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(54) **MONEY HANDLING APPARATUS AND MONEY HANDLING METHOD**

(57) Money that cannot move and remains in a money handling apparatus is detected. The money handling apparatus (1) includes: a storage (34) configured to store money; a gate member (44) configured to open and close a passage leading to the storage by moving between a closed position to restrict movement of the money and an opened position to allow the money to pass through the passage; and a detection unit configured to detect presence/absence of money caught by the gate member.

FIG.3

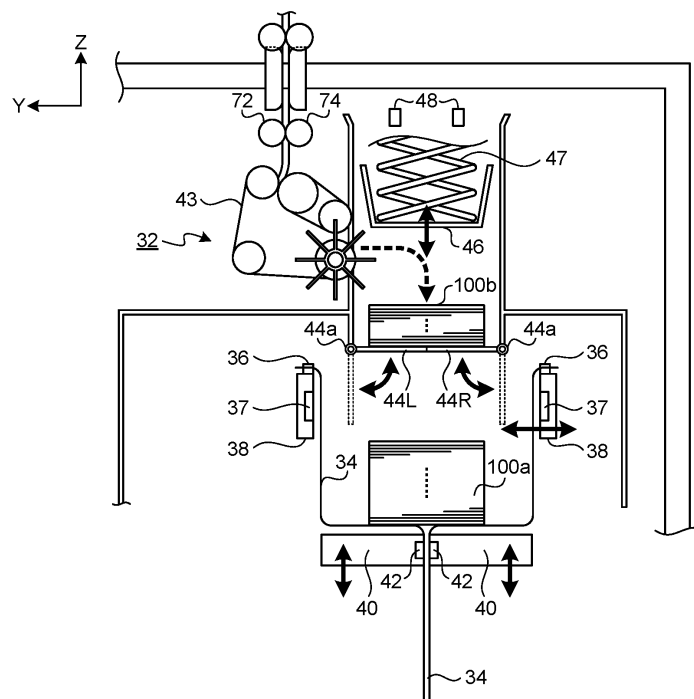


FIG.4A

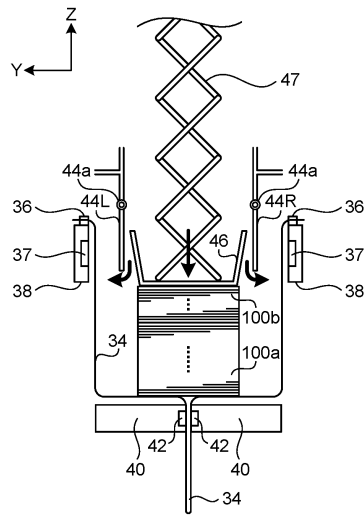


FIG.6

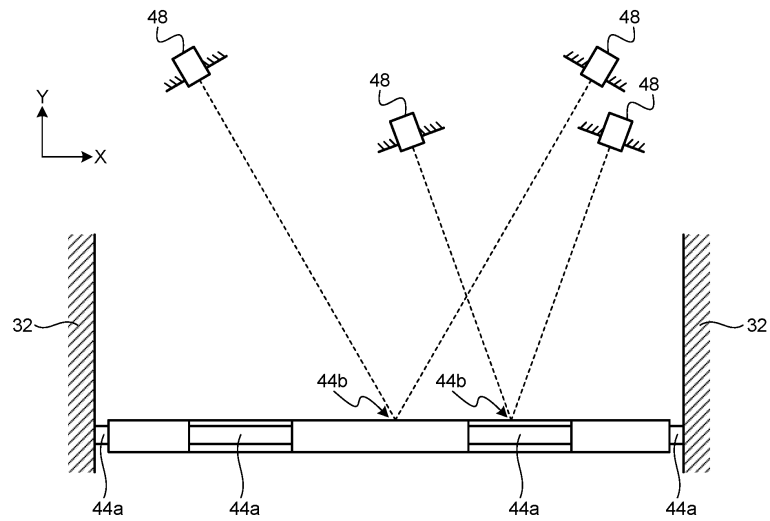


FIG.7A

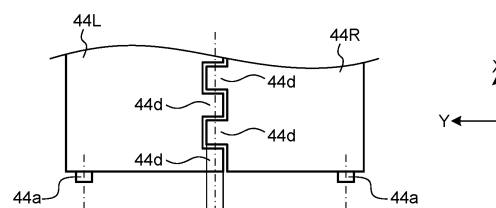


FIG.7B

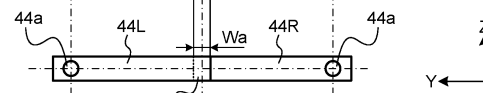
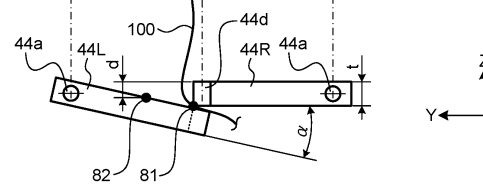


FIG.7C



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a money handling apparatus and a money handling method for detecting money that is to be moved but cannot move and remains in the apparatus.

Description of the Background Art

[0002] Conventionally, money handling apparatuses that store money therein have been used. Such a money handling apparatus transports money inside the apparatus. For example, money moves in the apparatus and is stored in a storage unit fixed in the apparatus or a storage container detachably mounted to the apparatus. For example, a cassette or a bag is used as the storage container for money. It is necessary to reliably transport all money to be moved in order to strictly manage all the money in the money handling apparatus. The money handling apparatus performs detection of money that cannot move and remains, by a sensor, in order to confirm that all money has moved.

[0003] Japanese Laid-Open Patent Publication No. 2016-162435 discloses an example in which a cassette detachably mounted to a money handling apparatus has a sensor for detecting remaining banknotes. The sensor includes a light emitting element and a light receiving element. Detection light for detecting remaining banknotes is emitted and received between the light emitting element and the light receiving element. When there is any banknote in the cassette, the banknote blocks the detection light. The money handling apparatus detects presence/absence of any banknote that cannot move and remains in the cassette, on the basis of a change in the detection light.

SUMMARY OF THE INVENTION

[0004] Even when the conventional art described above is used, however, remaining banknotes cannot be detected in some cases. For example, when banknotes are to be moved inside an apparatus, there are cases where any banknote becomes caught by a component of the apparatus, cannot move, and remains in the apparatus. In some cases, the remaining banknote blocks only a part of the detection light depending on the position or the shape of the banknote, and a change in the detection light cannot be detected in some cases.

[0005] The present invention has been made in view of the problem of the conventional art, and an object of the present invention is to provide a money handling apparatus and a money handling method that enable detection of money that is to be moved but cannot move and remains in the apparatus.

[0006] To solve the above-described problem and achieve the above-described object, a money handling apparatus according to one aspect of the present invention provides includes: a storage configured to store money therein; a gate member configured to open and close a passage leading to the storage by moving between a closed position to restrict movement of money along the passage and an opened position to allow the money to move along the passage; and a detection unit configured to detect presence/absence of money caught by the gate member.

[0007] The money handling apparatus includes a passage for moving money, and a gate member configured to open and close the passage. If there is money that cannot pass through the position at which the gate member is disposed and that is caught by the gate member, the detection unit detects the caught money. Accordingly, the money handling apparatus can detect money that cannot move and remains when money moves in the path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 shows the outer appearance of a money handling apparatus according to an embodiment;
FIG. 2 schematically shows the internal configuration of a banknote handling unit;
FIG. 3 schematically shows the configuration of a storage mechanism;
FIG. 4A and 4B illustrate a method for storing banknotes stacked on a gate member, into a storage bag;
FIG. 5 illustrates the gate member.
FIG. 6 illustrates arrangement of sensors;
FIGS. 7A to 7C illustrate a method for detecting a banknote caught by the gate member;
FIGS. 8A to 8C show the configuration of the gate member by which a banknote is caught with a right member located at the lower side;
FIG. 9 shows the structure of projections;
FIG. 10 shows a specific structure example of the gate member;
FIG. 11 shows a side surface shape of the gate member shown in FIG. 10;
FIGS. 12A and 12B show a state where a banknote is caught by the gate member shown in FIG. 10 and FIG. 11;
FIG. 13 shows an example in which sensors that emit and receive detection light in the short edge direction of the gate member are disposed;
FIGS. 14A to 14C show an example in which sensors that emit and receive detection light in the long edge direction of the gate member are disposed;
FIGS. 15A to 15D each show an example of projections having different shapes;
FIG. 16 shows an example of a gate member having

a different shape;

FIGS. 17A to 17C show an example of a gate member that opens and closes by moving parallel to a horizontal direction; and

FIGS. 18A and 18B show a part of the gate member and the storage mechanism shown in FIGS. 17A to 17C.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] Hereinafter, an embodiment of the money handling apparatus and the money handling method according to the present invention will be described with reference to the accompanying drawings. First, the configuration of the money handling apparatus will be described. FIG. 1 shows the outer appearance of a money handling apparatus 1 according to the present embodiment. In the drawings showing the configuration of the money handling apparatus 1 in the present embodiment, three axes of X, Y, and Z orthogonal to each other are shown such that the relationship between the parts shown in each drawing can be understood. The X axis indicates the width direction of the money handling apparatus 1 (right-left direction), the Y axis indicates the depth direction of the money handling apparatus 1 (front-rear direction), and the Z axis indicates the up-down direction.

[0010] The money handling apparatus 1 includes a coin handling unit 10 and a banknote handling unit 20. The coin handling unit 10 performs coin handling including depositing and dispensing of coins. The banknote handling unit 20 performs banknote handling including depositing and dispensing of banknotes. In depositing, coins are deposited from a depositing unit 11 of the coin handling unit 10, and banknotes are deposited from a depositing unit 21 of the banknote handling unit 20. Coins that cannot be deposited in the apparatus 1 are returned from an external reject unit 17, and banknotes that cannot be deposited in the apparatus 1 are returned from an external reject unit 27. In dispensing, coins are dispensed from a dispensing unit 12 of the coin handling unit 10, and banknotes are dispensed from a dispensing unit 22 of the banknote handling unit 20.

[0011] The money handling apparatus 1 includes an operation/display unit 29. The operation/display unit 29 is, for example, a touch panel type liquid crystal display device. The operation/display unit 29 serves as a display unit that displays information of coins handled by the coin handling unit 10 and information of banknotes handled by the banknote handling unit 20. The operation/display unit 29 also serves as an operation unit for an operator of the money handling apparatus 1 to input various kinds of information to the apparatus 1. The configurations of the money handling apparatus 1, the coin handling unit 10, and the banknote handling unit 20 and processes performed by the respective apparatus and units are disclosed, for example, in Japanese Laid-Open Patent Publication No. 2018-181137. Handling of banknotes and handling of coins are performed in a similar manner, and

thus the description will be continued with banknotes as an example.

[0012] FIG. 2 schematically shows the internal configuration of the banknote handling unit 20. As shown in FIG. 1 and FIG. 2, the banknote handling unit 20 includes the depositing unit 21, the dispensing unit 22, the external reject unit 27, an internal reject unit 28, a transport unit 23, a recognition unit 24, and a plurality of storage units 25. The banknote handling unit 20 further includes a storage bag 34 that is detachably mounted to the banknote handling unit 20, and a storage mechanism 32 that stores banknotes into the storage bag 34.

[0013] In depositing, the depositing unit 21 receives banknotes to be deposited, and feeds the banknotes into the unit one by one. The transport unit 23 transports the banknotes fed by the depositing unit 21, along a transport path. The recognition unit 24 recognizes and counts the banknotes transported on the transport path. For example, the recognition unit 24 recognizes denomination, fitness, and authenticity of each banknote and counts the number of banknotes for each denomination and the total monetary amount of all the banknotes. The transport unit 23 transports the banknotes to any of the storage units 25, the external reject unit 27, and the storage mechanism 32 on the basis of the result of recognition by the recognition unit 24. A kind of banknote to be stored can be set for each storage unit 25. For example, the denomination of banknotes to be stored in each storage unit 25 is set.

[0014] Banknotes that are determined not to be able to be deposited as a result of recognition by the recognition unit 24 are discharged as reject banknotes from the external reject unit 27. For example, banknotes that cannot be recognized by the recognition unit 24, and banknotes that are recognized as counterfeit banknotes by the recognition unit 24 are discharged from the external reject unit 27. On the other hand, banknotes that can be deposited are stored in the storage unit 25 corresponding to the kind of the banknotes, on the basis of the result of recognition. For example, banknotes are stored in the storage units 25 for each denomination.

[0015] When the storage unit 25 is filled with banknotes to a full state and any other banknote cannot be stored therein, the banknote is transported to the storage mechanism 32 and stored in the storage bag 34. A kind of banknote that can be deposited but is not set for any storage unit 25 is also transported to the storage mechanism 32 and stored in the storage bag 34. In addition, the storage bag 34 is also used for collection in which banknotes being stored in the storage units 25 are collected to take out to the outside of the unit 20. Specifically, banknotes to be collected are fed out from the storage units 25, transported to the storage mechanism 32, and stored in the storage bag 34. The storage mechanism 32 is configured such that the storage bag 34 is mountable and dismountable with respect to the storage mechanism 32. A person in charge of the collection can dismount the storage bag 34 from the storage mechanism 32 and col-

lect banknotes being stored in the storage bag 34, together with the bag 34.

[0016] In dispensing, banknotes to be dispensed are fed out from the storage units 25. The transport unit 23 transports the fed-out banknotes along the transport path. A sensor for detecting a banknote transport state is disposed on the transport path. When the sensor detects that a plurality of banknotes are transported while overlapping each other (double feed), if these banknotes are dispensed, the number of dispensed banknotes cannot be determined. Thus, banknotes for which overlapping has been detected are determined not to be able to be dispensed and are stored in the internal reject unit 28. Banknotes that can be dispensed are dispensed from the dispensing unit 22.

[0017] Next, the storage mechanism 32 that stores banknotes into the storage bag 34 will be described. FIG. 3 schematically shows the configuration of the storage mechanism 32. Banknotes transported along the transport path by the transport unit 23 are stored in the storage bag 34 by the storage mechanism 32. As shown in FIG. 3, the storage bag 34 is mounted to the storage mechanism 32 in a state where an opening of the storage bag 34 is opened. Banknotes 100a that are sent into the storage bag 34 through the opening are stored in the storage bag 34 in a stacked state.

[0018] As shown in FIG. 3, rollers 72 and 74 are disposed opposed to each other at an inlet of the storage mechanism 32 through which banknotes are received from the transport unit 23. A banknote passes between the rollers 72 and 74. The storage mechanism 32 includes a sending unit 43 including a plurality of rollers and a plurality of belts. The sending unit 43 sends a banknote that has passed between the rollers 72 and 74, onto a gate member 44 (44L, 44R) as indicated by a dashed arrow. A plurality of banknotes 100b are accumulated on the gate member 44 in a stacked state.

[0019] The gate member 44 serves as a partition member that separates the banknotes 100a that have already been stored in the storage bag 34, and the banknotes 100b that have not been stored in the storage bag 34, from each other. The gate member 44 serves as a temporary storage unit that temporarily stores the banknotes 100b before the banknotes 100b are stored in the storage bag 34.

[0020] The gate member 44 includes a plurality of plate-shaped members 44L and 44R opposed to each other. Hereinafter, the member shown at the left side in FIG. 3 is referred to as left member 44L, and the member shown at the right side in FIG. 3 is referred to as right member 44R. The left member 44L and the right member 44R are each supported at one end portion thereof by a shaft 44a. When the shafts 44a are rotated, the left member 44L and the right member 44R rotate. The left member 44L and the right member 44R each rotate about the shaft 44a, as indicated by an arrow, between a position indicated by solid lines and a position indicated by dashed lines as shown in FIG. 3.

