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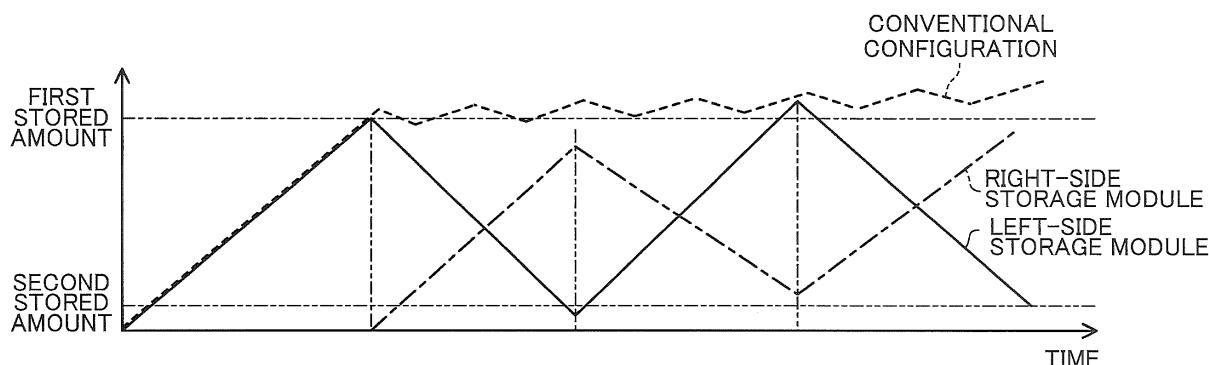
PAPER SHEET HANDLING DEVICE AND PAPER SHEET HANDLING METHOD

- (57)

A paper sheet handling device (banknote depositing and dispensing machine (1)) includes: at least one storage unit (storage module (31)) configured to store paper sheets therein and feed stored paper sheets therefrom; and a control unit (513) configured to control storage and feeding of paper sheets into and from the

storage unit, and the control unit prohibits one of storage of paper sheets into the respective storage unit and feeding of paper sheets from the respective storage unit when the stored amount of the respective storage unit is within a preset range.

FIG.10



Description

TECHNICAL FIELD

[0001] The technology disclosed herein relates to a paper sheet handling device and a paper sheet handling method.

BACKGROUND ART

[0002] Patent Document 1 describes a banknote teller machine provided with a plurality of winding storage units. Each winding storage unit stores banknotes by winding banknotes around a drum together with tapes drawn from tape reels.

[0003] Patent Document 2 describes a banknote teller machine provided with a plurality of stacking storage units. Each stacking storage unit stores banknotes by stacking banknotes on a stage.

[0004] Both types of storage units described in Patent Documents 1 and 2 are configured to be able to feed stored banknotes.

CITATION LIST

PATENT DOCUMENT

[0005]

PATENT DOCUMENT 1: Japanese Patent No. 5650317

PATENT DOCUMENT 2: Japanese Unexamined Patent Publication No. 2014-109797

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0006] The present inventor has found that, irrespective of the winding storage units or the stacking storage units, various troubles occur when storage and feeding of banknotes into and from a storage unit is repeated. In particular, the troubles occur prominently in a state where the stored amount of the storage unit is within a predetermined range. The state where the stored amount of the storage unit is within a predetermined range is a state where the storage unit is near full, for example.

[0007] Repetition of storage and feeding of banknotes in a state where a storage unit is near full can occur for the following reason. In a banknote teller machine, when there are a plurality of storage units storing the same kind of banknotes, use priorities are assigned to the plurality of storage units. That is, in storing a banknote, the banknote is stored into the storage unit of highest use priority. When this storage unit becomes full, i.e., when no more banknote can be stored in the storage unit of highest use priority, a banknote is stored into a storage unit of second highest use priority. In this configuration, since the stor-

age unit of highest use priority stores banknotes preferentially, it tends to become full. Here, consider the state where the storage unit of highest use priority is full and no banknote available for feeding is stored in any other storage unit. If storage of a banknote into the storage unit of highest use priority becomes possible by feeding of a banknote from the full-state storage unit, a banknote to be stored next will be stored into the storage unit of highest use priority. This storage unit will become full again. In this state, no banknote can be stored into this storage unit, but once storage of a banknote into this storage unit becomes possible by feeding a banknote from this storage unit, a banknote to be stored next will be stored into the storage unit of highest use priority. In this way, with assignment of use priorities, storage and feeding of banknotes into and from the storage unit of highest use priority will be repeated in a near-full state.

[0008] In the winding storage unit, banknotes are wound around a drum together with tapes drawn from tape reels. Therefore, in a near-full state of the winding storage unit, the outer diameter of the drum with tapes and banknotes wound thereon has become large. Note that the "outer diameter of the drum" as used herein refers to the outer diameter including the portion constituted by the tapes and banknotes wound around the drum body. In the following description, the "drum" sometimes includes the drum body and the tapes and banknotes wound around the drum body.

[0009] When the drum is rotated in the winding direction to store banknotes in a state where the outer diameter of the drum has become large, portions of the tapes closer to the drum body (i.e., radially inner portions) are wound in the winding direction following the rotation of the drum body. However, portions of the tapes away from the drum body (i.e., radially outer portions) have difficulty in following the rotation of the drum body under the influence of inertia. This causes slippage between the inner and outer portions of the tapes.

[0010] Also, during rotation of the drum in the winding direction, portions of the tapes in the outermost-diameter part of the drum are stably tightened with some degree of force because tension is imparted to the tapes. As a result, when the drum with an increased outer diameter is rotated in the winding direction, while the radially inner portions of the tapes are strongly tightened, radially intermediate portions of the tapes between the inner portions and outermost-diameter portions of the tapes become weak in tightening as the inner portions of the tapes are wound in the winding direction.

[0011] Moreover, in feeding of a banknote, the drum is rotated in the feeding direction opposite to the winding direction. After completion of the feeding of the banknote, however, the drum is rotated in the winding direction to adjust the position of the drum. During feeding of a banknote, therefore, the radially inner portions of the tapes are also strongly tightened when the drum is rotated in the winding direction.

[0012] For the above reasons, when storage and feed-

ing of banknotes is repeated in a state where the winding storage unit is near full, tightening of the radially inner portions of the tapes become gradually strong, and with this, tightening of the radially intermediate portions of the tapes become gradually weak. As a result, a trouble that banknotes wound around the drum are displaced at a place where tightening of the tapes has become weak may occur.

[0013] This trouble is prominent especially when a banknote having a nonuniform thickness is stored. An example of a banknote having a nonuniform thickness is a banknote made of a combination of a paper material and a polymer material (a so-called composite banknote). Among such composite banknotes, there is a banknote of which the polymer portion has a depression/projection where the banknote is projected on one surface and depressed on the other surface. A banknote having a non-uniform thickness has difficulty in bending along the surface of the drum when being wound around the drum, whereby a gap may appear between the banknote and the tapes. With a gap present between the banknote wound around the drum and the radially inner portions of the tapes, when the drum is rotated in the winding direction, the tapes are wound so as to remove the gap between the tapes and the banknote in the radially inner part, further strengthening the tightening of the tapes. With this stronger tightening of the radially inner portions of the tapes, tightening of the radially intermediate portions of the tapes becomes further weak. As a result, in storing composite banknotes, a trouble that a banknote wound around the drum is displaced easily occurs. Note that, not only the composite banknotes, but also banknotes having braille characters partly on their surfaces and banknotes having an anticounterfeit thread or hologram are nonuniform in thickness, and thus, like the composite banknotes, a banknote wound around the drum is easily displaced.

