR (TRANSMISSION GEAR)
56	SECOND TRANSMISSION GEAR (TRANSMISSION GEAR)
57	THIRD TRANSMISSION GEAR (TRANSMISSION GEAR)
58	DRIVE GEAR (TRANSMISSION GEAR)
59	TORQUE LIMITER
D	LOWER END
U	UPPER END
M	UP-DOWN AREA
P1	UP POSITION
P2	DOWN POSITION
S	AREA OF PROJECTION

Claims

1. A paper sheet storage device comprising:

a storage space in which paper sheets are stored;
a placement table that is provided in the storage space and on which the paper sheets are accumulated and placed;
a support base that supports the placement table;
a first up-down mechanism that causes the placement table to rise and lower to an up position and a down position with respect to the support base; and
a second up-down mechanism that causes the support base to rise and lower in the storage space,
wherein the first up-down mechanism includes a rack unit that is provided on the placement table and a pinion unit that causes the rack unit to move.

2. The paper sheet storage device according to claim 1, wherein the support base and the first up-down mechanism are arranged in a projection area in which the placement table is projected on a plane orthogonal to an up-down direction in which the second up-down mechanism causes the support base to rise and lower.

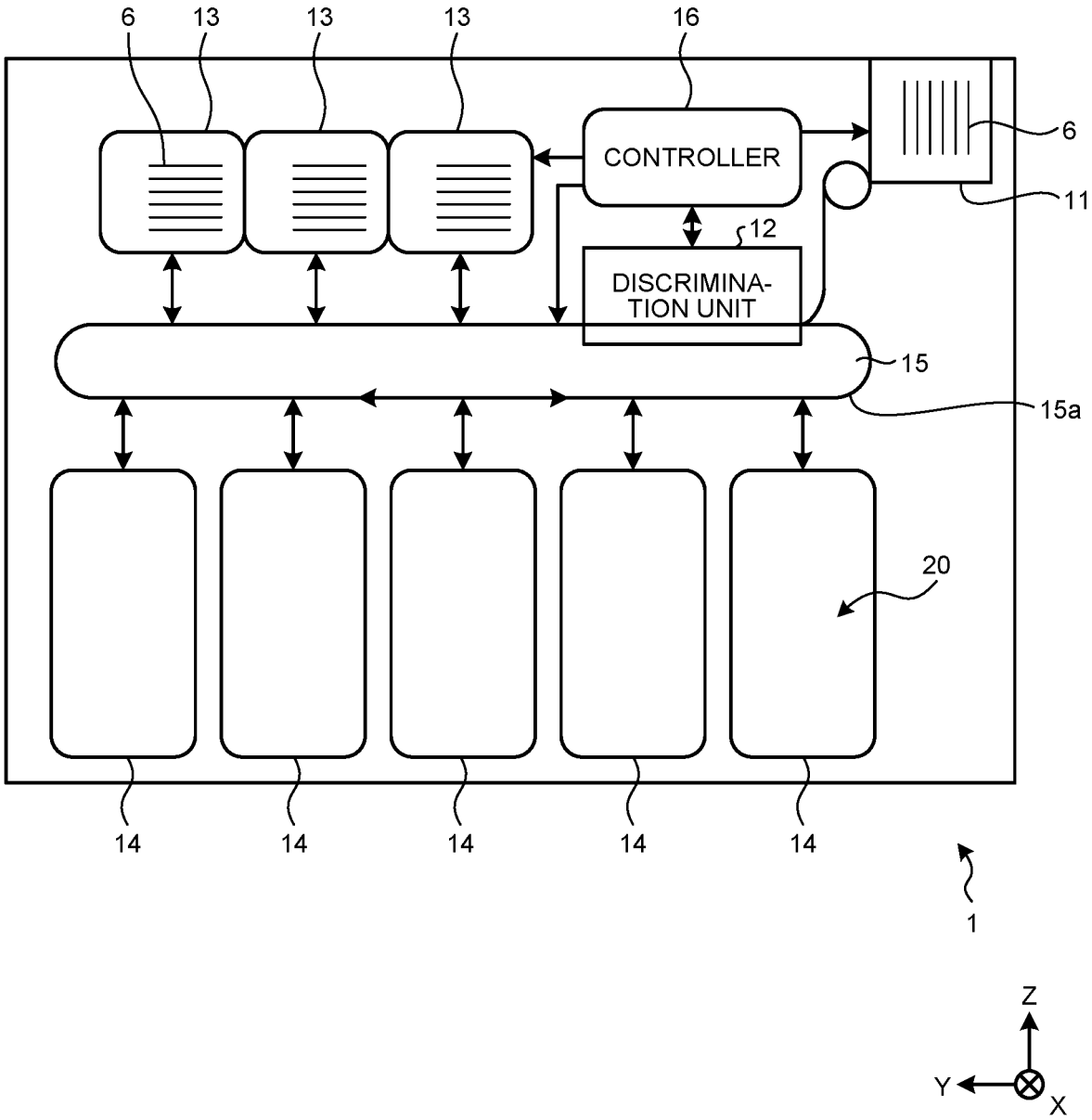
3. The paper sheet storage device according to claim 1, wherein the first up-down mechanism causes the placement table to rise and lower with respect to the support base simultaneously with an up-down operation in which the second up-down mechanism causes the support base to rise or lower.