[0021] In a closed position where the left member 44L and the right member 44R are located at the positions indicated by the solid lines in FIG. 3, the gate member 44 closes a passage leading to the storage bag 34 such that banknotes to be sent to the storage bag 34 cannot pass through the passage. The left member 44L and the right member 44R are normally biased by a spring member, which is not shown, so as to be located at the closed position where movement of banknotes along the passage is restricted. When the left member 44L and the right member 44R are at the closed position, the upper surface of the left member 44L and the upper surface of the right member 44R form a flat surface that is a substantially horizontal plane. When the gate member 44 is at the closed position, movement of banknotes moving toward the storage bag 34 is blocked, so that the banknotes cannot move along the passage leading to the storage bag 34 and are stacked on the gate member 44. That is, the upper surface of the gate member 44 serves as a stacking surface for banknotes.

[0022] In an opened position where the left member 44L and the right member 44R are located at the positions indicated by the dashed lines in FIG. 3, the gate member 44 opens the passage leading to the storage bag 34 such that banknotes to be sent to the storage bag 34 can pass through the passage. The opened position is a position where the left member 44L has rotated by substantially 90 degrees clockwise from the closed position and the right member 44R has rotated by substantially 90 degrees counterclockwise from the closed position. When the left member 44L and the right member 44R are at the opened position, the upper surfaces of the left member 44L and the right member 44R, which are substantially horizontal when being at the closed position, are substantially vertical.

[0023] When the gate member 44 has moved from the closed position to the opened position, banknotes blocked from moving to the storage bag 34 by the gate member 44 can move toward the storage bag 34 again. Specifically, when the left member 44L and the right member 44R have rotated from the closed position to the opened position to open the gate member 44, the banknotes 100b stacked on the gate member 44 drop and are stored in the storage bag 34 located at the lower side of the gate member 44.

[0024] Rotation of the left member 44L and the right member 44R to open the gate member 44 is performed by a gate member drive unit that is not shown. The left member 44L and the right member 44R move in conjunction with each other and open at the same time. For example, the left member 44L and the right member 44R are connected by a connection mechanism that is not shown. When the gate member drive unit drives the connection mechanism, the left member 44L and the right member 44R open at the same time. The left member 44L and the right member 44R rotate by the same angles by the connection mechanism. The connection mechanism for moving the left member 44L and the right mem-

ber 44R in conjunction with each other is configured, for example, by using a rack and a pinion. Alternatively, for example, the connection mechanism is configured by a plurality of members including at least one of a gear, a belt, and an arm. The connection mechanism for moving the members in conjunction with each other is a conventional technique, and thus the detailed description thereof is omitted. When the drive by the gate member drive unit is released, the left member 44L and the right member 44R return from the opened position to the closed position by the bias force of the spring member.

[0025] In the storage mechanism 32, a pair of holding members 36 are disposed so as to be opposed to and spaced apart from each other. Each holding member 36 holds the vicinity of the opening of the storage bag 34. Whereas a position of the holding member 36 at the left side in FIG. 3 is fixed, the holding member 36 at the right side in FIG. 3 can move between a position shown in FIG. 3 and a position at which the holding member 36 at the right side is in contact with the holding member 36 at the left side.

[0026] A heating member 37 for sealing the opening of the storage bag 34 is disposed at each of the left and right holding members 36. After a predetermined number of banknotes are stored in the storage bag 34 held by the holding members 36, one of the holding members 36 moves to a position at which the holding member 36 is in contact with the other holding member 36 with the opening of the storage bag 34 therebetween. In a state where the storage bag 34 is interposed between the two holding members 36, the heating members 37 apply heat to the storage bag 34 to thermally seal the opening.

[0027] The storage mechanism 32 includes a pair of stages 40 for supporting the storage bag 34 held by the holding members 36, from below. The stages 40 are disposed so as to be movable in the up-down direction. The left and right stages 40 are connected by a hinge structure so as to be able to open and close. Opening/closing and up/down movement of the stages 40 are performed by a stage drive unit that is not shown. FIG. 3 shows a state where the left and right stages 40 are closed with the storage bag 34 interposed in the gap therebetween. The storage bag 34 held by the holding members 36 is brought into a state where a lower part thereof extends downward through the gap between the stages 40.

[0028] A heating member 42 for thermally bonding the storage bag 34 is disposed at each of the left and right stages 40. After a predetermined number of banknotes are stored in the storage bag 34 held by the holding members 36, the left and right stages 40 move from positions where a gap is formed therebetween to closed positions where the stages 40 are in contact with each other with the storage bag 34 therebetween. In a state where the storage bag 34 is interposed between the two stages 40, the heating members 42 apply heat to a portion that is to be a bottom portion of the storage bag 34 having the banknotes stored therein, thereby thermally bonding the portion. The position where thermal bonding is performed

by each heating member 42 is adjusted in accordance with the number of banknotes stored in the storage bag 34, by moving the stages 40 up or down.

[0029] A pushing member 46 for pushing the banknotes 100b stacked on the gate member 44, into the storage bag 34, is disposed above the gate member 44. The pushing member 46 and the storage mechanism 32 are connected by a pantograph type link mechanism 47. The pushing member 46 moves in the up-down direction as indicated by an arrow in FIG. 3, by the link mechanism 47. Movement of the pushing member 46 is performed by a pushing member drive unit that is not shown.

[0030] A plurality of sensors 48 are disposed above the gate member 44. A sensor 48 including a light emitter and a light receiver is disposed so as to correspond to the left member 44L. The sensor 48 applies detection light from the light emitter to the left member 44L and receives the detection light reflected by the left member 44L, by the light receiver. In addition, another sensor 48 including a light emitter and a light receiver is disposed so as to correspond to the right member 44R. The sensor 48 applies detection light from the light emitter to the right member 44R and receives the detection light reflected by the right member 44R, by the light receiver.

[0031] When there is any banknote on the gate member 44, the amount of the detection light received by each sensor 48 is changed. The money handling apparatus 1 detects presence/absence of the banknotes 100b stacked on the gate member 44, on the basis of a change in the detection light emitted and received by each sensor 48.

[0032] Also, the amount of the detection light received by each sensor 48 changes during the gate member 44 opens and closes in a state where there is no banknote thereon. It is because the direction of the detection light reflected by each of the left member 44L and the right member 44R is changed in accordance with the rotation position of each member 44L and 44R. The money handling apparatus 1 detects the positions of the left member 44L and the right member 44R, which open and close, on the basis of a change in the detection light emitted and received by each sensor 48. The money handling apparatus 1 detects whether or not the left member 44L and the right member 44R that have moved from the closed position to the opened position have returned to the closed position again when opening and closing the gate member 44. The detection method will be described in detail later.

[0033] Next, a method for storing banknotes in the storage bag 34 will be described. FIG. 4A and 4B illustrate a method for storing the banknotes 100b stacked on the gate member 44, into the storage bag 34. As shown in FIG. 3, the banknotes 100b to be stored in the storage bag 34 are stacked on the gate member 44 that is at the closed position. When the number of the banknotes 100b stacked reaches a predetermined number (for example, 10), the money handling apparatus 1 suspends stacking of banknotes onto the gate member 44 and opens the

gate member 44 as indicated by arrows in FIG. 4A.

[0034] When the left member 44L and the right member 44R have moved from the closed position to the opened position to open the gate member 44, the passage leading to the storage bag 34 is opened, so that the banknotes 100b can pass through the passage. The banknotes 100b stacked on the gate member 44 drop between the left member 44L and the right member 44R that have rotated to the opened position, due to the weights of the banknotes 100b, and are stored in the storage bag 34. When there are banknotes 100a already stored in the storage bag 34, the dropped banknotes 100b are stacked on the banknotes 100a as shown in FIG. 4A.

[0035] The money handling apparatus 1 further pushes the banknotes 100b that have dropped into the storage bag 34, from above by the pushing member 46 to store the banknotes 100b into the storage bag 34. Specifically, the pushing member drive unit that is not shown drives the link mechanism 47 having an upper end connected to the storage mechanism 32 to stretch in the up-down direction. Accordingly, the pushing member 46 connected to the lower end of the link mechanism 47 moves downward to push the banknotes 100b into the storage bag 34.

[0036] After the pushing member 46 moves downward to push the banknotes 100b into the storage bag 34 as shown in FIG. 4A, the pushing member 46 moves upward and returns to the original position as indicated by an arrow in FIG. 4B. After the pushing member 46 returns to the original position, the drive by the gate member drive unit is released, and the left member 44L and the right member 44R return to the closed position as indicated by arrows in FIG. 4B, by the bias force of the spring member.

[0037] As described above, by opening and closing the gate member 44, the money handling apparatus 1 stores the banknotes 100b stacked on the gate member 44, into the storage bag 34. After the money handling apparatus 1 stores the banknotes 100b into the storage bag 34, the money handling apparatus 1 detects whether or not there is any banknote that is not stored in the storage bag 34 and remains, by using the sensors 48.

[0038] If it is confirmed that there is no remaining banknote, the money handling apparatus 1 restarts stacking of banknotes onto the gate member 44. Each time a predetermined number of banknotes are stacked on the gate member 44, the money handling apparatus 1 opens the gate member 44 and stores the banknotes into the storage bag 34 by the pushing member 46.

[0039] If it is confirmed that there is any remaining banknote, the money handling apparatus 1 performs a retry process. In the retry process, an operation of opening the gate member 44 and pushing the banknote into the storage bag 34 by the pushing member 46 is performed.

[0040] After the retry process is ended, the money handling apparatus 1 confirms whether the remaining banknote has disappeared, by using the sensors 48. If it is

confirmed that the remaining banknote has disappeared, the money handling apparatus 1 restarts stacking of banknotes onto the gate member 44. If it is confirmed that the remaining banknote is still there, the money handling apparatus 1 performs the retry process again. If the remaining banknote is repeatedly detected even when the retry process is performed a predetermined number of times that is set in advance, the money handling apparatus 1 determines that an error has occurred, and notifies the operator of the money handling apparatus 1 that the error has occurred. For example, the money handling apparatus 1 displays information indicating the occurrence of the error and information indicating that there is a remaining banknote, on the operation/display unit 29. The operator confirms the information displayed on the operation/display unit 29, removes the remaining banknote, and then restarts handling of banknotes.

[0041] Regarding the error notification, it is possible to set that the notified content is changed in accordance with the state of the storage bag 34. In the case of such setting, when the sensors 48 detect any remaining banknote, the money handling apparatus 1 changes the notification content on the basis of the number of banknotes stored in the storage bag 34.

[0042] Upon opening and closing the gate member 44, an uppermost banknote 100c among the banknotes 100b stored in the storage bag 34 may be in a standing state and caught between the left member 44L and the right member 44R returning from the opened position to the closed position, as indicated by a dashed arrow in FIG. 4B. When the number of banknotes stored in the storage bag 34 is close to the maximum number of banknotes that can be stored in the storage bag 34, a state where the banknote 100c is caught by the gate member 44 as described above is likely to occur.

[0043] The number of banknotes that is close to the maximum number of banknotes that can be stored in the storage bag 34 is set as a threshold in advance. If the number of banknotes being stored in the storage bag 34 is smaller than the threshold when the sensors 48 detect any remaining banknote, the money handling apparatus 1 determines that the sensors 48 have detected a banknote on the gate member 44. In this case, the money handling apparatus 1 displays information indicating that there is a remaining banknote on the gate member 44, on the operation/display unit 29. If the number of banknotes being stored in the storage bag 34 is equal to or larger than the threshold when the sensors 48 detect any remaining banknote, the money handling apparatus 1 determines that the sensors 48 have detected a banknote caught between the left member 44L and the right member 44R. In this case, the money handling apparatus 1 displays information indicating that there is a remaining banknote caught by the gate member 44, on the operation/display unit 29. The operator can search for and remove the remaining banknote on the basis of the content displayed on the operation/display unit 29.

[0044] The money handling apparatus 1 has one fea-

ture that, when there is the banknote 100c caught by the gate member 44 as shown in FIG. 4B, the banknote 100c can be accurately detected. The sensors 48, which are disposed above the gate member 44 as shown in FIG. 3, detect any remaining banknote on the basis of a change in the amount of the detection light when the detection light applied to and reflected by the gate member 44 is blocked by the remaining banknote. For example, when a remaining banknote is caught by the gate member 44 in a state where a banknote surface thereof is almost vertical, there is a possibility that the detection light is not sufficiently blocked by the remaining banknote. Even in such a case, the money handling apparatus 1 can detect the remaining banknote on the basis of the positions of the left member 44L and the right member 44R. Specifically, the gate member 44 has a structure in which, when a remaining banknote is caught between the left member 44L and the right member 44R, at least either one of the left member 44L and the right member 44R cannot return to the closed position. That is, when a remaining banknote is caught by the gate member 44, the remaining banknote blocks at least either one of the left member 44L and the right member 44R from returning to the closed position. Even when a remaining banknote caught by the gate member 44 is not directly detected by the sensors 48, any of the sensors 48 detects that at least either one of the left member 44L and the right member 44R has not returned to the closed position due to the presence of the remaining banknote. The money handling apparatus 1 can detect that there is a remaining banknote, on the basis of a detection result of the sensors 48. Hereinafter, the structure of the gate member 44 and a method for detecting the position of the gate member 44 by the sensors 48 will be described.

[0045] The gate member 44 will be described. FIG. 5 illustrates the gate member 44. The gate member 44 includes the two members 44L and 44R each having a substantially rectangular plate shape. Irregularities are formed on the side surface of the members 44L and 44R. A banknote 100 sent from the transport unit 23 is stacked on the gate member 44 as indicated by a dotted line in FIG. 5. The gate member 44 is configured to allow a banknote having a maximum length in the short edge direction thereof (Y axis direction), among a plurality of kinds of banknotes to be handled by the money handling apparatus 1, to be stacked on the gate member 44 in a flat shape without being bent. In addition, the gate member 44 is configured to allow a banknote having a maximum length in the long edge direction thereof (X axis direction), among the plurality of kinds of banknotes to be handled by the money handling apparatus 1, to be stacked on the gate member 44 in a flat shape without being bent.

[0046] A plurality of projections 44d are formed in a comb shape over the entirety of one long edge side surface of each of the left member 44L and the right member 44R. A plurality of projected portions 44e each having a through hole for inserting the shaft 44a are formed on

the other long edge side surface of each of the left member 44L and the right member 44R. Each projection 44d has a substantially rectangular parallelepiped shape projecting outward from the side surface of the member 44L or 44R.

[0047] The left member 44L and the right member 44R are disposed opposed to each other. A plurality of projections 44d are formed on the long edge side surface, of the left member 44L, opposing the right member 44R, so as to project from the long edge side surface toward the right member 44R. Similarly, a plurality of projections 44d are formed on the long edge side surface, of the right member 44R, opposing the left member 44L, so as to project from the long edge side surface toward the left member 44L.

[0048] As shown in FIG. 5, the projections 44d having the same shape are formed on the side surface of each of the members 44L and 44R at equal intervals in a row in the long edge direction. The projections 44d of the left member 44L and the projections 44d of the right member 44R have the same shape. The projections 44d of the left member 44L are formed at the same intervals as the projections 44d of the right member 44R.