[0014] Meanwhile, in the stacking storage unit, a number of banknotes are stacked on the stage in a state where the stored amount is near full, whereby the stacked banknotes are unstable. Therefore, when a new banknote is to be stacked, the storage quality degrades. Also, in feeding of a banknote from the stacking storage unit, the uppermost banknote is fed out while the stacked banknotes are being compressed in the stacking direction. In a near-full state of the stacking storage unit, the uppermost banknote is unstable when the stacked banknotes are compressed downward. As a result, the banknote feeding quality degrades (e.g., the banknote is skewed).

[0015] Note that, not only in the storage of vertically stacking banknotes, but also in the storage of horizontally placing banknotes in a line, the storage quality and the feeding quality degrade when storage and feeding of banknotes is repeated in a near-full state.

[0016] Moreover, when banknotes having a nonuniform thickness are stacked in the stacking storage unit, the stacked banknotes tend to tilt, making the stacked

banknotes further unstable. Therefore, the banknote storage quality and feeding quality further degrade.

[0017] As described above, in a state where the storage unit, whether it is of a winding type or a stacking type, is near full, repetition of storage and feeding of banknotes should be avoided.

[0018] Note that the above-described troubles are not limited to storage and feeding of banknotes. Similar troubles can also occur for paper sheets in general including securities such as exchange coupons and checks as the object to be stored in the storage unit.

[0019] The technology disclosed herein has been created in consideration of the above problems, and the objective thereof is reducing the troubles occurring when the storage unit stores and feeds paper sheets in a paper sheet handling device, and in particular, preventing the troubles by controlling storage and feeding of paper sheets.

SOLUTION TO THE PROBLEM

[0020] The technology disclosed herein is related to a paper sheet handling device, which includes: at least one storage unit configured to store paper sheets therein and feed stored paper sheets therefrom; and a control unit configured to control storage and feeding of paper sheets into and from the at least one storage unit.

[0021] When a stored amount of a respective storage unit is within a preset range, the control unit prohibits one of storage of paper sheets into the respective storage unit and feeding of paper sheets from the respective storage unit and permits the other of storage of paper sheets into the respective storage unit and feeding of paper sheets from the respective storage unit.

[0022] According to the above configuration, storage and feeding of paper sheets is controlled by prohibiting either storage of paper sheets into the storage unit or feeding of paper sheets from the storage unit.

[0023] The control unit may prohibit storage of paper sheets into the respective storage unit and permit feeding of paper sheets from the respective storage unit when the stored amount of the respective storage unit reaches a predetermined first stored amount, until the stored amount reaches a predetermined second stored amount, wherein the second stored amount is smaller than the predetermined first stored amount, and permit storage of paper sheets within the respective storage unit when the stored amount of the respective storage unit reaches the predetermined second stored amount by way of feeding of paper sheets from the respective storage unit.

[0024] According to the above configuration, when the stored amount of the storage unit reaches the first stored amount, storage of paper sheets into the storage unit is prohibited. This prohibition of storage continues until the stored amount of the storage unit reaches the second stored amount. That is, the storage unit performs only feeding of paper sheets, not performing storage of paper sheets, until the stored amount of the storage unit reach-

es the second stored amount.

[0025] Note that the first stored amount may be the maximum capacity (capacity set as a so-called full capacity) of the storage unit or a capacity near the maximum capacity (capacity set as a so-called near-full capacity). Setting the first stored amount at a large value increases the number of paper sheets that can be stored in the storage unit.

[0026] The second stored amount can be appropriately set at a value smaller than the first stored amount. If it is intended to prevent repetition of storage and feeding of paper sheets in a state where the storage unit is near full, the second stored amount should preferably be comparatively small. The second stored amount may be zero (i.e., the storage unit being empty) or an amount near zero (i.e., an amount set as near empty). When the second stored amount is set at zero or an amount near zero, the storage unit performs only feeding until stored paper sheets are no more left or hardly left, without performing storage of paper sheets. Therefore, repetition of storage and delivery of paper sheets in a state where the storage unit is near full is prevented reliably.

[0027] Thus, in the configuration described above, it is possible to avoid the troubles caused by repetition of storage and delivery of paper sheets in a state where the stored amount of the storage unit is near full.

[0028] The control unit may prohibit feeding of paper sheets from the respective storage unit and permit storage of paper sheets within the respective storage unit when the stored amount of the respective storage unit reaches a predetermined third stored amount, until the stored amount reaches a predetermined fourth stored amount, wherein the predetermined fourth stored amount is larger than the predetermined third stored amount; and permit feeding of paper sheets from the respective storage unit when the stored amount of the respective storage unit reaches the predetermined fourth stored amount by way of storage of paper sheets into the respective storage unit.

[0029] Note that the third storage amount may be zero or an amount near zero. The third storage amount may be the same as the second stored amount. The fourth storage amount can be appropriately set at a value larger than the third storage amount. The fourth storage amount may be the same as the first stored amount.

[0030] According to the above configuration, when the stored amount of the storage unit reaches the third storage amount, the storage unit performs only storage of paper sheets, not performing feeding of paper sheets, until the stored amount reaches the fourth storage amount. Therefore, repetition of storage and delivery of paper sheets in a state where the storage unit is near full is prevented.

[0031] The at least one storage unit may include a plurality of storage units, and when storage of paper sheets is permitted for any of the plurality of storage units, the control unit may store paper sheets into a storage unit having a lower stored amount.

[0032] By doing so, paper sheets are stored into a plurality of storage units as equally as possible, and thus the situation that the storage units become full or near full is prevented or reduced.

5 **[0033]** The at least one storage unit may include at least a first storage unit and a second storage unit, and when the stored amount of either one of the first storage unit and the second storage unit reaches the predetermined first stored amount, the control unit may designate the storage unit in question as a feeding-dedicated storage unit that performs only feeding of paper sheets and designate the other storage unit as a storage-dedicated storage unit that performs only storage of paper sheets.

10 **[0034]** When any of the storage units reaches the first stored amount, the storage unit in question is made feeding-dedicated, whereby repetition of storage and feeding of paper sheets in a state where the stored amount of the storage unit is close to the first stored amount (i.e., in a state where the storage unit is near full) is prevented.

15 **[0035]** Although the storage unit in question is set as feeding-dedicated, the other storage unit can be set as storage-dedicated, permitting storage of paper sheets. Thus, the paper sheet handling device having this configuration can perform both storage and feeding of paper sheets at all times using a plurality of storage units. Also, this configuration, unlike the conventional configuration where use priorities are assigned, a plurality of storage units can be used equally.

20 **[0035]** When the stored amount of the feeding-dedicated storage unit reaches the predetermined second stored amount, the control unit may designate the storage unit in question as a storage-dedicated storage unit and designate the other storage unit as a feeding-dedicated storage unit.