4. The paper sheet storage device according to claim 1, wherein the rack unit includes racks in a pair that are provided oppositely to each other, and
the pinion unit includes pinions in a pair that are engaged with the racks in a pair, respectively, and the pinions in a pair are engaged with each other.

5. The paper sheet storage device according to claim 1, further comprising a drive force transmission mechanism that transmits a drive force to the first up-down mechanism using an up-down operation in which the second up-down mechanism causes the support base to rise and lower,
wherein the drive force transmission mechanism includes a rack member that is provided over an up-down area of the support base and a transmission gear that is rotated by the rack member and drives the pinion unit of the first up-down mechanism to cause the pinion unit to rotate.

6. The paper sheet storage device according to claim 5, wherein the drive force transmission mechanism includes a torque limiter that blocks the drive force that is transmitted to the pinion unit, and
the first up-down mechanism causes the placement table to move from the up position to the down position before the support base that is lowered by the second up-down mechanism reaches a lower end of the up-down area.

FIG.1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13
13
16
CONTROLLER
6
11
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DISCRIMINA-
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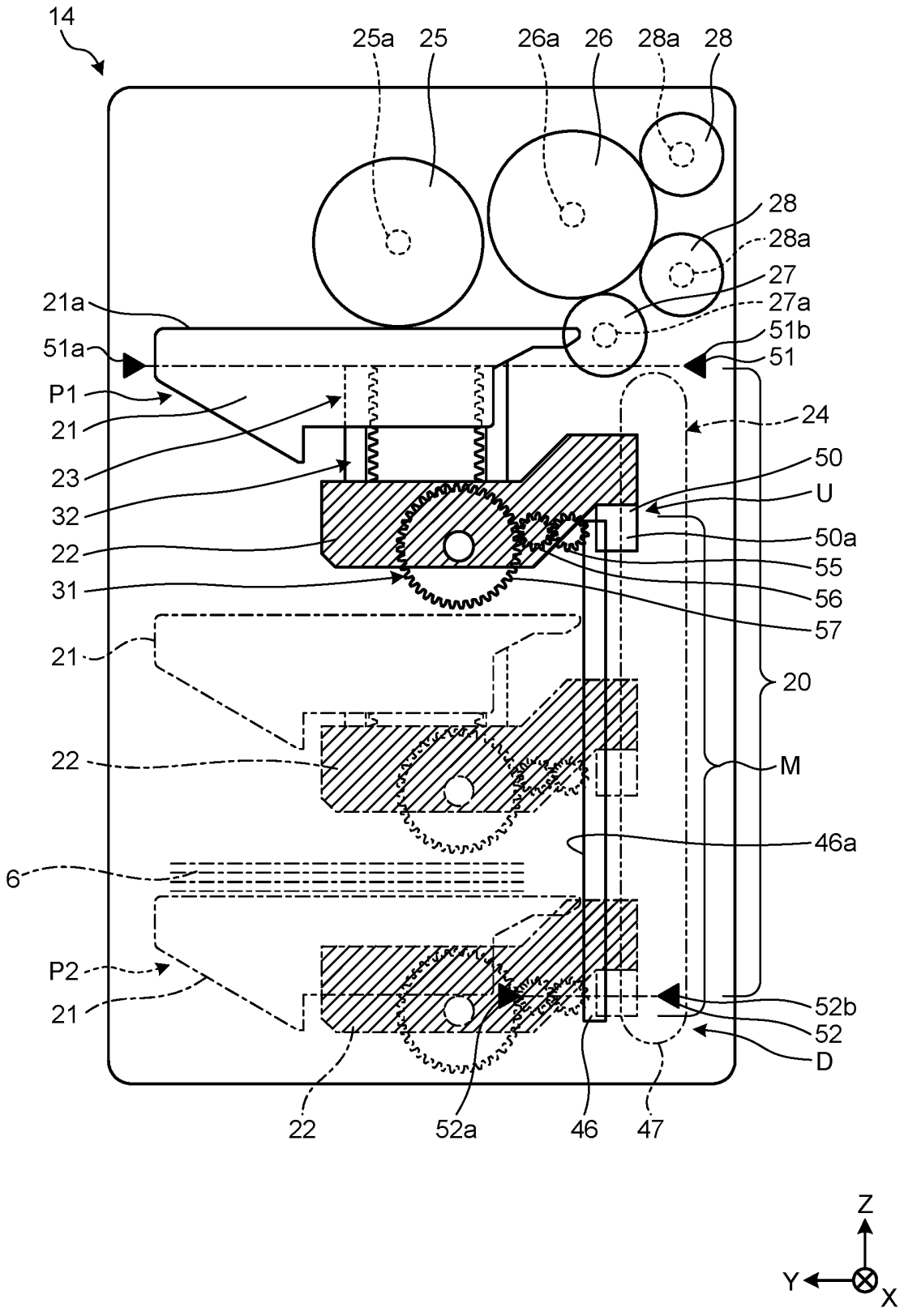
1
Z
Y
X