[0049] The projections 44d of the left member 44L and the projections 44d of the right member 44R are formed at different positions in the long edge direction so as to be shifted relative to each other as shown in FIG. 5, when the left member 44L and the right member 44R are at the closed position. The projections 44d of the left member 44L and the projections 44d of the right member 44R do not overlap each other and are engaged in mesh with each other as shown in FIG. 5, when the left member 44L and the right member 44R are at the closed position. The projections 44d formed in a comb shape on the long edge side surface of the left member 44L are arranged so as to fill the recessed spaces between the respective projections 44d formed in a comb shape on the long edge side surface of the right member 44R.

[0050] In the short edge direction, when the gate member 44 is at the closed position as shown in FIG. 5, the tips of the projections 44d of the left member 44L are located at the base side with respect to the tips of the projections 44d of the right member 44R. In other words, the positions of the tip ends of the projections 44d projecting in the Y axis negative direction from the long edge side surface of the left member 44L are at the Y axis negative direction side with respect to the positions of the tip ends of the projections 44d projecting in the Y axis positive direction from the long edge side surface of the right member 44R.

[0051] As shown in FIG. 5, when the gate member 44 is at the closed position, each projection 44d of the left member 44L is located between two adjacent projections 44d of the right member 44R. When the gate member 44 is at the closed position, a substantially horizontal flat surface having no step is formed by the upper surface of the left member 44L and the upper surface of the right member 44R, so that banknotes can be stacked on this

flat surface.

[0052] When the gate member 44 is at the closed position, the projections 44d of the left member 44L and the projections 44d of the right member 44R, which are arranged alternately in the long edge direction, are brought into mesh with each other, so that the gap between the left member 44L and the right member 44R is not linear but has a zigzag shape. Accordingly, a banknote sent from the transport unit 23 is prevented from dropping through the gap between the left member 44L and the right member 44R into the storage bag 34 located at the lower side (in the Z axis negative direction) of these members 44L and 44R.

[0053] Each shaft 44a having an axis along the X axis direction is supported at both ends thereof by a side wall of the storage mechanism 32. Although not shown in FIG. 5, for example, the shaft 44a at the left member 44L and the shaft 44a at the right member 44R are connected by a connection mechanism such that the left member 44L and the right member 44R open in conjunction with each other.

[0054] As shown in FIG. 5, each shaft 44a is inserted through both through holes formed in a plurality of projected portions 32a of the side wall of the storage mechanism 32 and through holes formed in the projected portions 44e formed on the long edge side surface of the gate member 44. The projected portions 44e of the gate member 44 are inserted between the projected portions 32a of the storage mechanism 32, so that the gap between the long edge side surface of the gate member 44 and the storage mechanism 32 is not linear. Accordingly, a banknote sent from the transport unit 23 is prevented from dropping downward through the gap between the gate member 44 and the storage mechanism 32.

[0055] A plurality of projected portions 44c for closing the gap between the storage mechanism 32 and the gate member 44 are formed on short edge side surfaces of the gate member 44. The projected portions 44c are formed on both the short edge side surface at the upper side shown in FIG. 5 and the short edge side surface at the lower side shown in FIG. 5. Accordingly, a banknote sent from the transport unit 23 is prevented from dropping downward through the gap between each short edge side surface of the gate member 44 and the storage mechanism 32.

[0056] As shown in FIG. 5, a plurality of detection areas 44b are formed on the upper surface of the gate member 44. Specifically, a plurality of detection areas 44b are formed on the upper surface of the left member 44L, and a plurality of detection areas 44b are also formed on the upper surface of the right member 44R. The detection areas 44b reflect the detection light applied from the sensors 48. For example, the detection areas 44b are each formed by attaching a mirror-finished flat member to the gate member 44.

[0057] FIG. 6 illustrates the arrangement of the sensors 48. The sensors 48 include a light emitter and a light receiver. The sensors 48 are disposed so as to corre-

spond to the respective detection areas 44b formed on the gate member 44, respectively. Each sensor 48 is disposed such that detection light applied from the light emitter and reflected by the detection area 44b is received by the light receiver as indicated by a dotted line in FIG. 6.

[0058] Each detection area 44b is formed at a position that is covered by the banknote 100 when the banknote 100 is stacked on the upper surface of the gate member 44 as indicated by the dotted line in FIG. 5. The money handling apparatus 1 detects presence/absence of the banknote 100 stacked on the gate member 44, on the basis of a change in the amount of detection light due to blocking of the detection light, which is emitted and received by the sensors 48, by the banknote 100. Some banknotes may include a transparent area that transmits light. When the transparent area of the banknote 100 stacked on the gate member 44 coincides with the detection areas 44b, there is a possibility that the detection light is not blocked by the banknote 100 and the banknote 100 cannot be detected on the basis of a change in the amount of detection light. Even when the detection light passes through the transparent area of the banknote 100 at some of the detection areas 44b, the money handling apparatus 1 can detect the banknote 100 by the detection light at the other detection areas 44b.

[0059] When the banknote 100c caught by the gate member 44 as shown in FIG. 4B covers at least either one of the detection areas 44b, the money handling apparatus 1 can detect the banknote 100c by the corresponding sensor 48. Depending on the state of the banknote 100c, there is a possibility that none of the detection areas 44b is covered. However, in such a case as well, the money handling apparatus 1 can detect that there is the banknote 100c, on the basis of the position of the gate member 44.

[0060] FIGS. 7A to 7C illustrate a method for detecting a banknote caught by the gate member 44. As shown in FIGS. 7A and 7B, the projections 44d of the left member 44L and the right member 44R that are at the closed position are engaged in mesh with each other, and the left member 44L and the right member 44R overlap each other by a width W_a in the lateral direction (Y axis direction) when being seen from the longitudinal direction (X axis direction). Thus, when the banknote 100c is caught by the gate member 44 as shown in FIG. 4B, at least either one of the left member 44L and the right member 44R, which form the gate member 44, cannot return to the closed position.

[0061] For example, when the banknote 100 is caught through a position 81 between the lower surface of the right member 44R and the upper surface of the left member 44L as shown in FIG. 7C, the right member 44R can return to the closed position, but the left member 44L cannot return to the closed position due to the presence of the caught banknote 100. As shown in FIG. 7C, the left member 44L stops at a position where the left member 44L slightly rotates from the closed position toward the opened position.

[0062] The detection light applied from the sensors 48 to the detection areas 44b of the left member 44L is reflected at a position 82 shown in FIG. 7C. The gate member 44 is configured such that the amount of the detection light emitted and received by the sensors 48 changes between when the gate member 44 is at the closed position and when the gate member 44 is in the state shown in FIG. 7C. Specifically, a distance d shown in FIG. 7C is set to a distance that allows the sensors 48 to detect a change in the amount of the detection light. An angle α is set on the basis of the distance d , and the overlap width W_a of the projections 44d and the thickness t of each projection 44d are set on the basis of the angle α .

[0063] When the banknote 100 is caught between the left member 44L and the right member 44R as shown in FIG. 7C, the angle α formed by the lower surface of the right member 44R and the upper surface of the left member 44L is determined by the overlap width W_a and the thickness t of the projections 44d of the left member 44L and the right member 44R. The distance d is determined by the angle α and the position 82 at which the detection light is reflected. If the distance d is too small, a change in the amount of the detection light emitted and received by the sensors 48 is too small, and it cannot be detected that the left member 44L has not returned to the closed position. Thus, the distance d is set to a distance that allows the sensors 48 to detect that the left member 44L has not returned to the closed position. The dimensions and the shapes of the left member 44L and the right member 44R including the overlap width W_a and the thickness t are set such that the distance d is realized.

[0064] For example, even when the banknote 100 caught by the gate member 44 is in a standing state as shown in FIG. 7C and does not block the detection light, the sensors 48 detect that the left member 44L has not returned to the closed position, on the basis of a change in the amount of the detection light applied to and reflected by the gate member 44. Accordingly, the money handling apparatus 1 can detect that there is a banknote 100 caught by the gate member 44.

[0065] FIG. 7C shows the case where the banknote 100 is caught between the upper surface of the left member 44L and the lower surface of the right member 44R, but the banknote 100 may be caught between the lower surface of the left member 44L and the upper surface of the right member 44R. In such a case as well, the money handling apparatus 1 can detect that the right member 44R has not returned to the closed position, on the basis of a change in the detection light emitted and received by the sensors 48 with respect to the detection areas 44b of the right member 44R. Accordingly, the money handling apparatus 1 can detect that there is a banknote 100 caught by the gate member 44.

[0066] In the case where the left member 44L and the right member 44R, which form the gate member 44, are disposed so as to be symmetric with respect to a center line in the short edge direction of the gate member 44, a banknote may be caught with the left member 44L located

at the lower side than the right member 44R, or a banknote may be caught with the right member 44R located at the lower side than the left member 44L. It is possible to configure the gate member 44 such that a banknote is caught with the same one member located at the lower side than the other member. A specific description will be given with the case where a banknote is caught with the right member 44R located at the lower side, as an example.

[0067] FIGS. 8A to 8C show the configuration of the gate member 44 by which the banknote 100 is caught with the right member 44R located at the lower side. As shown in FIG. 8A, the length in the short edge direction of the right member 44R is longer than that of the left member 44L. Specifically, a length L_a from the axis of the shaft 44a about which the right member 44R rotates to the tip end of the projection 44d of the right member 44R is longer than a length L_b from the axis of the shaft 44a about which the left member 44L rotates to the tip end of the projection 44d of the left member 44L ($L_a > L_b$).

[0068] After the left member 44L and the right member 44R move from the closed position to the opened position, the left member 44L and the right member 44R rotate by the same angles at the same timings and return to the closed position by the bias force of the spring member. As shown in FIG. 8B, when the left member 44L and the right member 44R return by the same angle from the closed position, the tips of the projections 44d of the right member 44R are located below the tips of the projections 44d of the left member 44L in the up-down direction. The banknote 100 between the left member 44L and the right member 44R is caught between the projections 44d of the left member 44L and the projections 44d of the right member 44R that are located below the projections 44d of the left member 44L. Thus, when the gate member 44 is closed as shown in FIG. 8C, the banknote 100 is caught between the lower surface of the left member 44L that has returned to the closed position and the upper surface of the right member 44R that cannot return to the closed position.

[0069] When using the configuration in which the one member 44R is always located at the lower side when the banknote 100 is caught between members 44L and 44R as described above, it is preferable to use sensors that detect with high accuracy the banknote 100 stacked on the member 44R and the position of the member 44R that cannot return to the closed position. For example, the number of sensors for the right member 44R is increased as compared to the number of sensors for the left member 44L. Alternatively, for example, sensors having higher performance than the sensors for the left member 44L are used for the right member 44R. Accordingly, the banknote 100 caught between the left member 44L and the right member 44R can be detected with higher accuracy.

[0070] The overlap width W_a of the left member 44L and the right member 44R shown in FIGS. 7A to 7C and FIGS. 8A to 8C changes depending on the shapes of the

projections 44d. FIG. 9 shows the structure of the projections 44d. For example, the overlap width W_a of the projections 44d shown in FIG. 9 is set to about 6 mm, and a gap W_b in the short edge direction between the left member 44L and the right member 44R is set to about 2 mm. In addition, a length L_c in the long edge direction of each projection 44d is set to about 6 mm, and each gap L_d in the long edge direction between the projections 44d of the left member 44L and the projections 44d of the right member 44R is set to about 3 mm.

[0071] FIG. 10 shows a specific structure example of the gate member 44. The projections 44d of the left member 44L and the projections 44d of the right member 44R shown in FIG. 10 are chamfered. The cross-sectional shape of each projection 44d seen from the short edge side (Y axis direction) is a trapezoidal shape in which the upper side is smaller than the lower side. The long edge side surface connecting two adjacent projections 44d is also chamfered similar to the projections 44d.

[0072] FIG. 11 shows a side shape of the gate member 44 shown in FIG. 10. The upper drawing of FIG. 11 is a view of the gate member 44 shown in FIG. 10 as seen from the long edge direction (X axis negative direction). The left member 44L and the right member 44R are disposed such that the tips of the projections 44d thereof overlap each other in the width direction (Y axis direction) when being seen from the long edge direction. To show this overlap portion, only the right member 44R of the gate member 44 shown in the upper drawing of FIG. 11 is shown in the middle drawing, and only the left member 44L thereof is shown in the lower drawing.

[0073] A length L_1 from the axis of the shaft 44a of the right member 44R to the tip end of the projection 44d of the right member 44R is longer than a length L_3 from the axis of the shaft 44a of the left member 44L to the tip end of the projection 44d of the left member 44L ($L_1 > L_3$). For example, the length L_1 of the right member 44R is longer than the length L_3 of the left member 44L by a few millimeters. Thus, a length L_2 from a center line between the axis of the shaft 44a of the right member 44R and the axis of the shaft 44a of the left member 44L to the tip end of the projection 44d of the right member 44R is longer than a length L_4 from the center line to the tip end of the projection 44d of the left member 44L ($L_2 > L_4$).

[0074] FIGS. 12A and 12B show a state where the banknote 100 is caught by the gate member 44 shown in FIG. 10 and FIG. 11. FIG. 12A shows the case where the banknote 100 is caught with the left member 44L located at the lower side, and FIG. 12B shows the case where the banknote 100 is caught with the right member 44R located at the lower side.

[0075] For example, the length L_1 shown in FIG. 11 is set to about 55.5 mm, the length L_3 shown in FIG. 11 is set to about 51.5 mm, the length L_2 shown in FIG. 11 is set to about 4.5 mm, the length L_4 shown in FIG. 11 is set to about 1.5 mm, and the thickness t of the projections 44d shown in FIG. 11 is set to about 7 mm. In this case, angles β_1 and β_2 shown in FIGS. 12A and 12B are each

about 8 degrees, and can be detected by the sensors 48 when the banknote 100 is caught and the left member 44L or the right member 44R cannot return to the closed position. Although FIGS. 12A and 12B respectively show the case where the banknote 100 is caught with the left member 44L located at the lower side and the case where the banknote 100 is caught with the right member 44R located at the lower side, since the length L_1 of the right member 44R is longer than the length L_3 of the left member 44L, the banknote 100 is normally caught with the right member 44R located at the lower side as shown in FIG. 12B.

[0076] FIG. 6 shows the example in which whether or not the left member 44L and the right member 44R that have rotated to the opened position have returned to the closed position is detected by using the sensors 48 that is also used for detecting presence/absence of any banknote stacked on the gate member 44, but the usage of sensors is not limited thereto. For example, in addition to the sensors 48 for detecting presence/absence of any banknote stacked on the gate member 44, a sensor for detecting any banknote caught by the gate member 44 may be disposed.

[0077] FIG. 13 shows an example in which sensors 51 and 52 that emit and receive detection light in the short edge direction of the gate member 44 are disposed. FIG. 13 shows a state where a banknote is caught between the left member 44L and the right member 44R, although the caught banknote is not shown in FIG. 13 for easy explanation.

[0078] As shown in FIG. 13, the sensor 51 is disposed such that the detection light passes slightly above the upper surface of the gate member 44 at the closed position and passes substantially parallel to the upper surface. Accordingly, if a part of the banknote caught by the gate member 44 is located above the upper surface of the gate member 44 at the closed position, the money handling apparatus 1 can detect the caught banknote by the sensor 51. FIG. 13 shows one sensor 51, but, when a plurality of sensors 51 are disposed so as to be spaced apart from each other in the X axis direction, the detection accuracy is further improved.