25 **[0036]** When the feeding-dedicated storage unit reaches the second stored amount, the stored amount of the storage unit in question should have sufficiently decreased to permit storage of paper sheets. So, the storage unit in question is switched from the feeding-dedicated storage unit to a storage-dedicated storage unit. Meanwhile, the other storage unit is set as a feeding-dedicated storage unit, to permit feeding of paper sheets. The paper sheet handling device having this configuration can perform both storage and feeding of paper sheets at all times.

30 **[0037]** The at least one storage unit may be a winding-type storage unit, in which paper sheets are wound around a drum together with a tape.

35 **[0038]** As described earlier, in a winding storage unit, repetition of storage and feeding of paper sheets in a near-full state may cause displacement of paper sheets wound around a drum. However, by avoiding repetition of storage and feeding of paper sheets in a state where the storage unit is near full as described above, occurrence of displacement of paper sheets in the storage unit is prevented.

40 **[0039]** The at least one storage unit may be a stacking-type storage unit, in which paper sheets are placed in

contact with each other.

[0040] As described earlier, in a stacking storage unit, repetition of storage and feeding of paper sheets in a near-full state may degrade the storage quality and/or the feeding quality. However, by avoiding repetition of storage and feeding of paper sheets in a state where the storage unit is near full as described above, degradation in storage quality and/or feeding quality is prevented.

[0041] The paper sheet handling method disclosed herein includes the steps of: storing paper sheets into at least one storage unit; feeding paper sheets from the at least one storage unit; and prohibiting either storage of paper sheets into a respective storage unit or feeding of paper sheets from the respective storage unit when a stored amount of the respective storage unit is within a preset range.

[0042] Since either storage of paper sheets into the storage unit or feeding of paper sheets from the storage unit is prohibited, repetition of storage and feeding of paper sheets in a state where the storage unit is near full is prevented.

[0043] The paper sheet handling method disclosed herein also includes the steps of: when a stored amount of a storage unit configured to store paper sheets and feed stored paper sheets reaches a predetermined first stored amount, prohibiting storage of paper sheets into the storage unit and permitting feeding of paper sheets from the storage unit, until the stored amount reaches a predetermined second stored amount, wherein the predetermined second stored amount is smaller than the predetermined first stored amount; and permitting storage of paper sheets into the storage unit when the stored amount of the storage unit reaches the predetermined second stored amount by way of feeding of paper sheets from the storage unit.

[0044] According to the above, repetition of storage and feeding of paper sheets in a state where the storage unit is near full is prevented.

[0045] The paper sheet handling method described above may include the steps of: prohibiting feeding of paper sheets from the storage unit and permitting storage of paper sheets into the storage unit when the stored amount of the storage unit reaches a predetermined third stored amount, until the stored amount reaches a predetermined fourth stored amount, wherein the predetermined fourth stored amount is larger than the predetermined third stored amount; and permitting feeding of paper sheets from the storage unit when the stored amount of the storage unit reaches the predetermined fourth stored amount by way of storage of paper sheets into the storage unit.

[0046] According to the above, repetition of storage and feeding of paper sheets in a state where the storage unit is near full is prevented.

[0047] The step of storing paper sheets into the storage unit may include winding paper sheets around a drum together with a tape, and the step of feeding paper sheets from the storage unit may include sending out paper

sheets from the drum together with the tape. That is, the storage unit may be a winding storage unit.

ADVANTAGES OF THE INVENTION

[0048] As described above, according to the paper sheet handling device and the paper sheet handling method described above, occurrence of the troubles is prevented by controlling storage and feeding of paper sheets.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049]

[FIG. 1] FIG. 1 is a view showing the appearance of a banknote depositing and dispensing machine.

[FIG. 2] FIG. 2 is a view showing the internal structure of a banknote depositing and dispensing machine provided with a winding storage unit.

[FIG. 3] FIG. 3 is a view showing the configuration of a winding storage module.

[FIG. 4] FIG. 4 is a block diagram showing a configuration related to operation control of a banknote depositing and dispensing machine.

[FIG. 5] FIG. 5 is a view explaining the relationship between the front/back and orientation of a banknote having a depression/projection and easiness of winding of the banknote around a drum.

[FIG. 6] FIG. 6 is a view exemplifying a state where tapes and banknotes wound around a drum form a truncated cone shape.

[FIG. 7] FIG. 7 is a view explaining a tightened state of a tape wound around a drum.

[FIG. 8] FIG. 8 is a transition diagram exemplifying states of storage units observed when banknotes are stored into and fed from a plurality of storage units in a conventional configuration.

[FIG. 9] FIG. 9 is a transition diagram exemplifying states of storage units observed when banknotes are stored into and fed from a plurality of storage units in the present configuration.

[FIG. 10] FIG. 10 is a view showing an example of a change in the stored amount of a storage unit in a conventional configuration and examples of changes in the stored amounts of two storage units in the present configuration.

[FIG. 11] FIG. 11 is a view exemplifying light-shading seals provided on tapes for switching between a first mode and a second mode.

[FIG. 12] FIG. 12 is a view for comparison of states of banknotes wound around a drum forming a truncated cone shape.

[FIG. 13] FIG. 13 is a view explaining the relative positions of a depression/projection of a banknote wound around a drum with respect to tapes.

[FIG. 14] FIG. 14 is a view showing, in a tabular form, combinations of various factors and whether storage

of composite banknotes into a storage unit is permitted or not.

[FIG. 15] FIG. 15 is a view showing the internal structure of a banknote depositing and dispensing machine provided with a stacking storage unit.

DESCRIPTION OF EMBODIMENTS

[0050] The paper sheet handling device disclosed herein will be described in detail with reference to the accompanying drawings. Note that the following description is merely illustrative. FIG. 1 shows the appearance of a banknote depositing and dispensing machine 1 as a paper sheet handling device. The banknote depositing and dispensing machine 1 is placed at a teller counter of a bank, for example.

[0051] The banknote depositing and dispensing machine 1 performs at least depositing processing of storing a banknote put on an inlet 211 into a storage unit 3 and dispensing processing of paying out a banknote stored in the storage unit 3 to an outlet 231. As will be described later, the storage unit 3 is configured to be capable of feeding banknotes stored. The banknote depositing and dispensing machine 1 is a so-called circular banknote depositing and dispensing machine 1. That is, banknotes paid out during the dispensing processing include banknotes stored into the storage unit 3 during the depositing processing.

[0052] As shown in FIGS. 1 and 2, the banknote depositing and dispensing machine 1 is roughly divided into an upper-side processing section 11 and a lower-side safe section 13. A housing 111 constituting the processing section 11 accommodates: a depositing unit 21 having the inlet 211; a dispensing unit 23 having the outlet 231; a recognition unit 25 that recognizes banknotes; a processing section-side transport unit 41 including a loop transport path 411 that links the depositing unit 21, the dispensing unit 23, and the recognition unit 25. A housing 131 constituting the safe section 13 accommodates: a storage unit 3 including a plurality of (eight in the illustrated example) winding storage modules 31; and a safe section-side transport unit 43 including a transport path 431 that connects the loop transport path 411 of the processing section-side transport unit 41 with the storage modules 31. Unlike the housing 111 constituting the processing section 11, the housing 131 constituting the safe section 13 is a protecting housing 131 configured to protect the storage unit 3, etc. housed therein at a predetermined level or higher of security.