FIG.2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23
U
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50a
22
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31
56
57
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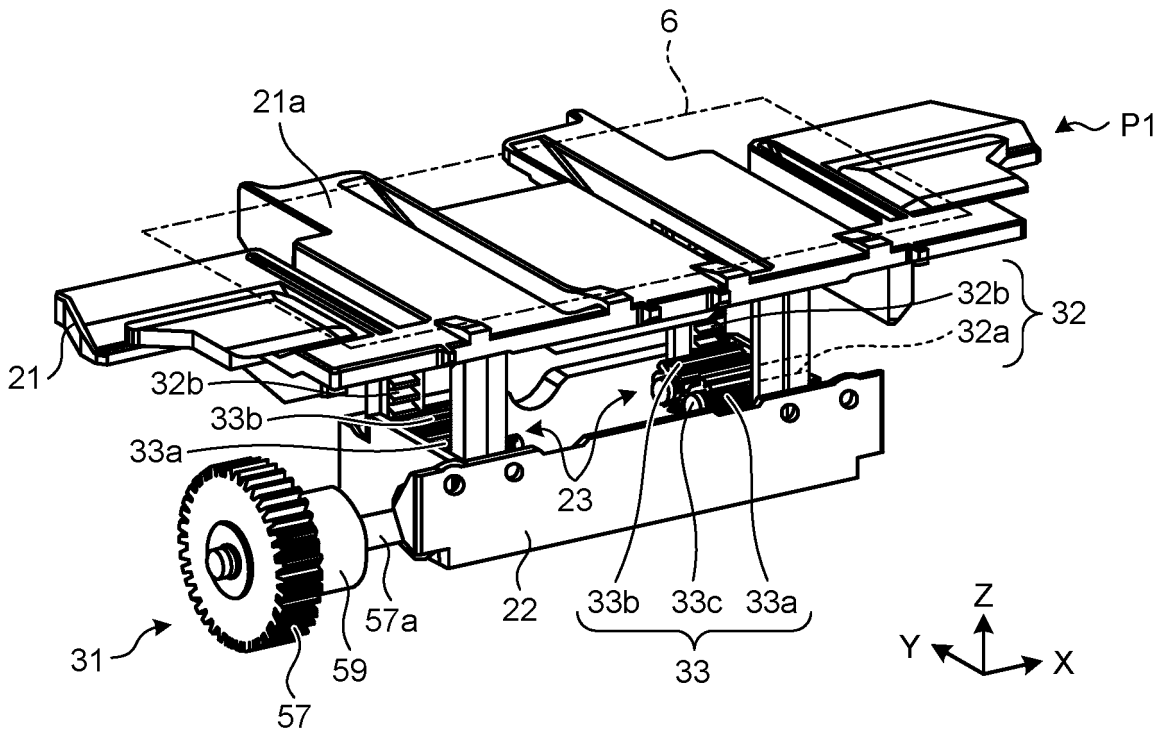
FIG.3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31
59
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Z
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X