[0079] As shown in FIG. 13, the sensor 52 is disposed such that the detection light passes slightly below the lower surfaces of the projections 44d at the closed position and passes substantially parallel to the upper surface of the gate member 44 at the closed position. Accordingly, if a part of the banknote caught by the gate member 44 is located below the lower surfaces of the projections 44d of the gate member 44 at the closed position, the money handling apparatus 1 can detect the caught banknote by the sensor 52. In addition, the projections 44d of the right member 44R that cannot return to the closed position due to the caught banknote block the detection light of the sensor 52 as shown in FIG. 13, and therefore it enables the money handling apparatus 1 to detect that there is the banknote caught by the gate member 44. FIG. 13 shows one sensor 52, but, when a plurality of

sensors 52 are disposed so as to be spaced apart from each other in the X axis direction, the detection accuracy is further improved.

[0080] FIGS. 14A to 14C show an example in which sensors 53 and 54 that emit and receive detection light in the long edge direction of the gate member 44 are disposed. FIG. 14A shows the gate member 44 at the closed position. FIGS. 14B and 14C each show a state where a banknote is caught between the left member 44L and the right member 44R, although the caught banknote is not shown in FIGS. 14B and 14C for easy explanation.

[0081] As shown in FIG. 14A, the sensors 53 and 54 are disposed such that the detection light passes slightly below the lower surfaces of the projections 44d and passes substantially parallel to the upper surface of the gate member 44 at the closed position. As shown in FIG. 14B, the detection light by the sensor 53 is emitted and received at a position overlapping the projections 44d of the left member 44L that cannot return to the closed position due to the caught banknote. As shown in FIG. 14C, the detection light by the sensor 54 is emitted and received at a position overlapping the projections 44d of the right member 44R that cannot return to the closed position due to the caught banknote. If a part of a banknote caught by the gate member 44 is located below the lower surface of the left member 44L or the right member 44R that has returned to the closed position, the money handling apparatus 1 can detect the caught banknote by the sensor 53 or 54. In addition, the projections 44d of the left member 44L or the right member 44R that cannot return to the closed position due to the caught banknote block the detection light of the sensor 53 or 54, and therefore it enables the money handling apparatus 1 to detect that there is the banknote caught by the gate member 44.

[0082] FIG. 5 to FIG. 14C show examples in which the projections 44d having the same shape which is a substantially rectangular parallelepiped shape are formed in a comb shape in a row at equal intervals on each of the opposing side surfaces of the left member 44L and the right member 44R, but the configurations of the projections 44d are not limited thereto.

[0083] The shapes of the projections 44d are not particularly limited, as long as: any banknote does not drop downward through the gap of the gate member 44 when the gate member 44 is at the closed position; and a component of the gate member 44 that cannot return to the closed position when a banknote is caught by the gate member 44 can be detected.

[0084] FIGS. 15A to 15D each show an example of projections 144a and 144b having different shapes. For example, the projections 144a and 144b are not limited to those all having the same length in the long edge direction. Some of the projections 144a and 144b may have different lengths in the long edge direction as shown in FIG. 15A. Similarly, the projections 144a and 144b are not limited to those all having the same length in the short

edge direction, and some of the projections 144a and 144b may have different lengths in the short edge direction.

[0085] The projection 144a of a left member 144L and the projections 144b of the right member 144R are not limited to those all in mesh with each other at the closed position. For example, the left member 144L and the right member 144R may include projections 144c that are not engaged in mesh with each other at the closed position as shown in FIG. 15B.

[0086] The shape of each projection is not limited to a substantially rectangular parallelepiped shape. As long as the gate member 44 can be opened and closed, the shapes of the projections 144a and 144b as seen from above may include curved lines, for example, as shown in FIG. 15C. Similarly, the shapes of the projections 144a and 144b as seen from the short edge side may include curved lines.

[0087] The projections 144a of the left member 144L and the projections 144b of the right member 144R are not limited to those arranged alternately one by one in the long edge direction. For example, as shown in FIG. 15D, a plurality of projections 144a of the left member 144L may be arranged consecutively, and then a plurality of projections 144b of the right member 144R may be arranged consecutively.

[0088] FIG. 16 shows an example of a gate member 244 (244L, 244R) having different shapes. As shown in FIG. 16, a length W_a in the short edge direction of each projection 244a may be longer than a length W_c in the short edge direction of a body portion 244b connecting the projections 244a formed in a comb shape.

[0089] The method for opening and closing the gate member is also not limited to a method in which two members, a left member and a right member, disposed opposed to each other rotate to open and close the gate member. For example, the gate member may be opened or closed by translating the two members, i.e., the left member and the right member, such that mesh of projections of the two members is released.

[0090] FIGS. 17A to 17C show an example of the gate member 244 that is opened and closed by moving parallel in a horizontal direction. FIGS. 18A and 18B show a part of the gate member 244 and a part of the storage mechanism 32 shown in FIGS. 17A to 17C.

[0091] As shown in FIG. 18A, through holes 32c are formed in the side wall, which is parallel to the long edge direction (X axis direction), of the storage mechanism 32. Positions of the through holes 32c match with positions of projections 244a of the gate member 244, respectively. As shown in FIG. 18B, grooves 32b are formed on the side wall, which is parallel to the short edge direction (Y axis direction), of the storage mechanism 32. Positions of the grooves 32b match with positions of the short edge side surface of the gate member 244 such that the gate member 244 can move in the short edge direction. In a state where the projections 244a are inserted into the through holes 32c of the long edge side wall of the storage

mechanism 32, the gate member 244 is supported so as to be movable along the grooves 32b of the short edge side wall of the storage mechanism 32. Accordingly, a banknote is prevented from dropping downward through the gap between the gate member 244 and the storage mechanism 32.

[0092] As indicated by a dotted line in FIG. 17B, banknotes 100 sent by the transport unit 23 are stacked on the gate member 244 at a closed position where the projections 244a of the left member 244L and the projections 244a of the right member 244R are engaged in mesh with each other.

[0093] The left member 244L and the right member 244R are biased to the closed position by a spring member that is not shown. A gate member drive unit, which is not shown, drives the gate member 244 to slide and open as indicated by arrows in FIG. 17C. Specifically, as indicated by the arrows in FIG. 17C, the left member 244L slides along the groove 32b to the left of the drawing, and the right member 244R slides along the groove 32b to the right of the drawing. When the left member 244L and the right member 244R further move from the position shown in FIG. 17C such that the projections 244a are retracted to both outer sides, the banknotes 100 stacked on the gate member 244 drop and are stored in the storage bag 34 located at the lower side of the gate member 244. After storing of the banknotes into the storage bag 34 is completed and the drive by the gate member drive unit is released, the left member 244L and the right member 244R return to the closed position by the bias force of the spring member.

[0094] As shown in FIG. 17A, a sensor 151 that emits and receives detection light in the long edge direction (X axis direction) are disposed at the left side of the left member 244L. Another sensor 152 that emits and receives detection light in the long edge direction is disposed at the right side of the right member 244R. When the left member 244L and the right member 244R are at the closed position as shown in FIG. 17A, the detection light of the sensors 151 and 152 are in a transmitted state. The left member 244L and the right member 244R slide from the closed position shown in FIGS. 17A and 17B and move to the opened position shown in FIG. 17C. When the left member 244L slides leftward from the closed position, the detection light of the sensor 151 is blocked by the left member 244L. When the right member 244R slides rightward from the closed position, the detection light of the sensor 152 is blocked by the right member 244R. When the left member 244L and the right member 244R return to the closed position by the bias force of the spring member after moving to the opened position, the detection light of the sensors 151 and 152 returns to the transmitted state. If a banknote is caught between the left member 244L and the right member 244R, the left member 244L and the right member 244R each having the projections 244a in a comb shape cannot return to the closed position and therefore, the detection light of the sensors 151 and 152 is kept in a blocked state.

The money handling apparatus 1 can detect presence/absence of any banknote caught by the gate member 244, on the basis of a change between transmission and blocking of the detection light.

[0095] The sensor arrangement is not limited to the example shown in FIG. 17A. For example, sensors 153 and 154 that emit and receive detection light in the up-down direction (Z axis direction) may be used as shown in FIGS. 17B and 17C. Specifically, the sensor 153 that emits and receives detection light in the up-down direction is disposed at the left side of the left member 244L so as to correspond to the position where the projections 244a of the left member 244L pass when opening and closing the gate member 244. Similarly, the sensor 154 that emits and receives detection light in the up-down direction is disposed at the right side of the right member 244R so as to correspond to the position where the projections 244a of the right member 244R pass when opening and closing the gate member 244. When the left member 244L and the right member 244R are at the closed position as shown in FIG. 17B, the detection light of the sensors 153 and 154 are in a transmitted state. While the left member 244L and the right member 244R are moving to the opened position as shown in FIG. 17C, the detection light of the sensors 153 and 154 is blocked by the body portion 244b or the projections 244a to be brought into a blocked state. When the left member 244L and the right member 244R return to the closed position by the bias force of the spring member after moving to the opened position, the detection light of the sensors 153 and 154 returns to the transmitted state again. If a banknote is caught between the left member 244L and the right member 244R, the left member 244L and the right member 244R cannot return to the closed position and therefore, the detection light of the sensors 153 and 154 is kept in the blocked state. The money handling apparatus 1 can detect presence/absence of any banknote caught by the gate member 244, on the basis of a change between transmission and blocking of the detection light.

[0096] In the present embodiment, the positions of the members that form the gate member 44, 144, or 244 are detected by the optical sensors that emit and receive detection light. However, the types of the sensors are not particularly limited as long as whether or not the gate member 44, 144, or 244 has returned to the closed position can be detected. For example, a sensor for mechanically detecting the position of each member may be used. For example, it can be detected whether or not the gate member 44, 144, or 244 has returned to the closed position by arranging a switch type mechanical sensor having a position detection function such that the sensor is switched between ON and OFF depending on whether each member is at the closed position or not at the closed position. Alternatively, it may be detected whether or not the gate member 44, 144, or 244 has returned to the closed position, for example, by detecting a rotation angle of a rotary encoder connected to the gate

member 44, 144, or 244 that is opened and closed by rotation. Still alternatively, it may be detected whether or not the gate member 44, 144, or 244 has returned to the closed position, for example, on the basis of an image captured by a camera for capturing an image of the gate member 44, 144, or 244. Still alternatively, the detection method is not limited to use of a single method, and a plurality of types of detection methods may be used in combination.

[0097] In the present embodiment, the gate member 44, 144, or 244 opens and closes the banknote passage leading to the storage bag 34. However, the use of the gate member 44, 144, or 244 is not limited thereto. For example, even in the case of using a cassette as a storage container instead of the storage bag 34, each process can be performed as described above. In addition, for example, in the case of storing banknotes into each storage unit fixed within the money handling apparatus 1, each process can be performed as described above. Additionally, the gate member 44, 144, or 244 can be used as described above for performing a temporary storage process for temporarily storing banknotes before storing the banknotes into a storage unit or a storage container.

[0098] The configurations of the money handling apparatus 1, the banknote handling unit 20, and the storage mechanism 32 described in the present embodiment are illustrative, and the configuration of each component is not particularly limited as long as a remaining banknote caught by the gate member 44, 144, or 244 can be detected as describe above. For example, the configuration of the storage bag 34 is not particularly limited, and the components that hold, support, and seal the storage bag 34 may have configurations different from those shown in FIG. 3.

[0099] The money handling apparatus according to the present embodiment includes: a storage configured to store money therein; a gate member configured to open and close a passage leading to the storage by moving between a closed position to restrict movement of money along the passage, and an opened position to allow the money to move along the passage; and a detection unit configured to detect presence/absence of money caught by the gate member.

[0100] In the above configuration, the detection unit detects presence/absence of the money caught by the gate member, on the basis of a position of the gate member.

[0101] In the above configuration, the gate member rotates between the opened position and the closed position.

[0102] In the above configuration, movement of the gate member between the opened position and the closed position is parallel movement with respect to a horizontal direction.

[0103] In the above configuration, the gate member includes a first member and a second member disposed opposed to each other, the first member and the second

member have shapes with which at least either one of the first member and the second member is blocked from returning to the closed position when money is caught between the first member and the second member while the first member and the second member are moving from the opened position to the closed position, and the detection unit detects that at least either one of the first member and the second member does not return to the closed position when the gate member moves from the opened position to the closed position.

[0104] In the above configuration, the first member has, on a side surface opposing the second member, a plurality of projections projecting from the side surface toward the second member, the second member has, on a side surface opposing the first member, a plurality of projections projecting from the side surface toward the first member, and the projections of the first member and the projections of the second member are formed at positions that allow the projections of the first member and the projections of the second member to be engaged with each other at the closed position.

[0105] In the above configuration, a tip of at least one projection of the first member is located at a base side with respect to a tip of at least one projection of the second member when the gate member is at the closed position.

[0106] In the above configuration, the first member includes at least one set of two projections adjacent to each other between which at least one projection of the second member interposed therebetween in a state where the gate member is at the closed position.

[0107] In the above configuration, the gate member has a stacking surface on which money is stacked when the gate member is at the closed position, and the detection unit detects presence/absence of money stacked on the stacking surface.

[0108] In the above configuration, the gate member has a stacking surface on which money is stacked when the gate member is at the closed position, and, when the gate member moves to the opened position, money stacked on the stacking surface is stored in the storage located below the stacking surface.

[0109] In the above configuration, the detection unit includes a sensor configured to emit detection light to the gate member and receive the detection light reflected by the gate member.

[0110] In the above configuration, the detection unit includes a sensor configured to emit and receive detection light, and the sensor is disposed at a position that allows the detection light to be blocked by money caught by the gate member or the gate member when the gate member opens and closes.

[0111] In the above configuration, the detection unit includes a light emitter configured to emit the detection light and a light receiver configured to receive the detection light and the light receiver is disposed at a position at which, when money is caught by the gate member, the light receiver opposes the light emitter with the caught money therebetween.

[0112] In the above configuration, the detection unit includes a sensor configured to mechanically detect a change in a position of the gate member.

[0113] In the above configuration, the gate member rotates about a rotation shaft between the closed position and the opened position, and the detection unit includes a sensor configured to detect a rotation angle of the gate member.

[0114] In the above configuration, the detection unit includes a camera configured to take an image of the gate member.

[0115] The money handling method according to the present embodiment includes: closing by a gate member a passage leading to a storage configured to store money therein, such that movement of money is restricted; opening by the gate member the passage, such that money moves along the passage; and detecting by a detection unit presence/absence of money caught by the gate member, after opening and closing of the gate member.

[0116] As described above, the money handling apparatus includes, on a passage through which money moves, a gate member that opens and closes the passage. After the gate member is opened to move money, money that cannot move and remains can be detected. For example, when money is caught by the gate member while the gate member is moving between the closed position and the opened position, the money handling apparatus can detect the remaining money by a sensor. The gate member includes a member that does not return to the closed position when money is caught by the gate member. The money handling apparatus can detect presence/absence of remaining money by detecting the member that does not return to the closed position with use of a sensor. That is, even when remaining money caught by the gate member cannot be directly detected, the money handling apparatus can indirectly detect the remaining money on the basis of the position of the gate member. Accordingly, the money handling apparatus can detect presence/absence of remaining money with higher accuracy than in the conventional art.

[0117] As described above, the money handling apparatus and the money handling method according to the present embodiment are useful for detecting money that cannot move and remains upon moving money in the apparatus, with high accuracy.