[0053] The inlet 211 of the depositing unit 21 is configured to be capable of receiving a plurality of banknotes at a time. Although detailed illustration is omitted, the depositing unit 21 is provided with a feeding mechanism that feeds a plurality of banknotes put on the inlet 211 to the loop transport path 411 one by one. Also, the outlet 231 of the dispensing unit 23 is configured to be capable of holding a plurality of banknotes at a time.

[0054] The processing section-side transport unit 41

transports banknotes along the loop transport path 411 clockwise and counterclockwise as viewed from FIG. 2. The loop transport path 411 is constituted by a combination of a number of rollers, a plurality of belts, and a plurality of guides although illustration thereof is omitted. Banknotes are transported with their long edges facing forward in the transport direction along the loop transport path 411 with a predetermined spacing between adjacent banknotes.

[0055] The recognition unit 25 is placed on the loop transport path 411. The recognition unit 25 is configured to recognize at least any of the authenticity, denomination, and fitness of each of banknotes, one by one, transported along the loop transport path 411.

[0056] The transport path 431 of the safe section-side transport unit 43 is connected to the loop transport path 411 via a diverting mechanism 419. At a junction of the transport paths extending in three different directions, the diverting mechanism 419 operates to selectively transport a banknote being transported from a given direction to either of the other two directions. The diverting mechanism 419 performs switching between selectively sending a banknote being transported along the loop transfer path 411 clockwise or counterclockwise to the transport path 431 of the safe section-side transport unit 43 to be stored in the storage unit 3, or transporting a banknote fed from the storage unit 3 and transported along the transport path 431 of the safe section-side transport unit 43 to the loop transport path 411 clockwise or counterclockwise.

[0057] As described above, the storage unit 3 includes first to eighth winding (i.e., tape-type) storage modules 31₁ to 31₈ in the illustrated example. Note that, in the following description, the character "31" is assigned when the storage modules are collectively referred to, and the characters "31₁, 31₂, 31₃, ..." are assigned when the individual storage modules, such as the first, second, and third storage modules, are separately referred to. The number of storage modules is not specifically limited, but an appropriate number equal to or more than 1 may be set. The eight storage modules 31 are arranged to form two vertically-stacked rows each including four modules lined in the depth direction of the device (horizontally as viewed from FIG. 2).

[0058] Detailed illustration of the winding storage modules 31 is omitted here because the basic configuration thereof is well known. In the illustrated example, however, as shown in FIG. 3, the winding storage module 31 includes, in a roughly rectangular box-shaped housing, a tape reel 311 around which tapes 310 for guiding banknotes are wound and a drum 312 around which banknotes are wound together with the tapes 310.

[0059] Two tapes are arranged in parallel with spacing therebetween in the long edge direction of banknotes. The tapes 310 drawn out from the tape reel 311 are sent to the drum 312 after being guided by a tape regulating guide 313.

[0060] The drum 312 is connected to a rotary drive

source of which illustration is omitted. With driving of the rotary drive source, the drum 312 rotates in the banknote winding direction (i.e., clockwise in FIG. 3) and the banknote feeding direction (i.e., counterclockwise in FIG. 3). The tape reel 311 is provided with a torque limiter 314. When the drum 312 rotates in the winding direction to wind banknotes, the tape reel 311 rotates in the direction of sending of the tapes 310, following the rotation of the drum 312, with a predetermined tension F imparted to the tapes 310 by the torque limiter 314. When the drum 312 rotates in the banknote feeding direction, the driving force of the rotary drive source for the drum 312 is transmitted to the tape reel 311 by a power transmission mechanism of which illustration is omitted, whereby the tape reel 311 rotates in the direction of winding of the tapes 310.

[0061] Banknotes enter and exit the storage module 31 through a port 315 that connects the inside and outside of the storage module 31. The winding storage module 31 winds the two tapes 310 drawn out from the tape reel 311 around the drum 312 together with banknotes having entered the storage module 31, thereby storing the banknotes. The banknotes are wound around the drum 312 in the orientation of their long edges extending along the rotation central axis of the drum 312 with a predetermined spacing between adjacent ones (see also FIG. 6).

[0062] The configuration of the winding storage module is not limited to that described above. One tape or two or more tapes may be wound around the drum. Otherwise, two overlapping tapes with banknotes interposed therebetween may be wound around the drum.

[0063] Like the loop transport path 411 of the processing section-side transport unit 41, the transport path 431 of the safe section-side transport unit 43 is constituted by a combination of rollers, belts, and guides. The transport path 431 also transports banknotes one by one with their long edges facing forward in the transport direction. The transport path 431 extends downward vertically from the diverting mechanism 419 on the loop transport path 411, then bends backward in the depth direction (to the left as viewed from FIG. 2), and extends between the two rows of storage modules 31 stacked vertically toward the back of the banknote depositing and dispensing machine 1. Each storage module 31 is connected to the transport path 431 via a sorting mechanism 432. The sorting mechanism 432 switches the transport direction of banknotes transported along the transport path 431 between the direction along the transport path 431 and the direction toward the storage module 31. The driving of the sorting mechanism 432 is controlled by a control unit 513 to be described later. In this way, banknotes are sorted to and stored into a plurality of storage modules 31 depending on the denomination and/or fitness recognized by the recognition unit 25.

[0064] FIG. 4 shows a configuration related to the operation control of the banknote depositing and dispensing machine 1. The banknote depositing and dispensing machine 1 includes the control unit 513 that uses a well-

known microcomputer as a base, for example. To the control unit 513, the depositing unit 21, the dispensing unit 23, the storage unit 3 including the first to eighth storage modules 31, the processing section-side transport unit 41, and the safe section-side transport unit 43 described above are connected so as to be capable of transmitting/receiving signals. These units 21, 23, 3, 41, and 43 include various sensors having functions of detecting a banknote being transported on the transport path, for example, although illustration of such sensors is omitted, and detection signals from the sensors are input into the control unit 513. The control unit 513 outputs control signals based on the input detection signals, etc., and the units 21, 23, 3, 41, and 43 operate according to the control signals.

[0065] The recognition unit 25 is also connected to the control unit 513, and provides recognition results to the control unit 513. Although detailed illustration is omitted, the following units are connected to the banknote depositing and dispensing machine 1: a manipulation unit 55 as a human interface for an operator using the banknote depositing and dispensing machine 1, a communication unit 57 for allowing the banknote depositing and dispensing machine 1 to transmit/receive signals to/from a higher-ranking terminal and other equipment of which illustration is omitted through a LAN and a serial bus, for example, and a memory unit 59 for storing various types of information, constituted by a general-purpose storage device such as a hard disk drive and a flash memory.

[0066] The memory unit 59 at least stores the inventory amount that is the number of banknotes per denomination, or the amount of banknotes, stored in the banknote depositing and dispensing machine 1. The memory unit 59 also stores the inventory amount of each storage module 3.

[0067] The control unit 513 controls the operations of the units 21, 23, 25, 3, 41, 43, 55, 57, and 59 according to a command received from a higher-ranking terminal through the communication unit 57 and/or various commands received through the manipulation unit 55. In this way, the banknote depositing and dispensing machine 1 performs various types of processing including depositing processing and dispensing processing described below.