FIG.4

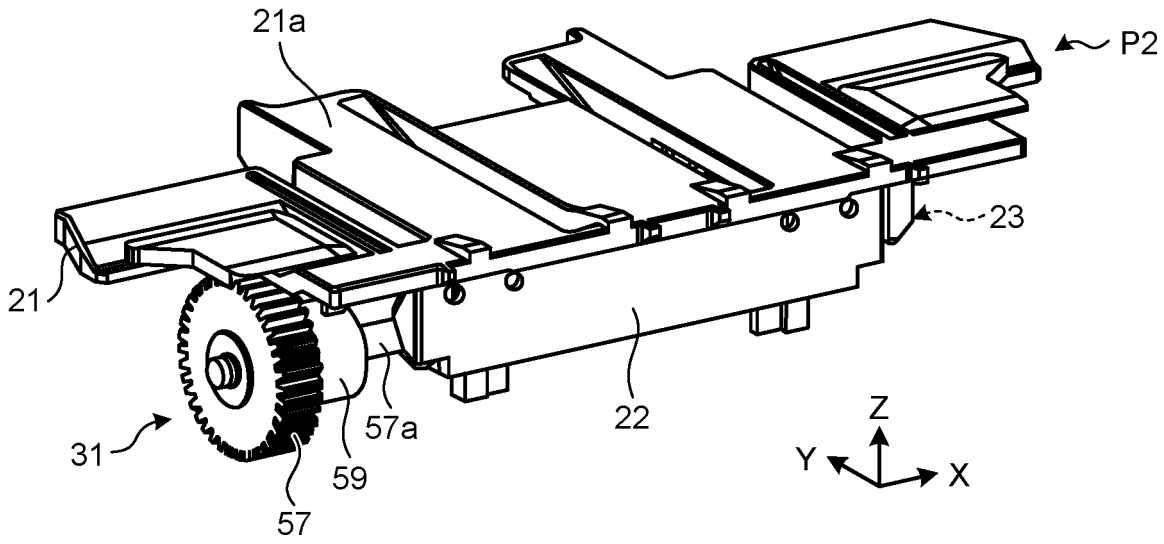
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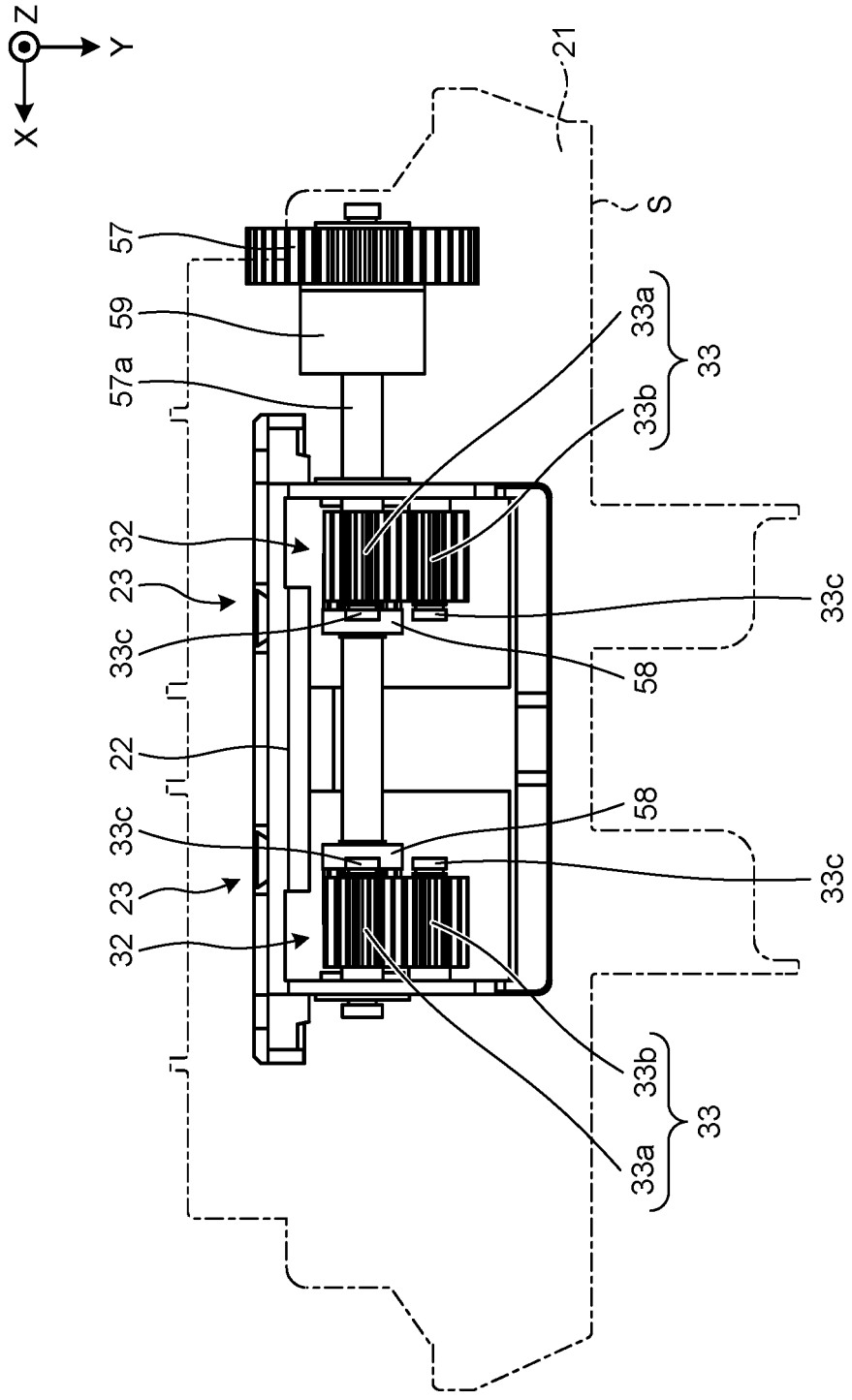