Claims

1. A money handling apparatus (1) comprising:

a storage (34) configured to store money;
a gate member (44) configured to open and close a passage leading to the storage (34) by moving between a closed position to restrict movement of the money and an opened position to allow the money to move along the passage; and

a detection unit (48) configured to detect presence/absence of money caught by the gate member (44).

2. The money handling apparatus (1) according to claim 1, wherein the detection unit (48) detects presence/absence of the money caught by the gate member (44) based on a position of the gate member (44).
3. The money handling apparatus (1) according to claim 1 or 2, wherein the gate member (44) rotates between the opened position and the closed position.
4. The money handling apparatus (1) according to claim 1 or 2, wherein movement of the gate member (244) between the opened position and the closed position is parallel movement with respect to a horizontal direction.
5. The money handling apparatus (1) according to any one of claims 1 to 4, wherein the gate member (44) includes a first member (44L) and a second member (44R) that are opposed to each other, the first member (44L) and the second member (44R) have shapes with which at least either the first member (44L) or the second member (44R) is blocked from returning to the closed position when money is caught between the first member (44L) and the second member (44R) while the first member (44L) and the second member (44R) are moving from the opened position to the closed position, and the detection unit (48) detects that at least either the first member (44L) or the second member (44R) does not return to the closed position when the gate member (44) moves from the opened position to the closed position.
6. The money handling apparatus (1) according to claim 5, wherein the first member (44L) has, on a side surface opposing the second member (44R), a plurality of projections projecting from the side surface toward the second member (44R), the second member (44R) has, on a side surface opposing the first member (44L), a plurality of projections projecting from the side surface toward the first member (44L), and the projections of the first member (44L) and the projections of the second member (44R) are formed at positions that allow the projections of the first member (44L) and the projections of the second member (44R) to be engaged with each other at the closed position.
7. The money handling apparatus (1) according to claim 6, wherein a tip of at least one projection of the

first member (44L) is located at a base side with respect to a tip of at least one projection of the second member (44L) when the gate member (44) is at the closed position.

8. The money handling apparatus (1) according to claim 6 or 7, wherein the first member (44L) includes at least one set of two projections adjacent to each other between which at least one projection of the second member (44R) interposed in a state where the gate member (44) is at the closed position. 5
9. The money handling apparatus (1) according to any one of claims 1 to 8, wherein the gate member (44) has a stacking surface on which money is stacked when the gate member (44) is at the closed position, and the detection unit (48) detects presence/absence of money stacked on the stacking surface. 10
10. The money handling apparatus (1) according to any one of claims 1 to 9, wherein the gate member (44) has a stacking surface on which money is stacked when the gate member (44) is at the closed position, and when the gate member (44) moves to the opened position, money stacked on the stacking surface is stored in the storage (34) located below the stacking surface. 15
11. The money handling apparatus (1) according to any one of claims 1 to 10, wherein the detection unit (48) includes a sensor configured to emit detection light to the gate member (44) and receive the detection light reflected by the gate member (44). 20
12. The money handling apparatus (1) according to any one of claims 1 to 11, wherein the detection unit (48) includes a sensor configured to emit and receive detection light, and the sensor is disposed at a position that allows the detection light to be blocked, while the gate member (44) opens and closes, by the gate member (44) and/or money caught by the gate member (44). 25
13. The money handling apparatus (1) according to claim 12, wherein the detection unit (51) includes a light emitter configured to emit the detection light and a light receiver configured to receive the detection light, and the light receiver is disposed at a position at which, when money is caught by the gate member (44), the light receiver opposes the light emitter with the caught money therebetween. 30
14. The money handling apparatus (1) according to any one of claims 1 to 13, wherein the detection unit includes a sensor configured to mechanically detect a change in a position of the gate member (44). 35

15. The money handling apparatus (1) according to any one of claims 1 to 14, wherein the gate member (44) rotates about a rotation shaft (44a) between the closed position and the opened position, and the detection unit includes a sensor configured to detect a rotation angle of the gate member (44). 40

16. The money handling apparatus (1) according to any one of claims 1 to 15, wherein the detection unit includes a camera configured to take an image of the gate member (44). 45

17. A money handling method comprising:

closing by a gate member (44) a passage leading to a storage (34) configured to store money therein, such that movement of the money is restricted;
opening by the gate member (44) the passage, such that the money moves along the passage; and
detecting by a detection unit (48) presence/absence of money caught by the gate member (44), after opening and closing of the gate member (44). 50