<Depositing processing>

[0068] The depositing processing is a type of processing of depositing (storing) a banknote into the banknote depositing and dispensing machine 1, in which the banknote put on the inlet 211 is basically stored into any of the storage modules 31 according to the recognition result from the recognition unit 25 and preset storage allocation. More specifically, the banknote depositing and dispensing machine 1 operates as follows at the depositing processing.

[0069] That is, a command of starting the depositing processing is input into the banknote depositing and dis-

pensing machine 1 by manipulation of a higher-ranking terminal and/or the manipulation unit 55, for example, in a state where banknotes to be deposited are put on the inlet 211. The feeding mechanism of the depositing unit 21 feeds the banknotes on the inlet 211 one by one to the processing section-side transport unit 41, which transports the banknotes to the recognition unit 25. The recognition unit 25 recognizes the banknotes and also counts them. The processing section-side transport unit 41 also transports a banknote recognized normally (called a normal banknote as opposed to a rejected banknote) along the loop transport path 411 through the diverting mechanism 419 to the safe section-side transport unit 43. The safe section-side transport unit 43 stores the normal banknote in a predetermined storage module 31 by controlling the sorting mechanism 432 according to the recognition result from the recognition unit 25 and the preset storage allocation. The normal banknote is stored in any of the storage modules 31 depending on the denomination and the fitness.

[0070] Meanwhile, the processing section-side transport unit 41 pays out a rejected banknote that cannot be accepted by the banknote depositing and dispensing machine 1 as it is, such as a banknote of which the authenticity cannot be recognized by the recognition unit 25, to the outlet 231. Also, a banknote having failed to be stored because the storage modules 31 are full at the time of depositing processing (i.e., an overflow banknote) is paid out to the outlet 231. After termination of the depositing processing, the inventory amounts stored in the memory unit 59 are updated.

<Dispensing processing>

[0071] The dispensing processing is a type of processing of paying out a banknote stored in the banknote depositing and dispensing machine 1. Specifically, the dispensing processing is started by predetermined dispensing manipulation of designating at least the denomination and the number of banknotes performed by a higher-ranking terminal and/or the manipulation unit 55. The storage unit 3 feeds the designated number of banknotes of the designated denomination from the storage modules 31 to the safe section-side transport unit 43, which transports the fed banknotes along the transport path 431 to the loop transport path 411 of the processing section-side transport unit 41. The processing section-side transport unit 41 transports the banknotes to the recognition unit 25. After recognition by the recognition unit 25, the banknotes are paid out to the outlet 231. After termination of the dispensing processing, the inventory amounts stored in the memory unit 59 are updated.

(Description of banknotes to be handled by banknote depositing and dispensing machine)

[0072] Next, banknotes to be handled by the banknote depositing and dispensing machine 1 will be described.

In recent years, so-called composite banknotes made of a combination of a paper material and a polymer material have been issued. A composite banknote has a depression/projection formed by a polymer material in a portion of the banknote, e.g., in a 20-euro banknote shown in FIG. 5, at a position closer to one side from the center in the long-edge direction of the banknote. The depression/projection is depressed on one face (the front in FIG. 5) of the banknote and projected on the other face (the back in FIG. 5). Such a composite banknote having a depression/projection is asymmetric in shape in the long-edge direction.

[0073] Banknotes put on the inlet 211 are not uniform in front/back and in orientation. Therefore, the banknotes transported along the loop transport path 411 and the transport path 431 have any of four positions, A to D as shown in FIG. 5. That is, in position A, a banknote is face-up and oriented in the transport direction (upward direction as viewed from FIG. 5, shown by the arrow). In position B, a banknote is face-up and oriented in a direction adverse to the transport direction. In position C, a banknote is face-down and oriented in the direction adverse to the transport direction. In position D, a banknote is face-down and oriented in the transport direction.

[0074] As described earlier, the banknote depositing and dispensing machine 1 is configured to transport banknotes with their long edges facing forward in the transport direction. Also, as shown in FIG. 6, the storage module 31 winds banknotes BN around the drum 312 so that the long edges of the banknotes are along the central axis of the drum 312. Therefore, when a banknote is in position A or position B, among the four positions described above, the projection of the depression/projection faces inward in the radial direction of the drum 312, located on the side contracting when the banknote is bended, whereby the banknote has difficulty in bending along the surface of the drum 312. In such a case, even if the banknote is tightened with the tapes 310, a gap may appear between the tapes 310 and the banknote BN especially in the portion of the depression/projection.

[0075] On the contrary, when a banknote is in position C or position D, the projection of the depression/projection faces outward in the radial direction of the drum 312, located on the side expanding when the banknote is bended, whereby the banknote bends comparatively easily along the surface of the drum 312.

[0076] Also, a banknote having a depression/projection is nonuniform in thickness. Therefore, when banknotes having a depression/projection are stacked in the radial direction of the drum 312, the banknotes may tilt.

[0077] When the difficulty in bending caused by the position of banknotes and the nonuniformity in thickness due to depression/projection described above are combined, the tapes 310 and the banknotes BN wound around the drum 312 may have a shape of, not a cylinder, but a truncated cone where the radius on one side in the central axis direction of the drum 312 is large while the radius on the other side is relatively small, as exagger-

atedly illustrated in FIG. 6, for example.

[0078] Note that banknotes to be handled by the banknote depositing and dispensing machine 1 include, not only composite banknotes, but also conventional banknotes made of a paper material, i.e., banknotes that are uniform in thickness and easily bend along the surface of the drum 312 irrespective of the position of the banknotes.

[0079] It is also possible to include, as banknotes to be handled by the banknote depositing and dispensing machine 1, a banknote having braille characters in a portion of the banknote and a banknote having an anticounterfeit thread or hologram in a portion of the banknote. Such banknotes having braille characters and a thread or a hologram are not necessarily uniform in thickness, and may change in easiness in bending along the surface of the drum 312 depending on the position of the banknotes. Therefore, as shown in FIG. 6, the tapes 310 and the banknotes BN wound around the drum 312 may have a shape of a truncated cone.

(Trouble that may occur in winding storage unit)

[0080] As described earlier, in the winding storage module 31, banknotes are wound around the drum 312 together with the tapes 310. As the stored amount of banknotes in the storage module 31 is larger, the outer diameter of the drum 312 becomes larger with the tapes 310 and the banknotes wound around the drum 312. When the drum 312 is rotated in the winding direction to store banknotes in a state where the outer diameter of the drum 312 has increased, portions of the tapes 310 closer to the drum 312 are wound in the winding direction following the rotation of the drum 312, as conceptually shown in FIG. 7. This strengthens the tightening of the portions of the tapes 310 closer to the drum 312. On the contrary, portions of the tapes 310 away from the drum 312 have difficulty in following the rotation of the drum 312 due to inertia. This causes slippage between the inner and outer portions of the tapes 310.

[0081] When the drum 312 is rotated in the winding direction, a predetermined tension F is imparted, by the torque limiter 314 of the tape reel 311, to portions of the tapes 310 in the outermost-diameter part of the drum 312 as described earlier. For this reason, the tightened state of the tapes 310 in the outermost-diameter part of the drum 312 is stable.