FIG.5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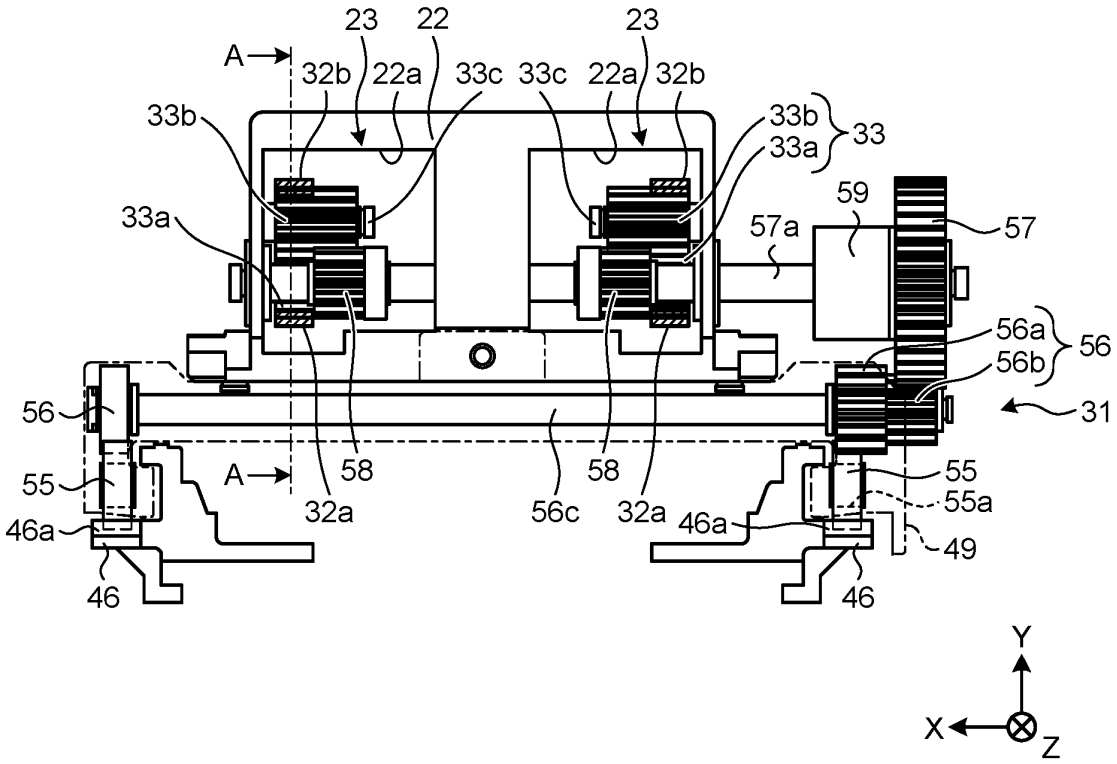
33b
33