FIG.1

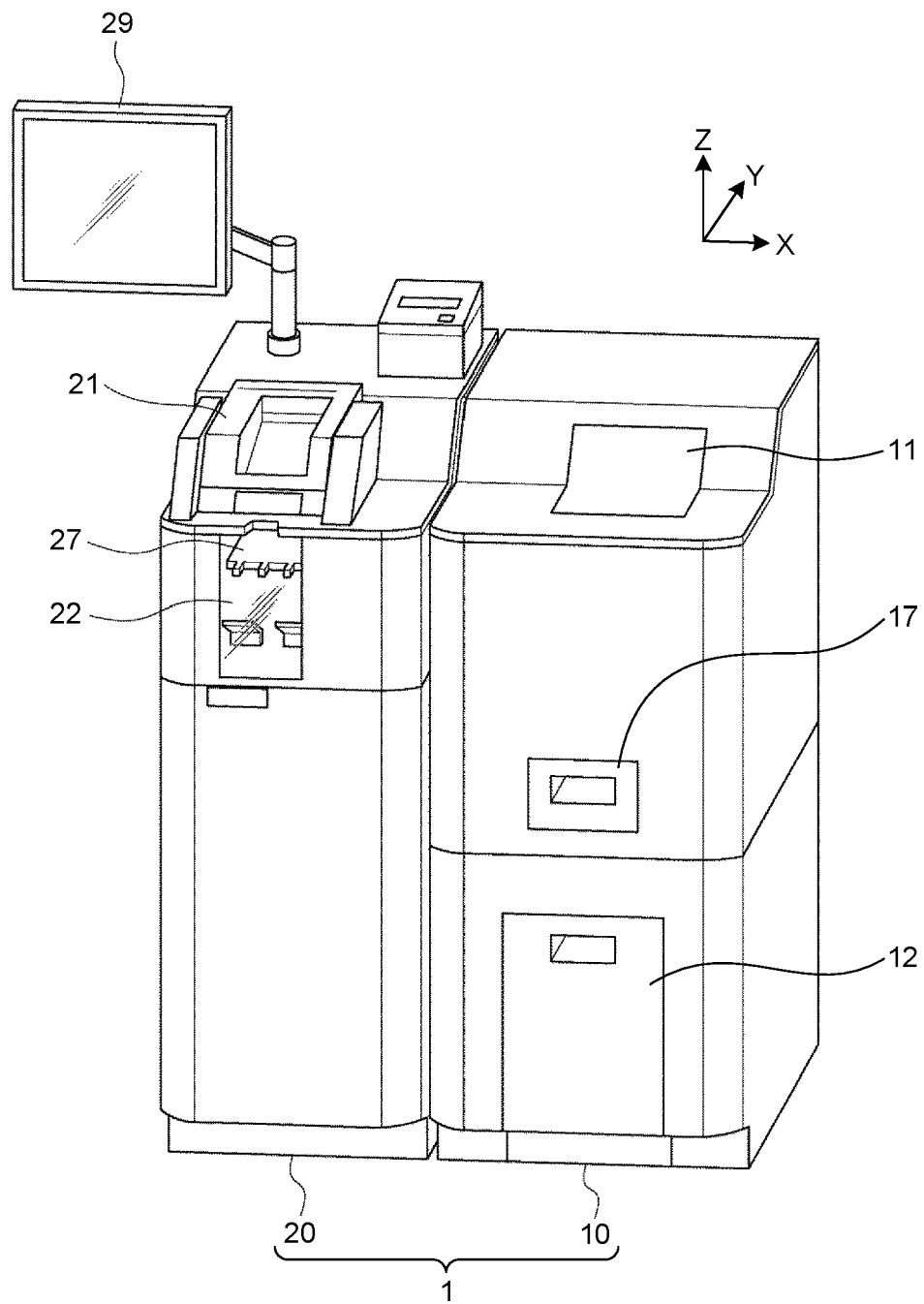


FIG.2

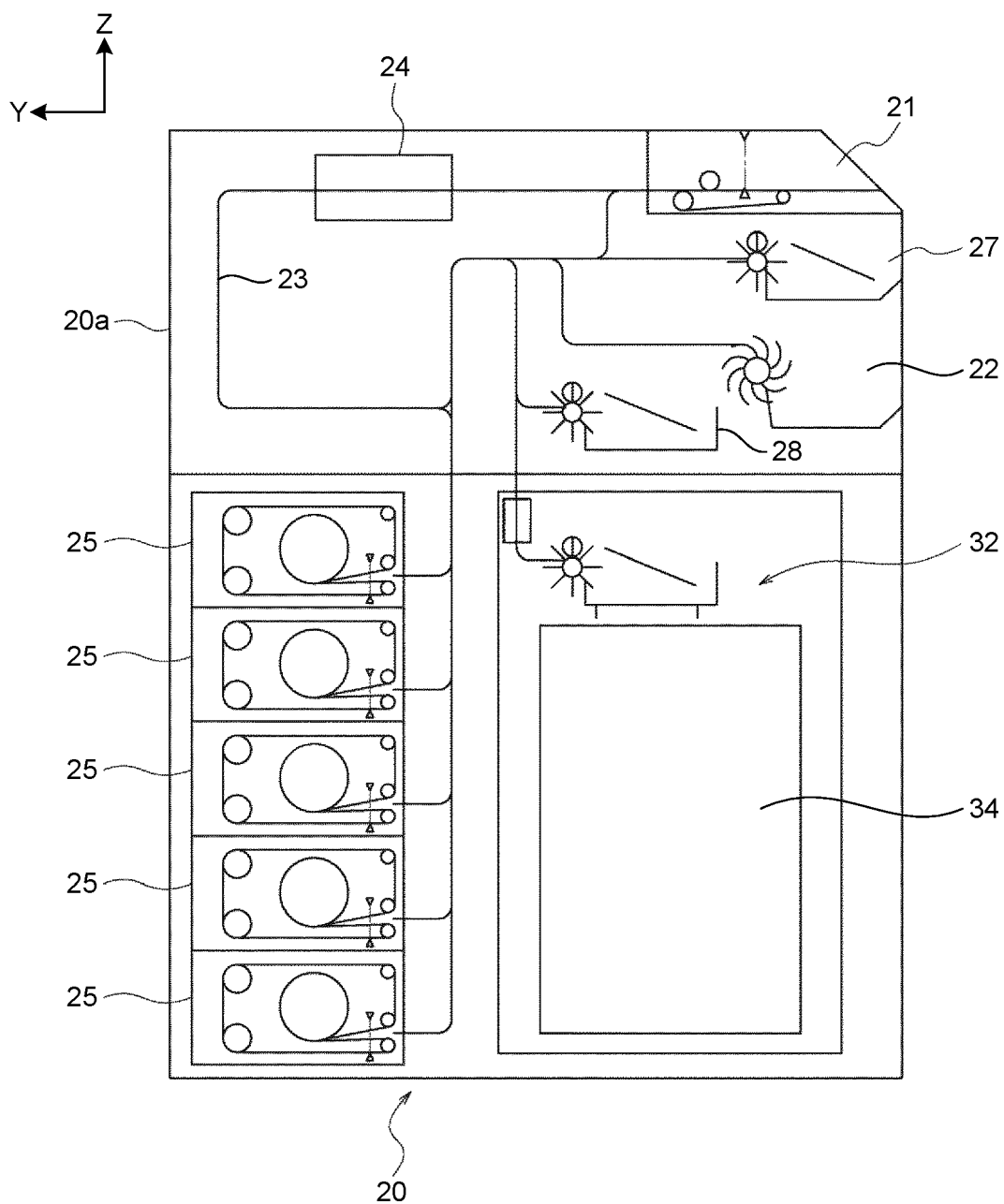


FIG.3

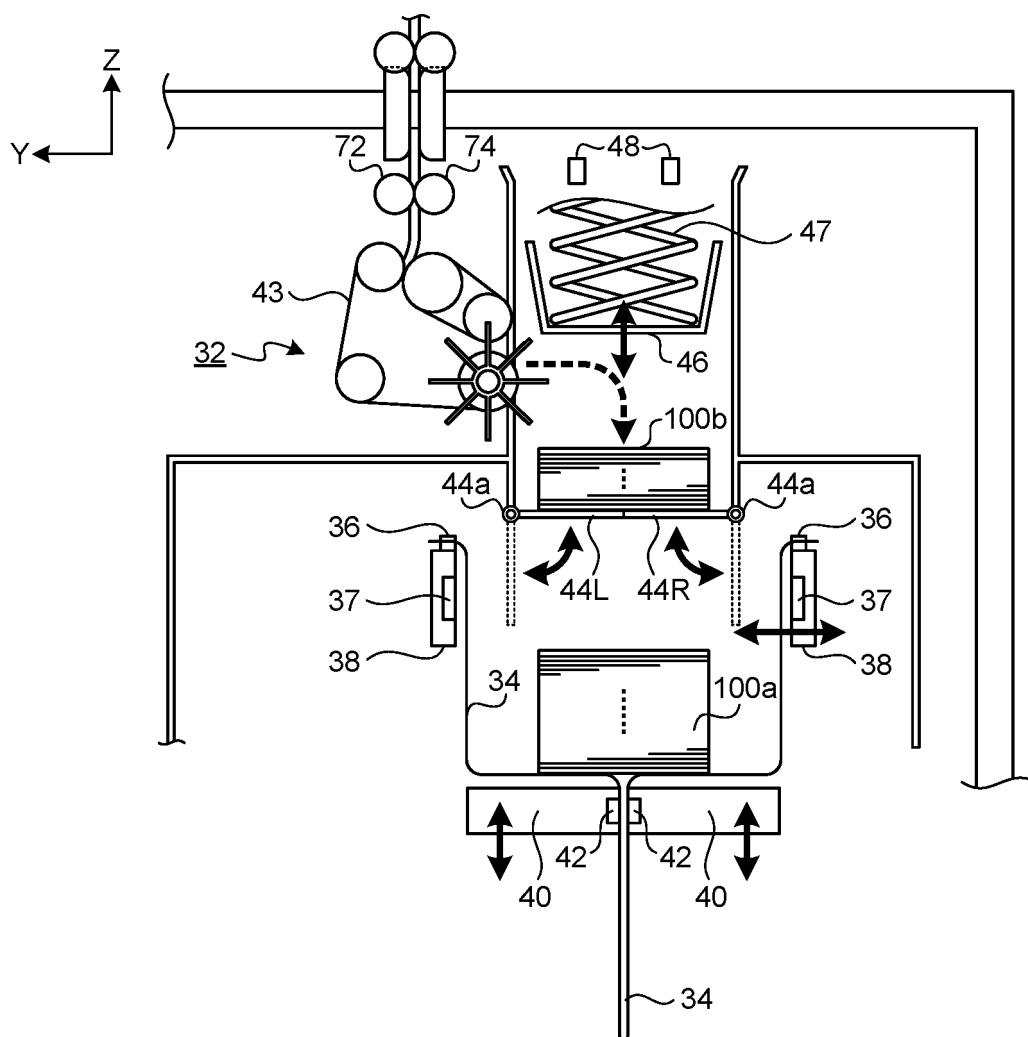


FIG.4A

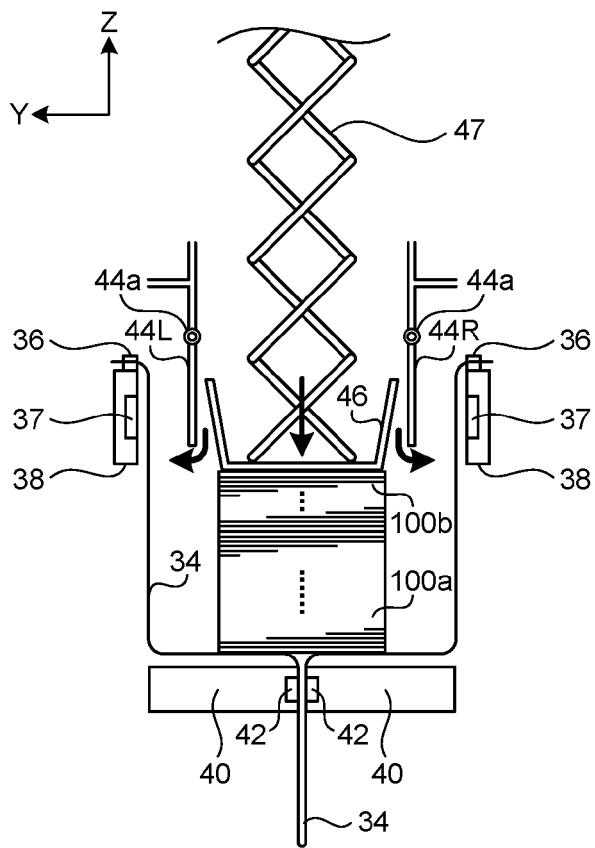


FIG.4B

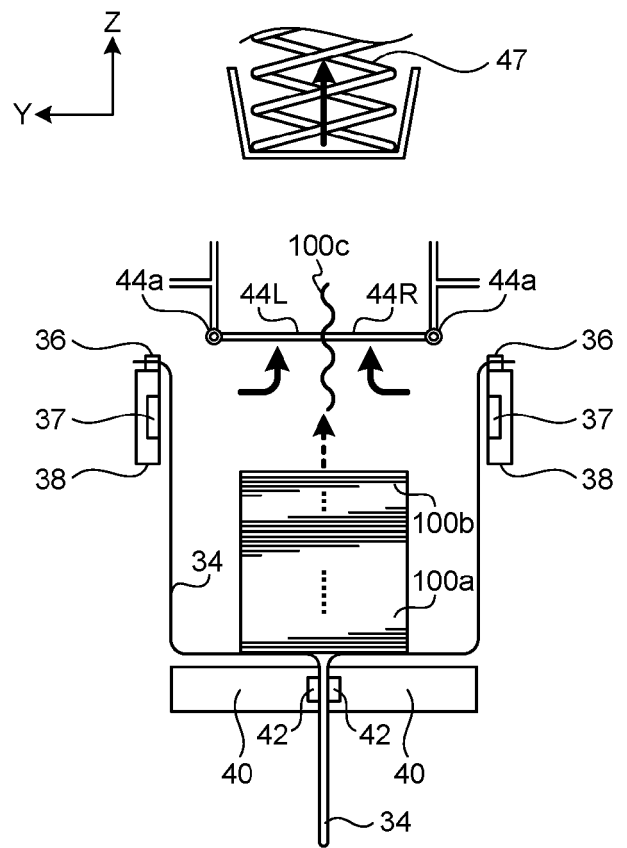


FIG.5

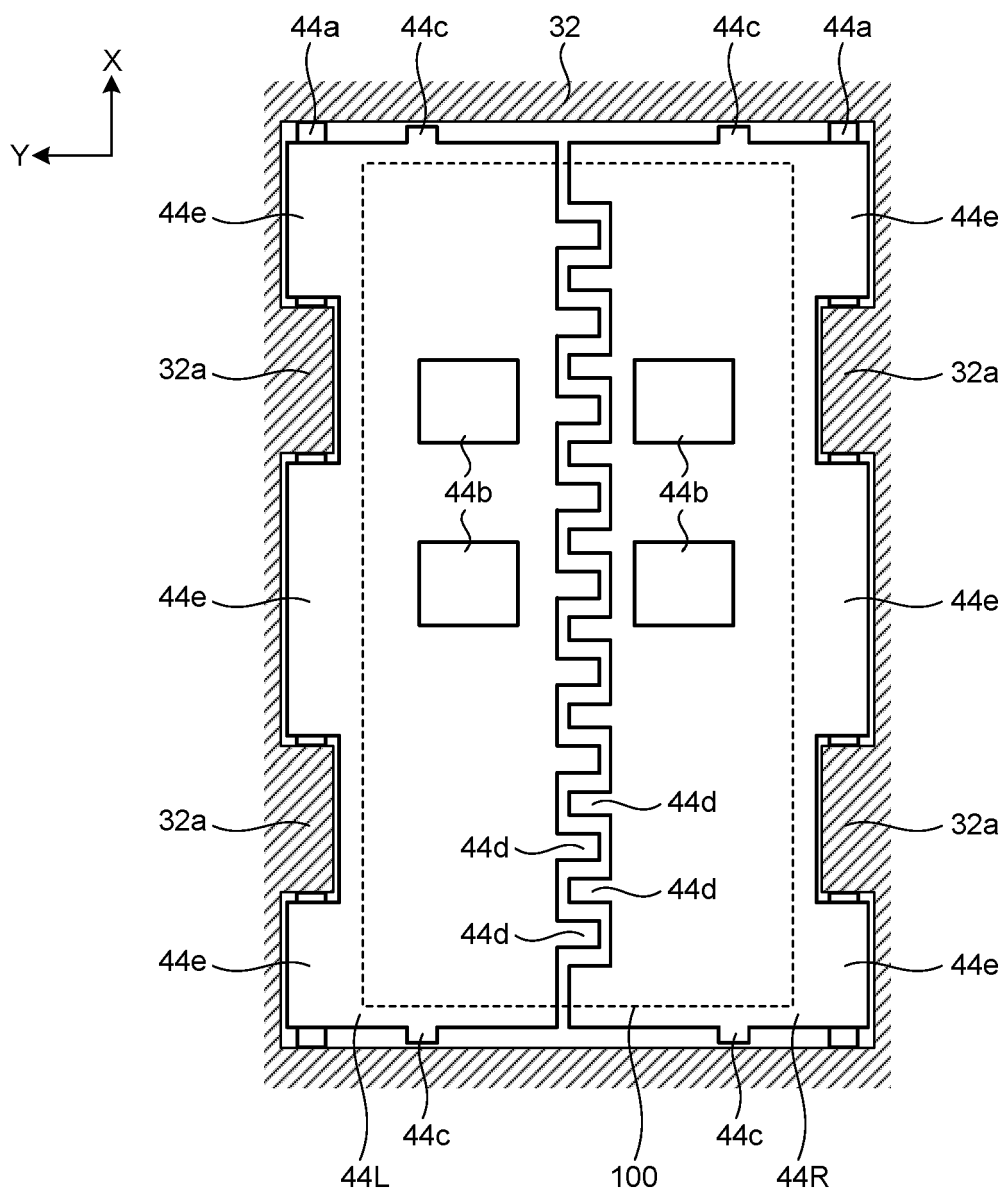


FIG.6

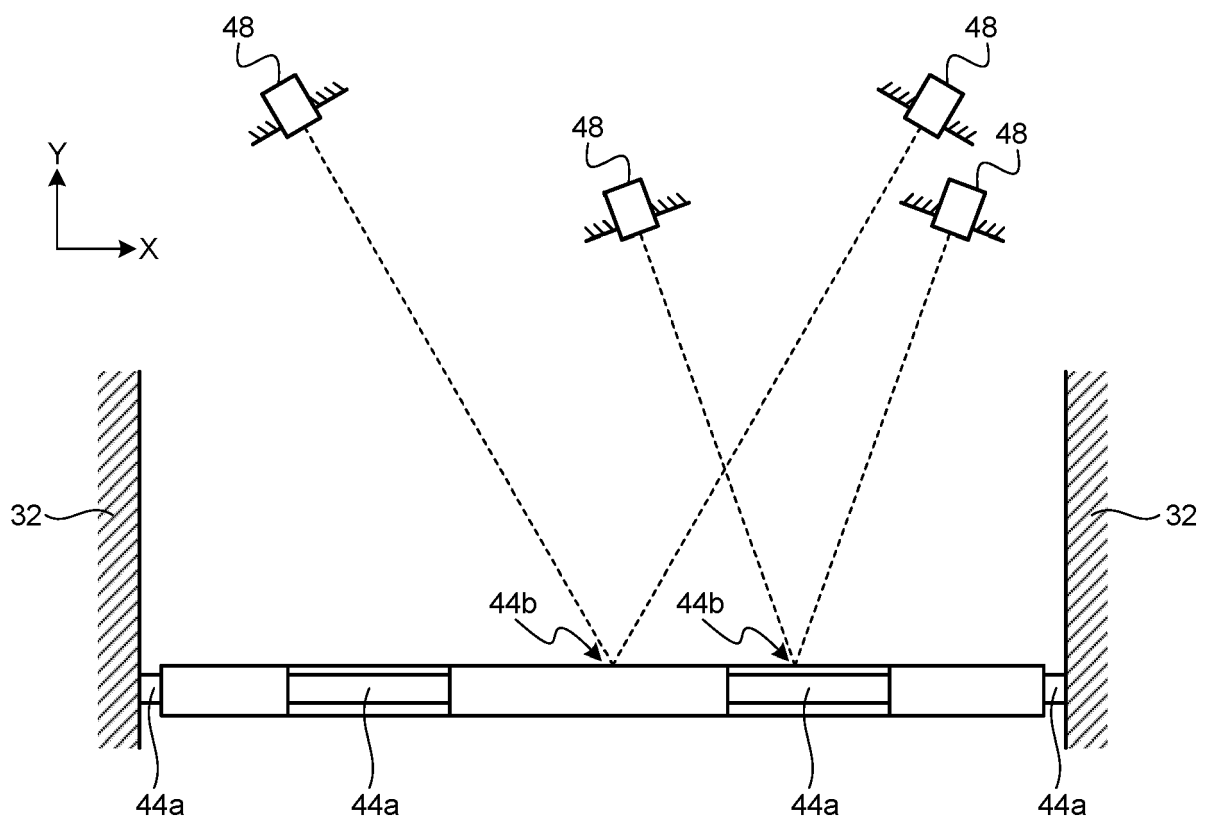


FIG.7A

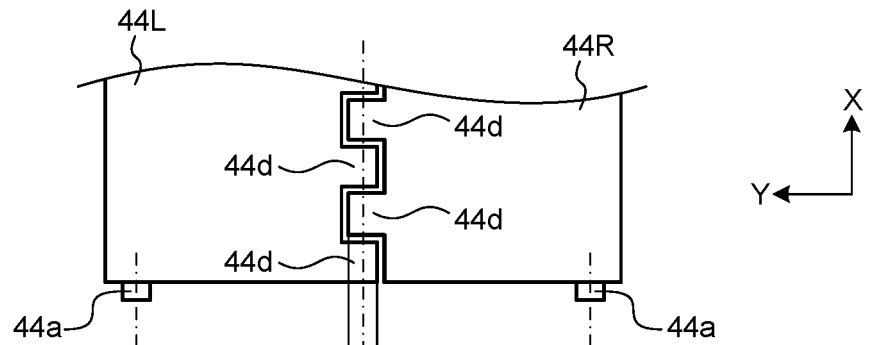


FIG.7B

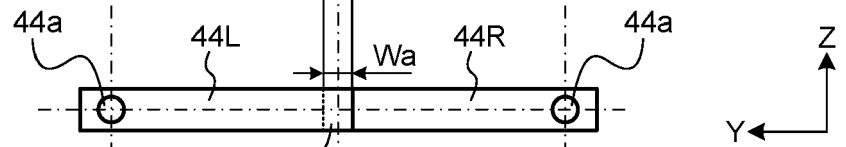


FIG.7C

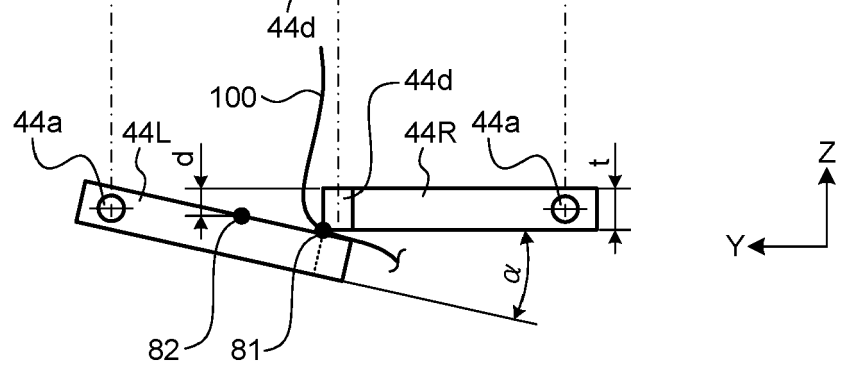


FIG.8A

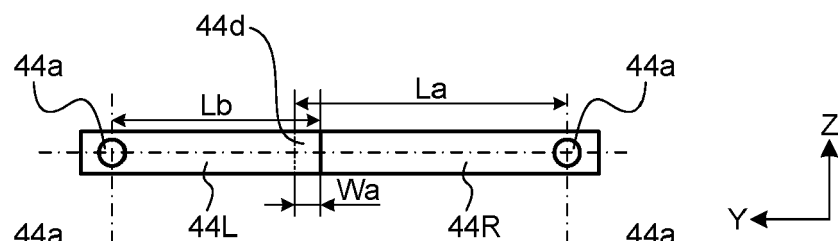


FIG.8B

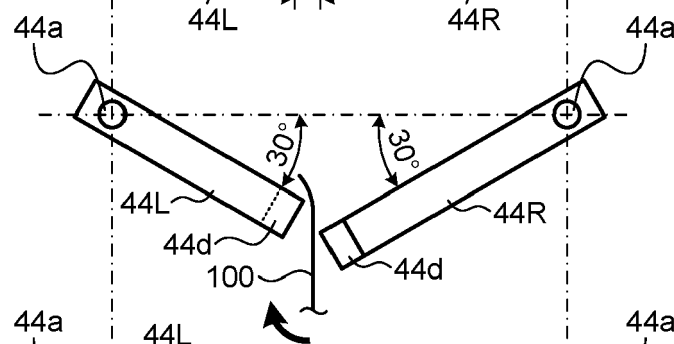


FIG.8C