[0082] Therefore, when the drum 312 is rotated in the winding direction in a state where the stored amount of the storage module 31 is large, the force of tightening the tapes 310 varies depending on the position in the radial direction of the drum 312. In particular, radially intermediate portions of the tapes 310 between the inner portions of the tapes 310 and the outermost-diameter portions of the tapes 310 become weak in tightening as the inner portions of the tapes 310 are wound in the winding direction. With the tightening of the tapes 310 becoming weak, a gap appears between the tapes 310 and the

banknotes, whereby the banknotes being wound around the drum 312 are easily displaced in the rotation axis direction of the drum 312.

[0083] When banknotes are fed from the winding storage module 31, the drum 312 is rotated in the direction reverse to the winding direction. After completion of the feeding of the banknotes, in order to adjust the position of the drum 312, the drum 312 is rotated a little in the winding direction. Therefore, as in the case of storage of banknotes, in the case of feeding of banknotes, also, the tightening of the tapes 310 in the inner part of the drum 312 may become strong, and the tightening of the intermediate portions of the tapes 310 may become weak.

[0084] Incidentally, in a conventionally configured banknote depositing and dispensing machine, when banknotes of the same kind were stored in a plurality of storage modules (e.g., when fit notes of the same denomination were allowed to be stored in either of two storage modules), use priorities were assigned to such storage modules.

[0085] The above conventional configuration will be described in detail with reference to FIG. 8. FIG. 8 shows two storage modules 31L and 31R on the left and on the right. The left-side and right-side storage modules 31L and 31R shown in FIG. 8 do not indicate storage modules adjacent to each other in the banknote depositing and dispensing machine, but indicate two storage modules for storing banknotes of the same kind. Assume that the left-side storage module 31L is relatively high in use priority and the right-side storage module 31R is relatively low in use priority.

[0086] In initial state P81 of the banknote depositing and dispensing machine, it is assumed that the two storage modules 31L and 31R are both empty. In storing banknotes in initial state P81, banknotes are stored in the left-side storage module 31L high in use priority. Also, in feeding banknotes, banknotes are fed from the left-side storage module where banknotes are stored (see the arrows in FIG. 8).

[0087] When the stored amount of the left-side storage module 31L becomes too large to allow further storage of banknotes in the left-side storage module 31L (to state correctly, when the left-side storage module 31L has reached the state of a preset full capacity or a near-full capacity close to the full capacity), banknotes are to be stored in the right-side storage module 31R low in use priority as shown in P82 of FIG. 8. The preset full capacity is the maximum value of the stored amount of the storage module 31L, which may be defined by the number of banknotes, by the maximum radius of the drum with banknotes wound around, or by the weight of banknotes stored. When the maximum value of the stored amount is set by the number of banknotes, the maximum radius of the drum will vary with the difference in thickness between new and old banknotes stored. Note that the full capacity may also be called being full in some cases.

[0088] In feeding banknotes, banknotes are fed from the left-side storage module 31L high in use priority. As

a result of the feeding of banknotes from the left-side storage module 31L, the left-side storage module 31L becomes again the state where storage of banknotes is permissible. Once the left-side storage module 31L resumes the state where storage of banknotes is permissible, banknotes will be stored in the left-side storage module 31L high in use priority, and also banknotes will be fed from the left-side storage module 31L (see P83).

[0089] FIG. 10 is a view illustrating a change in the stored amount of a storage module. As shown by the broken line in FIG. 10, in the conventional configuration where use priorities are assigned to a plurality of storage modules, the storage module high in use priority repeats storage and feeding of banknotes in a near-full state.

[0090] As described earlier, when storage of banknotes or feeding of banknotes is performed in a state where the stored amount of the storage module 31 is large, the tightening of the tapes 310 becomes weak in a radially intermediate part of the drum 312. Therefore, in the conventional configuration, the tightening of the tapes 310 will become further weak in the radially intermediate part of the drum 312.

[0091] In particular, when a composite banknote is included in banknotes being stored into the storage module 31, a gap may appear between the tapes 310 and the banknote due to the difficulty in bending of the composite banknote described earlier. Having such a gap is equivalent to having a space for tightening of the tapes 310 in the radially inner part of the drum 312. Therefore, there arises the following trouble: in rotation of the drum 312 in the winding direction, while the wound amount of the inner portions of the tapes 310 further increases, the tightening of the tapes 310 becomes further weak in the radially intermediate part of the drum 312. This further increases the gap between the tapes 310 and the banknotes, and thus displacement of banknotes wound around the drum 312 easily occurs.

[0092] The banknote depositing and dispensing machine 1 is configured to solve the above trouble by adopting configurations 1 to 4 described below. Note that the banknote depositing and dispensing machine 1 may adopt all of the configurations 1 to 4 or may appropriately select one or some of these configurations.

(Configuration 1: Configuration of preventing repetition of storage and feeding of banknotes in state where storage module is near full)

[0093] As described above, repetition of storage and feeding of banknotes in a state where the winding storage module 31 is near full causes displacement of banknotes. In consideration of this, the banknote depositing and dispensing machine 1 is configured so as to prevent the repetition of storage and feeding of banknotes in a state where the storage module 31 is near full itself.

[0094] Specifically, in the banknote depositing and dispensing machine 1, no use priorities are assigned to the storage modules 31. When the stored amount of a stor-

age module 31 is within a preset range, the control unit 513 of the banknote depositing and dispensing machine 1 prohibits either storage of a banknote into the storage module 31 or feeding of a banknote from the storage module 31 while permitting the other. To state in more detail, once the stored amount of a storage module 31 reaches a preset first stored amount, the control unit 513 prohibits storage of a banknote into this storage module 31, while permitting only feeding of a banknote from the storage module 31, until the stored amount reaches a preset second stored amount.

[0095] The first stored amount is set based on the maximum capacity (i.e., the full capacity) of the storage module 31 or an amount near the maximum capacity (i.e., a near-full capacity). The first stored amount may be the full capacity or a near-full capacity.

[0096] The second stored amount is an amount smaller than the first stored amount, set appropriately. In order to ensure not to repeat storage and feeding of banknotes in a state where the storage module 31 is near full, the second stored amount is preferably largely away from the first stored amount. The second stored amount may be zero (i.e., the storage module being empty) or an amount near zero (i.e., the storage module being near empty).

[0097] Next, referring to FIG. 9, an example of changes in the stored amounts of a plurality of storage modules 31L and 31R will be described.

[0098] Initial state P91 is the same as P81 in FIG. 8. In storing banknotes in initial state P91, banknotes can be stored in either of the left-side and right-side storage modules 31L and 31R. In the illustrated example, banknotes are being stored in the left-side storage module 31L. In feeding banknotes, banknotes are fed from the left-side storage module 31L in which banknotes are stored (see the arrows in FIG. 9).

[0099] When the stored amount of the left-side storage module 31L becomes large reaching the above first stored amount, the control unit 513 prohibits storage of banknotes into the left-side storage module 31L as described above, although it permits feeding of banknotes from the left-side storage module 31L. At this time, the control unit 513 permits storage of banknotes into the right-side storage module 31R (see P92 in FIG. 9).

[0100] Even when the stored amount of the left-side storage module 31L falls below the first stored amount by the feeding of banknotes from the left-side storage module 31L, the control unit 513 continues prohibiting storage of banknotes into the left-side storage module 31L until the stored amount reaches the second stored amount. Therefore, the left-side storage module 31L serves as a feeding-dedicated storage module until the stored amount reaches the second stored amount. During this time, banknotes are stored in the right-side storage module 31R. The control unit 513 prohibits feeding of banknotes from the right-side storage module 31R, using the right-side storage module 31R as a storage-dedicated storage module.