FIG.6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56b
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46
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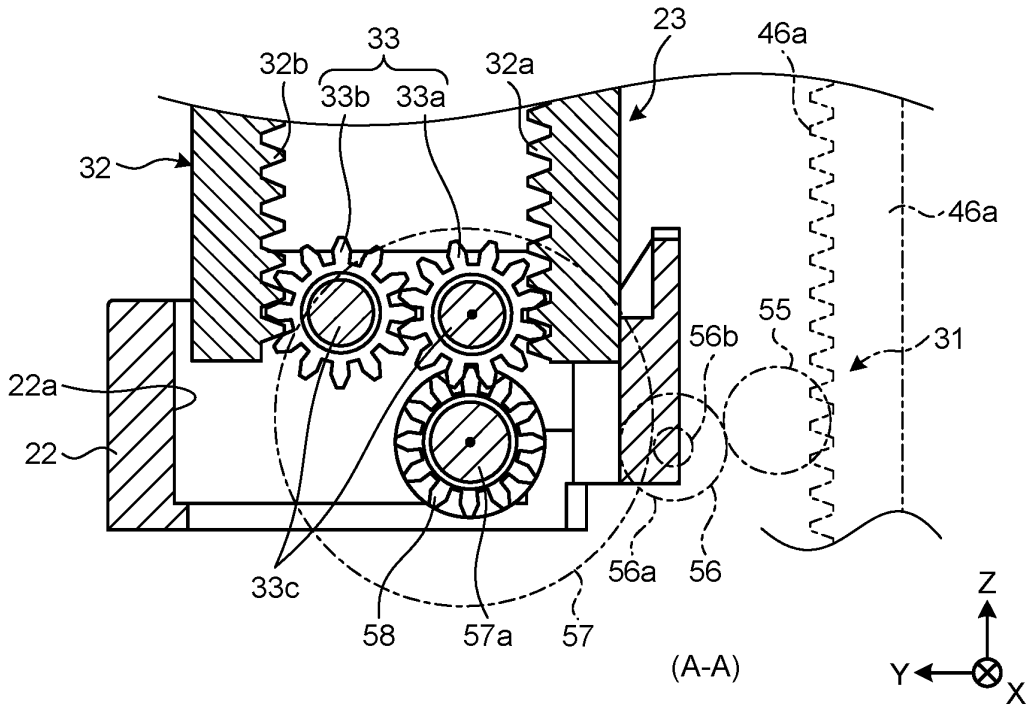
X
Z

FIG.7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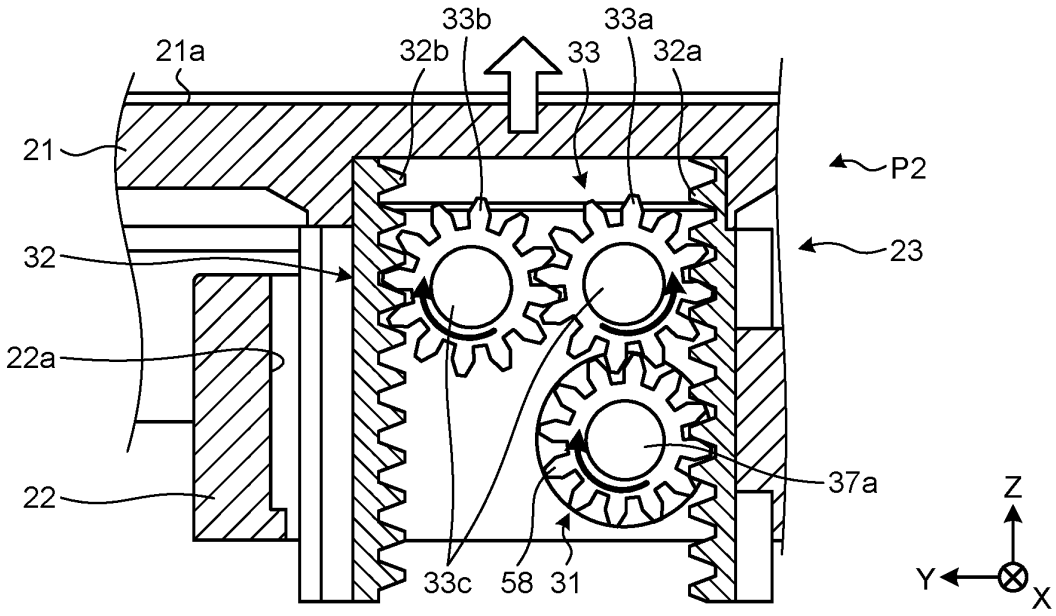
Y
X