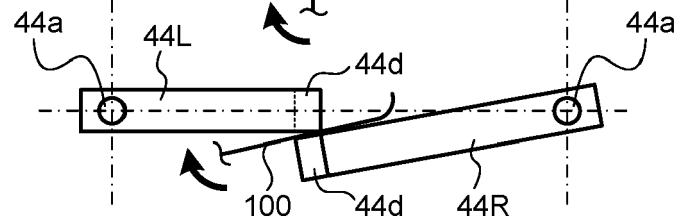


FIG.9

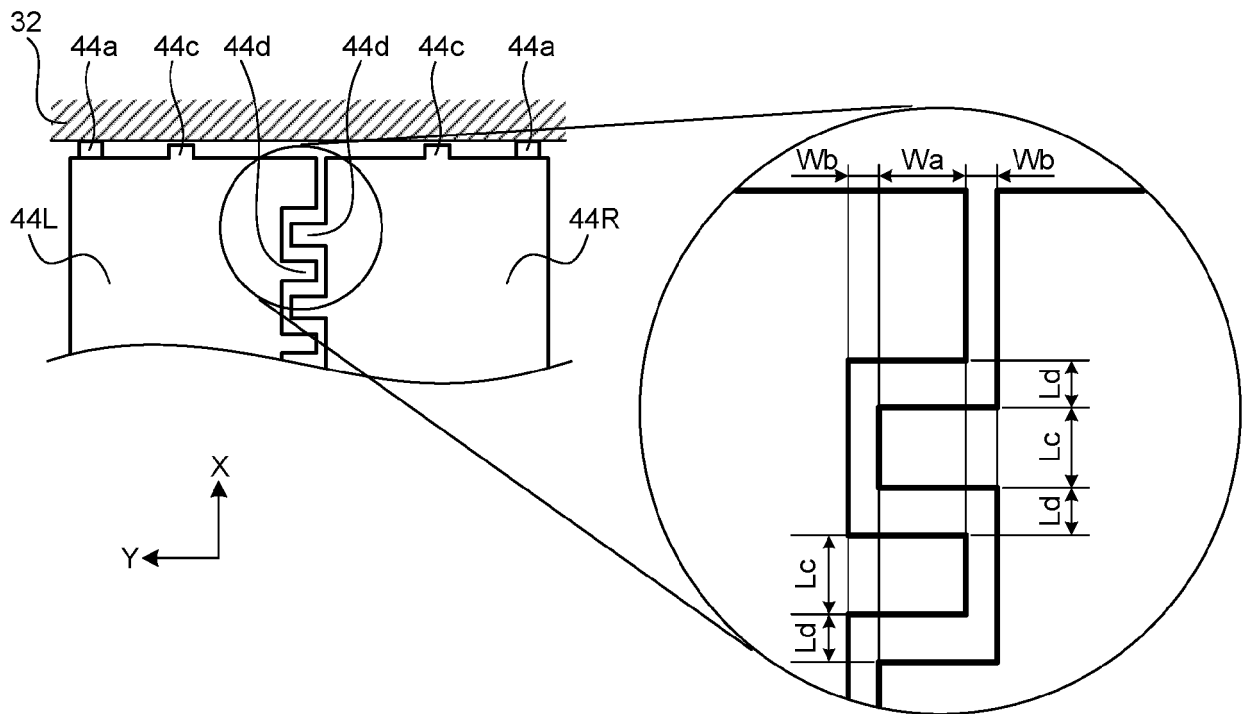


FIG.10

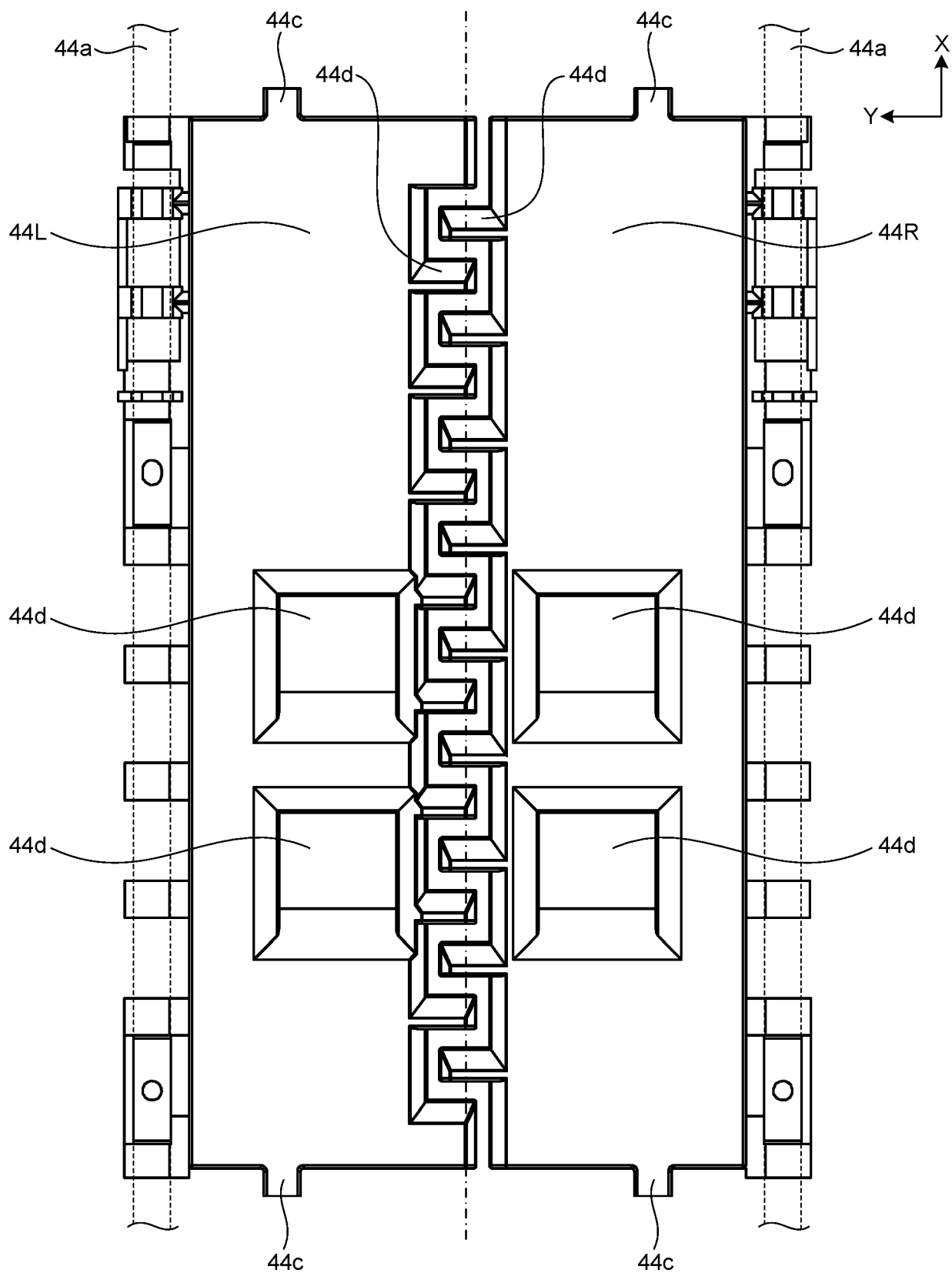


FIG.11

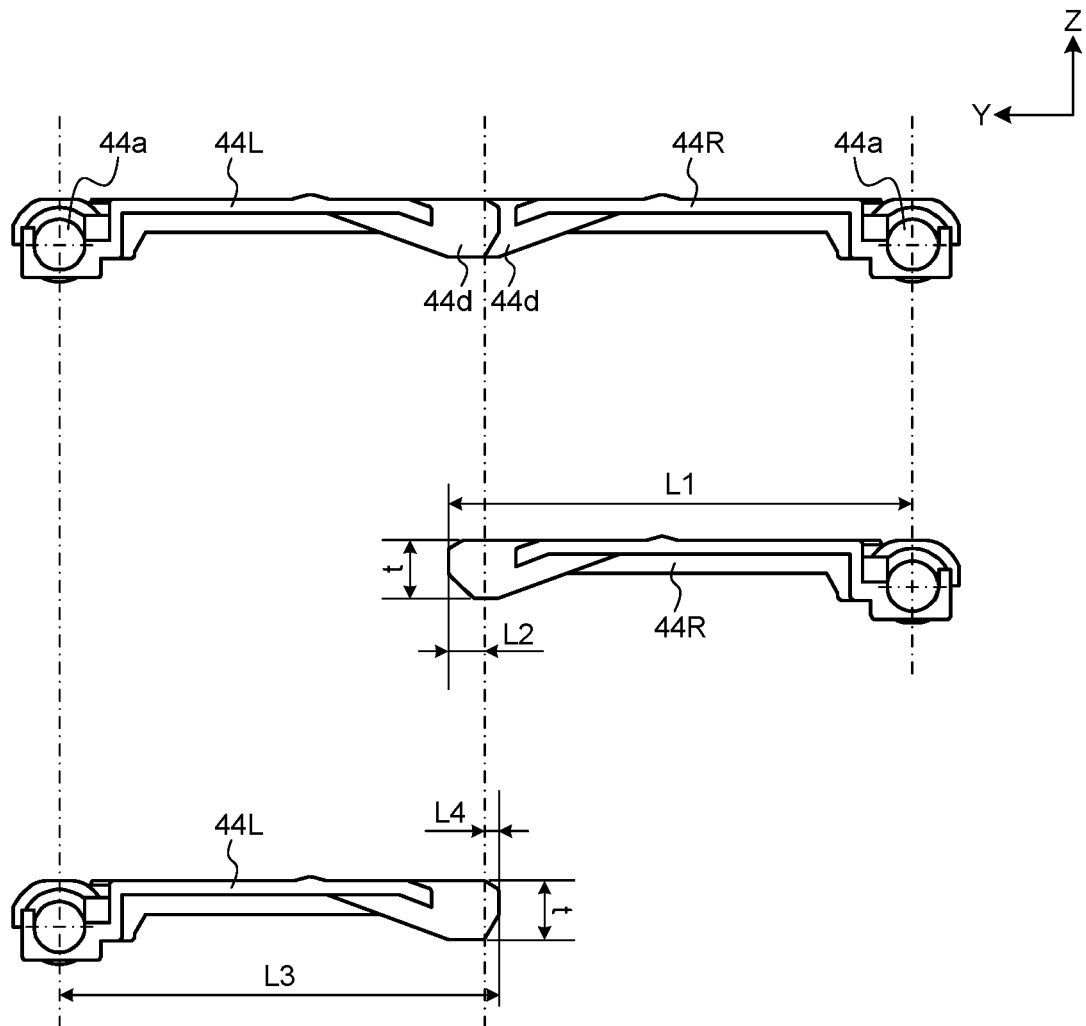


FIG.12A

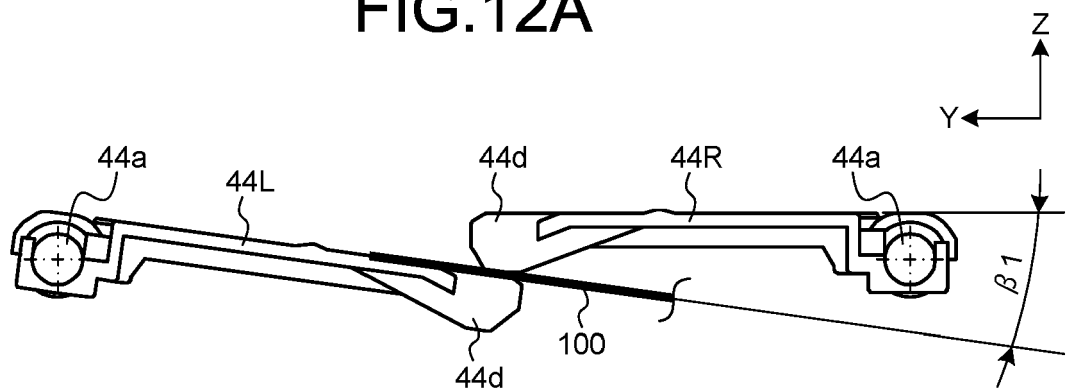


FIG.12B

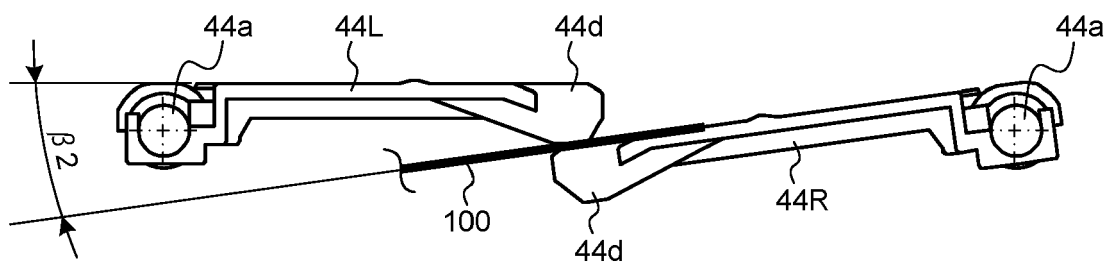


FIG.13

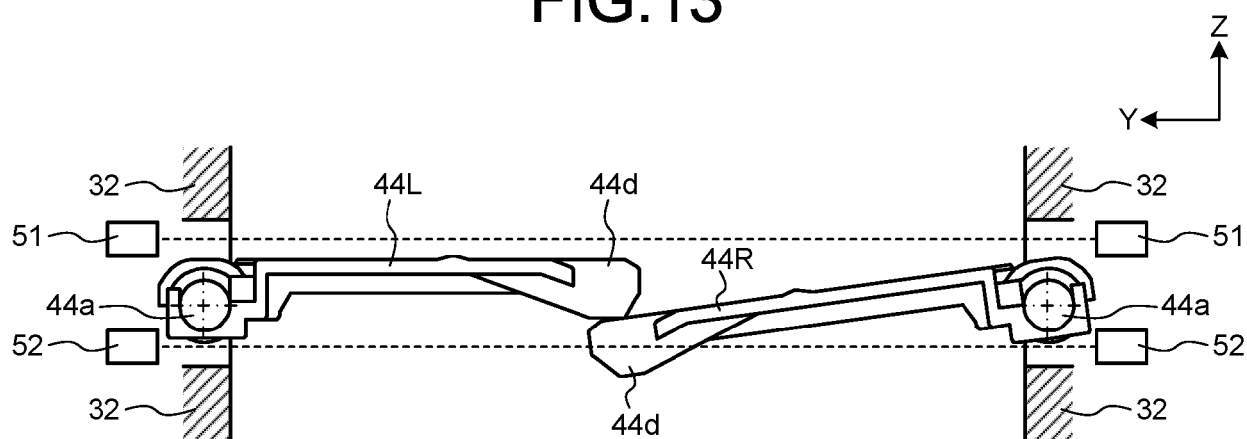


FIG.14A

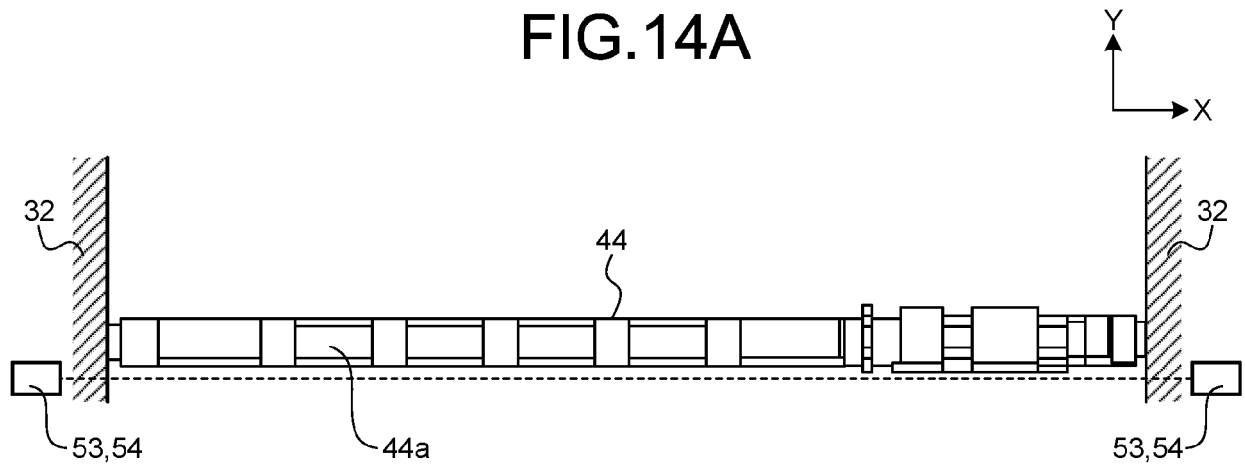


FIG.14B

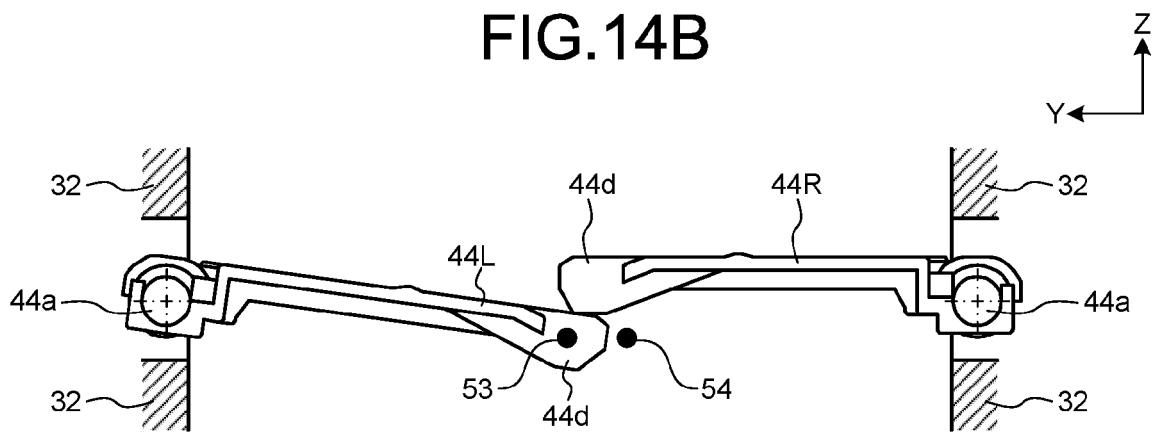


FIG.14C

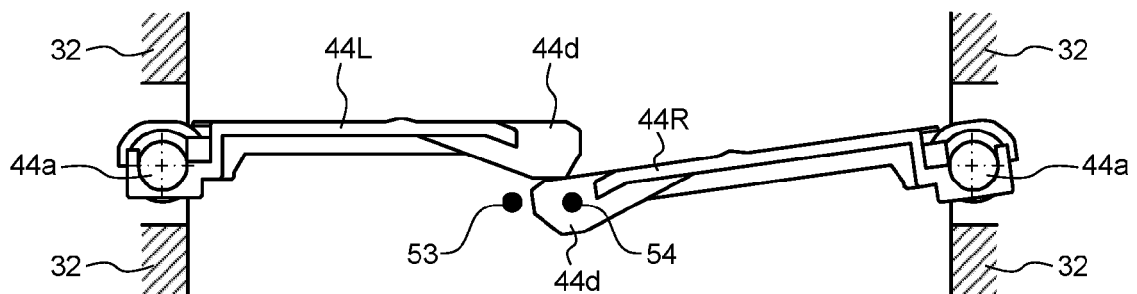


FIG.15A

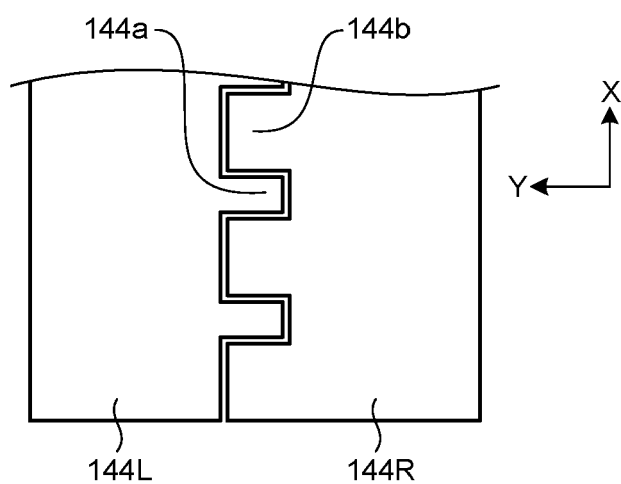


FIG.15B

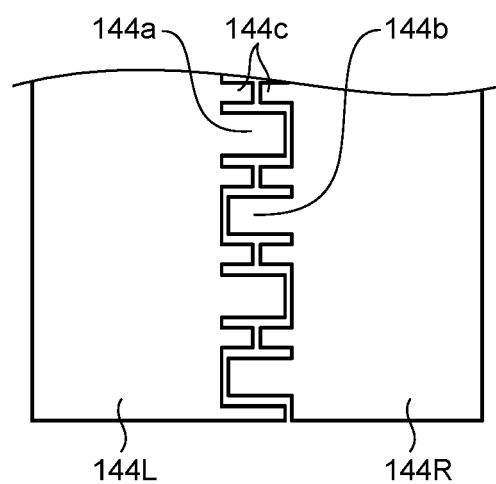


FIG.15C