[0101] When the stored amount of the left-side storage modules 31L reaches the second stored amount with the feeding of banknotes from the left-side storage modules 31L, the control unit 513 uses the left-side storage modules 31L as a storage-dedicated storage module, permitting storage of banknotes into the left-side storage modules 31L. On the contrary, the control unit 513 uses the right-side storage modules 31R as a feeding-dedicated storage module, prohibiting storage of banknotes into the right-side storage modules 31R. In other words, once the stored amount of the left-side storage modules 31L reaches the second stored amount, the storage-dedicated storage module and the feeding-dedicated storage module are interchanged (see P93 in FIG. 9).

[0102] As shown by the solid line in FIG. 10, the left-side storage modules 31L becomes a dispensing-dedicated storage module once its stored amount reaches the first stored amount, and storage of banknotes thereinto is prohibited until its stored amount reaches the second stored amount. In the left-side storage modules 31L, therefore, repetition of storage and feeding of banknotes in its near-full state is prevented.

[0103] Also, as shown in the dashed-dotted line in FIG. 10, the right-side storage modules 31R becomes a storage-dedicated storage module when the left-side storage modules 31L becomes a feeding-dedicated storage module, and becomes a feeding-dedicated storage module when the left-side storage modules 31L becomes a storage-dedicated storage module. Therefore, in the right-side storage modules 31R, also, repetition of storage and feeding of banknotes in its near-full state is prevented.

[0104] As a result, displacement of banknotes wound around the drum 312 inside the storage module 31 due to weakened tightening of the tapes 310 is prevented.

[0105] Also, in this configuration, where one of a plurality of storage modules 31 is set as a storage-dedicated storage module 31 and the other is set as a feeding-dedicated storage module 31, storage and feeding of banknotes can be performed at all times. Moreover, unlike the conventional configuration where use priorities are assigned, a plurality of storage modules 31 can be used equally.

[0106] Note that in the above description, when the stored amount of the left-side storage module 31L set as feeding-dedicated reaches the second stored amount, the left-side storage module 31L is set as a storage-dedicated storage module and the right-side storage module 31R as a feeding-dedicated storage module. Alternatively, if the stored amount of the right-side storage module 31R set as storage-dedicated reaches the first stored amount before the stored amount of the left-side storage module 31L reaches the second stored amount, the right-side storage module 31R may be set as a feeding-dedicated storage module and the left-side storage module 31L as a storage-dedicated storage module at this timing.

[0107] Otherwise, while either storage or feeding of banknotes is prohibited between the first stored amount

and the second stored amount for the left-side storage module 31L, either storage or feeding of banknotes may be prohibited between a third stored amount and a fourth stored amount for the right-side storage module 31R.

[0108] In the above configuration, when the stored amount is between the first stored amount and the second stored amount, one storage module 31 is storage-dedicated while the other storage module 31 is feeding-dedicated. Alternatively, each of the plurality of storage modules 31 may be configured to be available for both storage and feeding of banknotes. Once the stored amount of any one of the storage modules 31 reaches the first stored amount, storage of banknotes may be prohibited while feeding of banknotes being permitted for this storage module 31 until the stored amount reaches the second stored amount. For the other storage module, both storage and feeding of banknotes may be permitted.

[0109] That is, as described above, the trouble of displacement of banknotes occurs due to repetition of storage and feeding of banknotes in a state where the storage module 31 is near full. Such displacement of banknotes does not easily occur even if storage and feeding of banknotes is repeated in a state where the stored amount of the storage module 31 is small. Therefore, without setting of one storage module 31 as storage-dedicated and the other storage module 31 as feeding-dedicated, both storage and feeding of banknotes may be permitted for a plurality of storage modules 31 in the case that the stored amounts of the storage modules 31 are comparatively small.

[0110] In the above case, in storage of banknotes, banknotes may be stored into a storage module 31 small in stored amount among the plurality of storage modules 31, and in feeding of banknotes, banknotes may be fed from a storage module 31 large in stored amount among the plurality of storage modules 31. By doing this, it is possible to store banknotes into the plurality of storage modules 31 as equally as possible.

[0111] In the configuration where storage and feeding of banknotes are permitted for each of a plurality of storage modules 31, once the stored amount of any of the storage modules 31 reaches the first stored amount, storage of banknotes may be prohibited while feeding of banknotes being permitted for this storage module 31 until the stored amount reaches the second stored amount. By this, it is possible to prevent repetition of storage and feeding of banknotes in a state where the storage module 31 is near full.

(Configuration 2: Configuration of adjusting starting current for drum)

[0112] As described earlier, in the winding storage module 31, the drum 312 is connected to the rotary drive source. With the rotation of the drum 312 in the winding direction by the driving force of the rotary drive source, banknotes are wound around the drum 312 together with the tapes 310. In a state where the radius of the drum

312 has increased (i.e., the stored amount of the storage module 31 is large), if the drum 312 starts rotating vigorously at the start of winding of banknotes and the tapes 310, the tightening of the radially inner portions of the tapes 310 closer to the drum 312 will become strong. On the contrary, if the rotation of the drum 312 is initiated mildly, the tightening of the radially inner portions of the tapes 310 can be reduced. As a result, the situation that the tightening of the tapes 310 may become weak in the radially intermediate part of the drum 312 is prevented, and thus displacement of banknotes can be prevented.

[0113] The control unit 513 therefore changes the starting current at the start of rotation of the drum 312 depending on the stored amount of the storage module 31. Specifically, when the stored amount of the storage module 31 is smaller than a predetermined amount (i.e., when the radius of the drum 312 is comparatively small), the starting current is set at a first current value. The first current value is a relatively high current value, and the drum 312 starts rotating vigorously. However, since the radius of the drum 312 is small, allowing the tapes 310 wound around the drum 312 to follow the rotation of the drum 312, the situation that the tightening of the radially inner portions of the tapes 310 may become strong is avoided. Therefore, the situation that the tightening of the tapes 310 may become weak in the radially intermediate part of the drum 312 is prevented.

[0114] The control unit 513 sets the starting current at a second current value when the stored amount of the storage module 31 is equal to or more than the predetermined amount (i.e., when the radius of the drum 312 is comparatively large). The second current value is a current value lower than the first current value. With this, the drum 312 starts rotating mildly. As a result, even when the radius of the drum 312 is comparatively large, the situation that the tightening of the radially inner portions of the tapes 310 on the drum 312 may become strong is prevented, and thus the situation that the tightening of the tapes 310 may become weak in the radially intermediate part is prevented.

[0115] Note that, when the stored amount of the storage module 31 is equal to or more than a predetermined amount, the control unit 513 may reduce the starting current from the second current value as the stored amount increases. For example, the starting current may be reduced by 0.1 A as the stored amount (the number of banknotes stored) increases by 10. With this, it is possible to optimize the starting current depending on the magnitude of the radius of the drum 312, and thus prevent more reliably the situation that the tightening of the tapes 310 may become strong in the radially inner part of the drum 312.

(Configuration 3: Configuration of switching between operation modes of storage module)

[0116] One reason why the tightening of the radially inner portions of the tapes 310 on the drum 312 becomes

strong when the drum 312 is rotated in the winding direction is that the tightening of the tapes 310 wound around the drum 312 is originally weak.