FIG.8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X

FIG.9

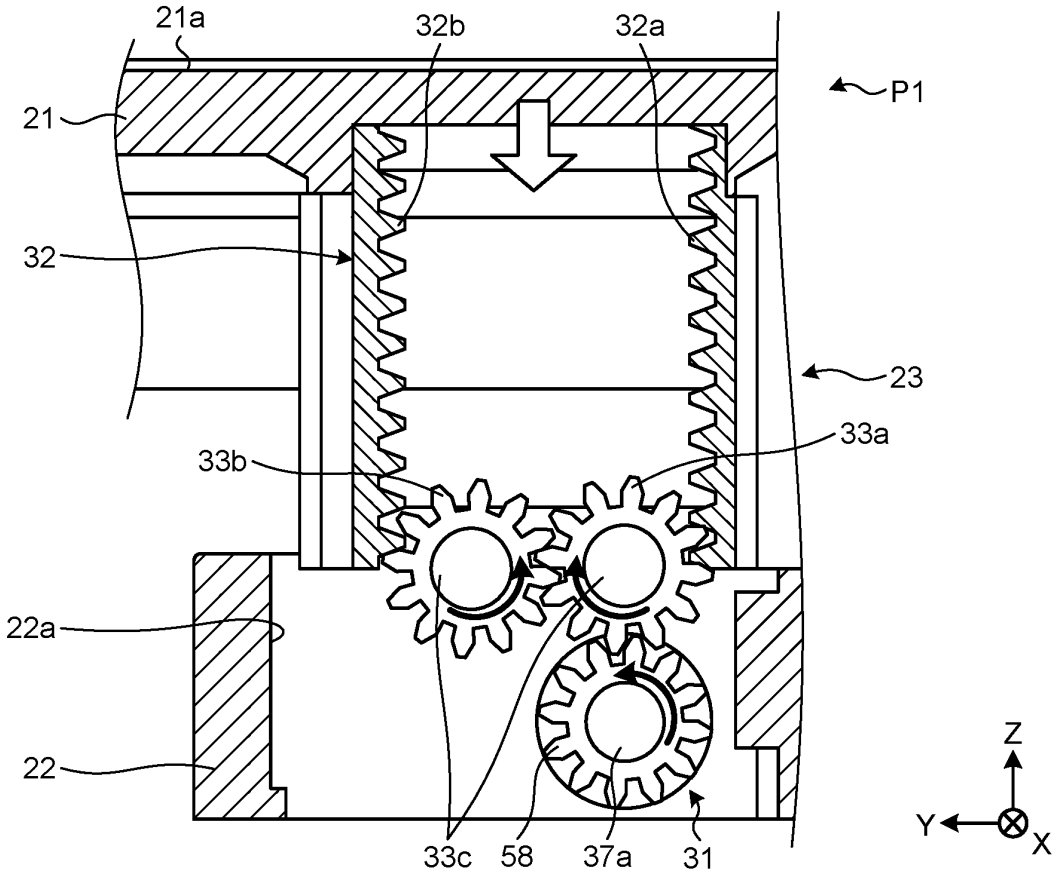
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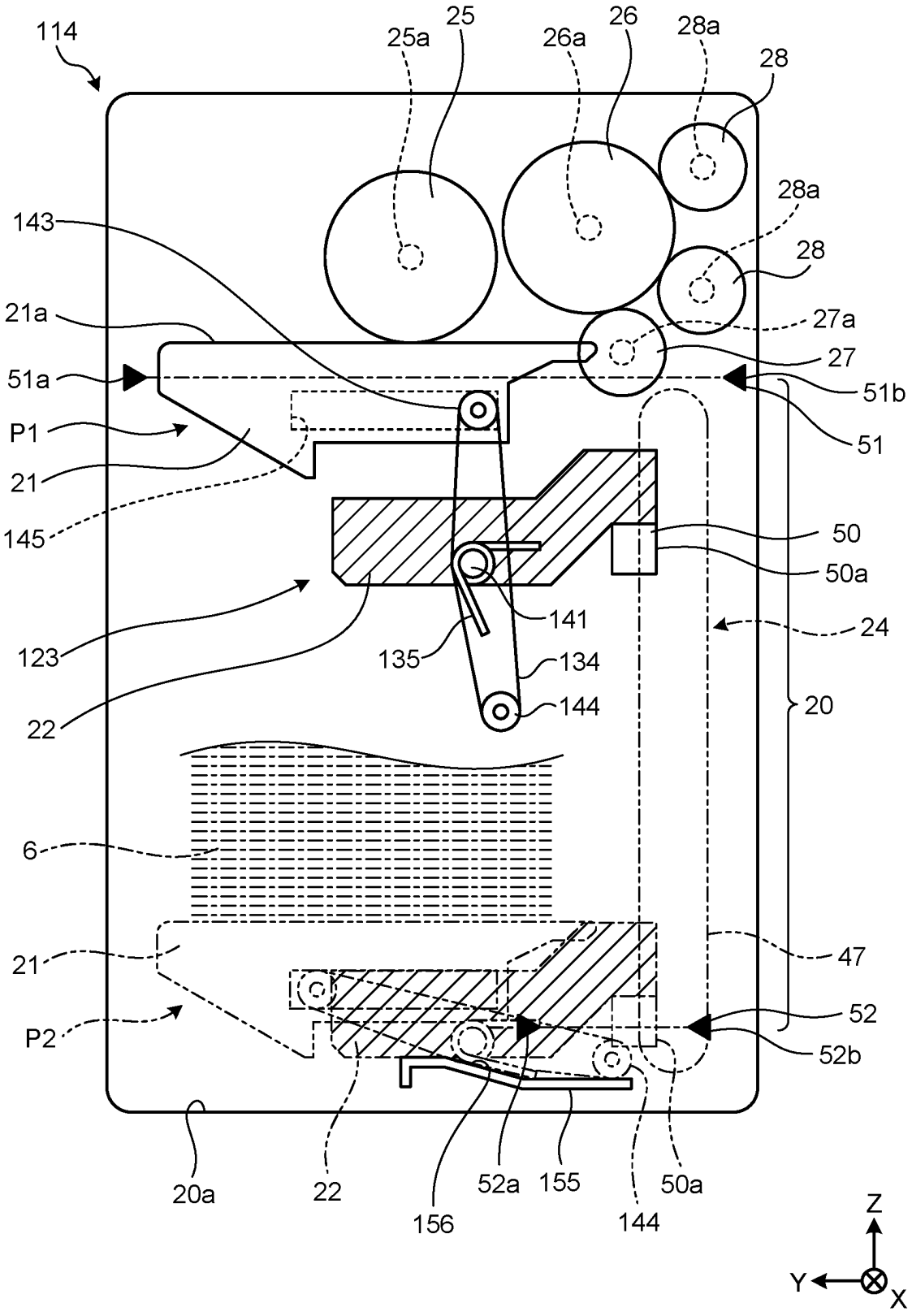
FIG.10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6
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P2
52b
20a
22
52a
155
50a
156
144
Z
Y
X

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/000090

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. G07D11/12(2019.01)i, B65H1/14(2006.01)i, B65H31/18(2006.01)i
FI: G07D11/12, B65H1/14 322B, B65H31/18

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)
Int. Cl. G07D11/12-11/13, B65H1/14, B65H31/18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 05-334523 A (OKI ELECTRIC INDUSTRY CO., LTD.) 17 December 1993, paragraphs [0003]-[0017], fig. 1-4, paragraphs [0003]-[0017], fig. 1-4	1 2-6
A	JP 2003-151007 A (GLORY LTD.) 23 May 2003, paragraph [0007]-[0041], fig. 1, 2	1-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19.02.2020	10.03.2020

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/000090

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 05-334523 A	17.12.1993	(Family: none)	
JP 2003-151007 A	23.05.2003	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012053637 A **[0004]**