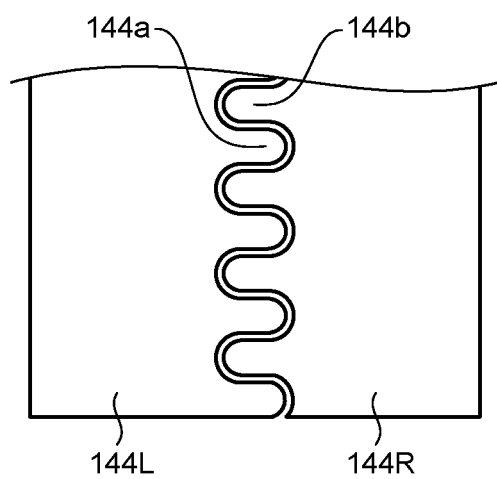


FIG.15D

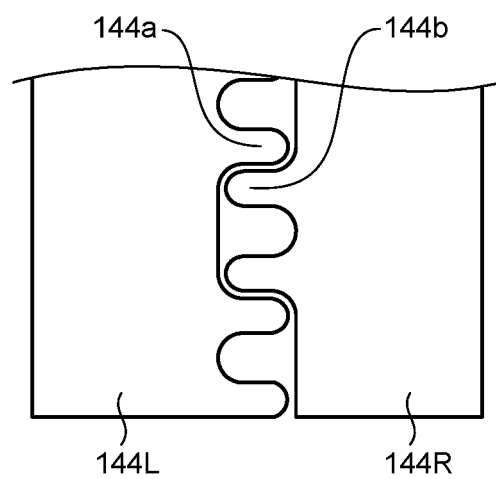


FIG.16

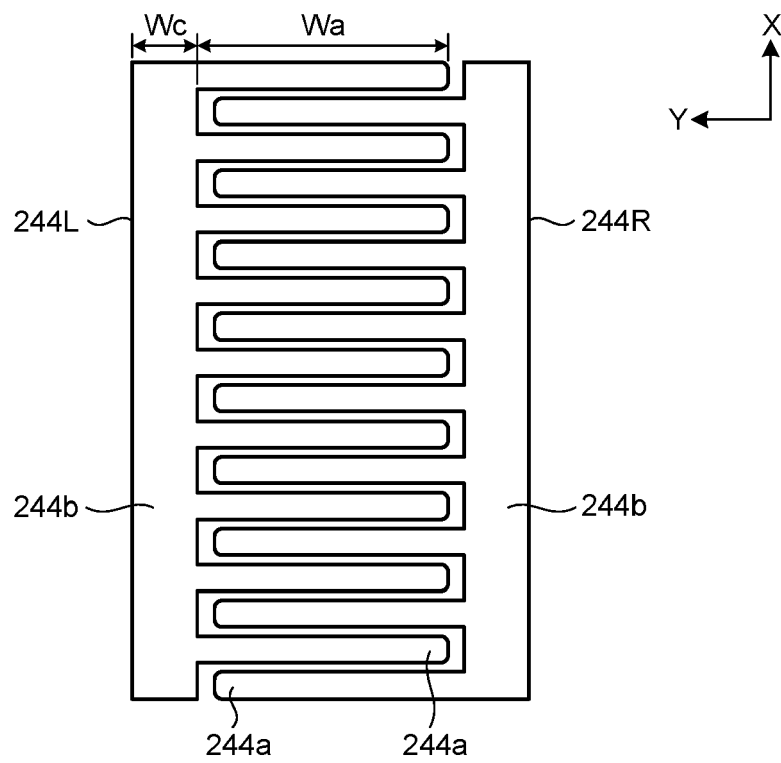


FIG.17A

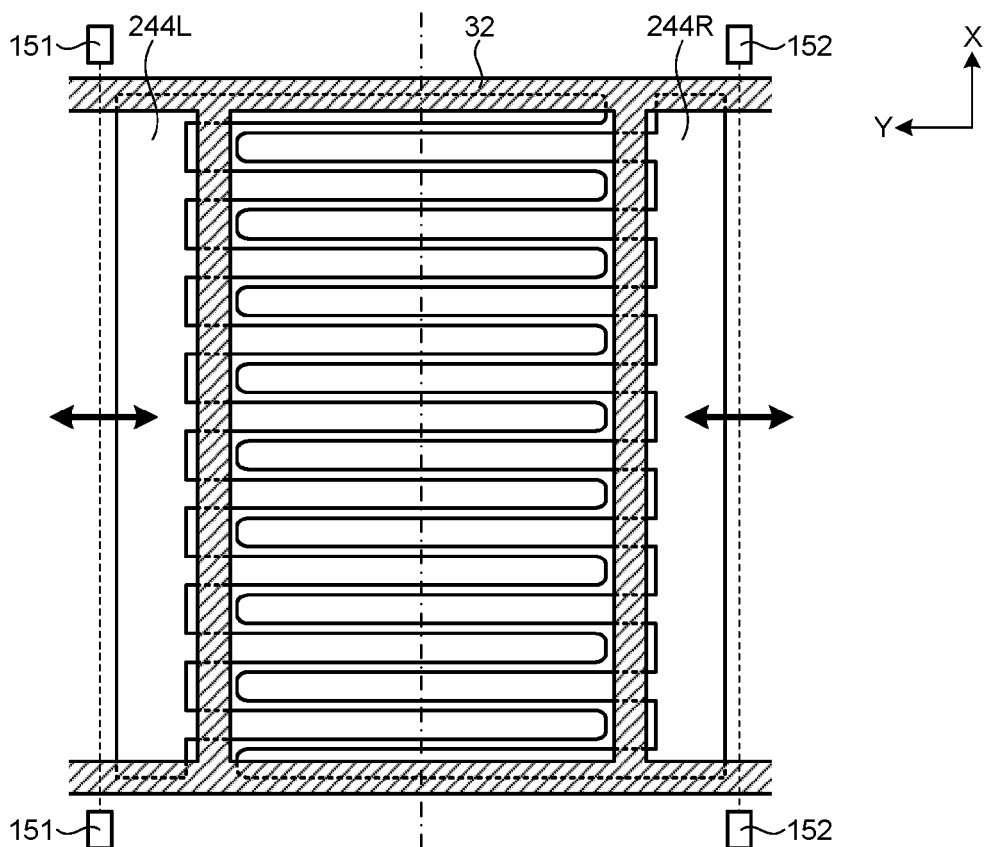


FIG.17B

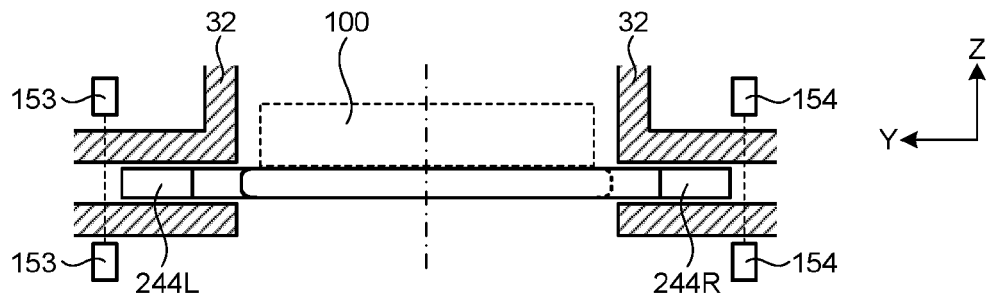


FIG.17C

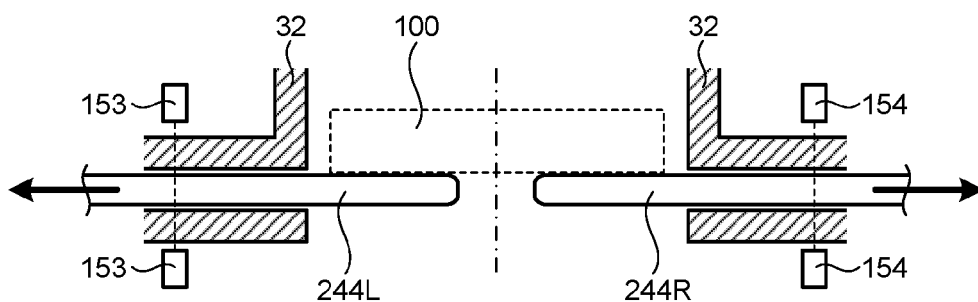


FIG.18A

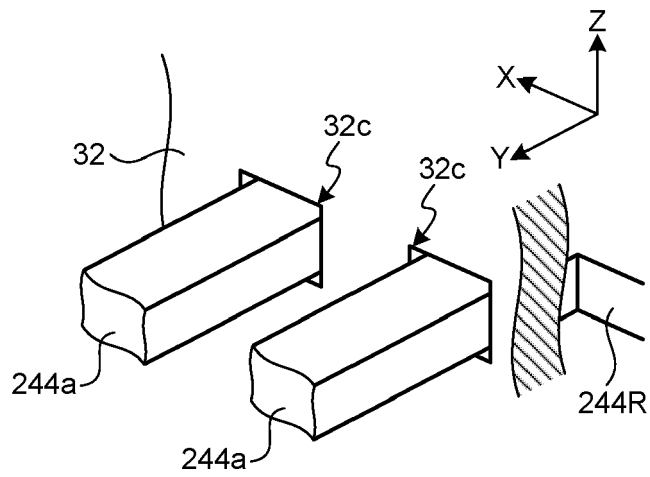
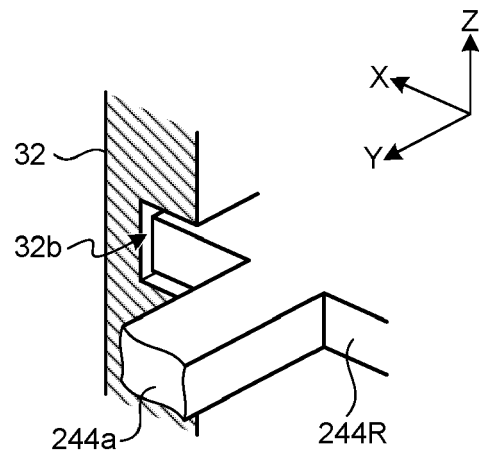


FIG.18B





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 Application Number
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 October 2020	Examiner Ureta, Rolando
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