[0117] As described earlier, even with composite banknotes having difficulty in bending along the surface of the drum 312, if the tension of the tapes 310 is sufficiently high when the banknotes are wound around the drum 312, it is possible to wind the composite banknotes around the drum 312 while bending the banknotes sufficiently along the surface of the drum 312. As a result, the tightening of the tapes 310 wound around the drum 312 is sufficiently strong with no gap between the tapes 310 and the banknotes. It is therefore possible to prevent the situation that the tightening of the radially inner portions of the tapes 310 may become relatively strong when the drum 312 is rotated in the winding direction.

[0118] As described earlier, in winding banknotes around the drum 312, the tape reel 311 rotates following the rotation of the drum 312. Therefore, as shown in FIG. 3, the tension F of the tapes 310 is determined by $F = T / R$ where T is the limit torque of the torque limiter 314 attached to the tape reel 311 and R is the radius of the tape reel 311. When the radius of the tape reel 311 is large (i.e., at the time of start of winding of the tapes 310 around the drum 312), the tension F of the tapes 310 is relatively small, and thus the tightening of the radially inner portions of the tapes 310 on the drum 312 becomes weak.

[0119] If increase in the tension F of the tapes 310 is intended, it is considered to increase the limit torque T of the torque limiter 314. However, a torque limiter 314 having a great limit torque T generally costs high. Therefore, in the banknote depositing and dispensing machine 1 provided with a plurality of storage modules 31, using high-cost torque limiters 314 for all storage modules 31 will considerably increase the cost.

[0120] Since displacement of banknotes is especially prominent in storage modules 31 for storing composite banknotes, it is considered to use high-cost torque limiters 314 only for some storage modules 31 for storing composite banknotes. However, if this resolution is adopted, two types of storage modules 31 are to be included in one banknote depositing and dispensing machine 1. This is not preferable from the standpoints of production management and maintenance management. Also, the storage modules 31 capable of storing composite banknotes are limited to specific storage modules 31. This is not preferable, either, from the standpoint of the usability of the banknote depositing and dispensing machine 1.

[0121] Also, even if the limit torque T of the torque limiter 314 is made great, it is presumed that, with future emergence of new banknotes having a structure that may have further difficulty in bending, a further great limit torque T will be required.

[0122] The configuration disclosed herein enhances the tension F of the tapes 310 without increasing the limit torque T of the torque limiter 314. As described above,

the tension F of the tapes 310 is determined by $F = T / R$, in which as the radius R of the tape reel 311 is smaller, the tension F of the tapes 310 is greater. Therefore, only the tapes 310 may be previously wound around the drum 312, thereby reducing the radius of the tape reel 311 from the initial state shown by the dashed-dotted line in FIG. 3. Then, it is possible to start winding banknotes around the drum 312 with the tension F of the tapes 310 having been enhanced.

[0123] With the previous winding of only the tapes 310 around the drum 312, however, the maximum capacity of the storage module 31 decreases by this winding.

[0124] In consideration of the above, the banknote depositing and dispensing machine 1 sets two modes as the operation modes for the storage modules 31, and switches between the two modes for each storage module 31.

[0125] One of the two operation modes is a first mode where the tension of the tapes 310 is enhanced as described above. In the first mode, only the tapes 310 are previously wound around the drum 312. The maximum capacity of the storage module 31 decreases in the first mode.

[0126] The other operation mode, a second mode, is a mode that does not involve winding of only the tapes 310 around the drum 312. In the second mode, while the tension of the tapes 310 is not enhanced, the maximum capacity is relatively large.

[0127] As shown in FIG. 11, the tapes 310 made of a translucent material have light-shading seals 3111 and 3112 for switching between the first and second modes. The light-shading seals 3111 and 3112 attached to the tapes 310 are for detecting the positions of the tapes 310 drawn out from the tape reel 311, and are detected with a translucent-type tape sensor (illustration omitted) placed on the drawing path for the tapes 310 extending from the tape reel 311 to the drum 312. The light-shading seals include the first light-shading seals 3111 for detecting the tape position in the first mode, and the second light-shading seals 3112 for detecting the tape position in the second mode. The first light-shading seals 3111 are placed at positions closer to the tape reel 311 than the second light-shading seals 3112.

[0128] When the storage module 31 is operated in the second mode, the control unit 513 draws out the tapes 310 until detecting the two second light-shading seals 3112 lined along the length of each tape 310. By this, the amount of the tapes drawn out from the tape reel 311 is relatively small, and the radius R of the tape reel 311 is large correspondingly.

[0129] When the storage module 31 is operated in the first mode, the control unit 513 draws out the tapes 310 until further detecting the first light-shading seals 3111 after detecting the second light-shading seals 3112. By this, the amount of the tapes drawn out from the tape reel 311 is relatively large, and the radius R of the tape reel 311 becomes small correspondingly.

[0130] The banknote depositing and dispensing ma-

chine 1 is configured so that the operator can set, for each of the first to eighth storage modules 31, whether the storage module is to be operated in the first mode or the second mode by manipulating the manipulation unit 55. For example, setting may be made to operate a storage module 31 for storing composite banknotes in the first mode and a storage module 31 for storing no composite banknotes in the second mode. With this setting, the tension F of the tapes 310 at the time of winding banknotes around the drum 312 is enhanced in the storage module 31 for storing composite banknotes where displacement of banknotes easily occurs, permitting reliable and stable winding of banknotes around the drum 312. As a result, it is possible to prevent the situation that the tightening of the radially inner portions of the tapes 310 may become strong and the tightening of the intermediate portions of the tapes 310 may become relatively weak when the drum 312 is rotated in the winding direction, causing displacement of banknotes. On the contrary, in the storage module 31 for storing no composite banknotes, where displacement of banknotes does not occur easily in the first place, there is little necessity to enhance the tension of the tapes 310. Therefore, by operating such a storage module 31 in the second mode, it is possible to avoid decrease in the maximum capacity of the storage module 31 while storing banknotes stably.

[0131] Note that the banknote depositing and dispensing machine 1 may be configured so that the operator sets, for each of the first to eighth storage modules 31, whether the storage module is to be operated in the first mode or the second mode, as described above. Otherwise, upon determination of the kind of banknotes to be stored in the first to eighth storage modules 31, setting may be made automatically to operate the storage module 31 for storing composite banknotes in the first mode and the storage module 31 for storing no composite banknotes in the second mode.

[0132] Enhancing the tension of the tapes 310 is also advantageous for preventing breaking of the tapes 310. That is, the tapes 310 drawn out from the tape reel 311 pass through the tape regulating guide 313 up to the drum 312 as shown in FIG. 3. When the tension of the tapes 310 is high, flopping of the tapes 310 is prevented or reduced. If the tapes 310 is floppy, the tapes 310 may interfere with the tape regulating guide 313, causing cutting of the tapes 310. By enhancing the tension of the tapes 310 thereby preventing or reducing flopping of the tapes 310, cutting of the tapes 310 can be prevented. Also, enhancing the tension F of the tapes 310 can prevent the trouble that the tightening of the tapes 310 with the rotation of the drum 312 in the winding direction may become excessively strong, and thus is effective in preventing breakage of the tapes 310 due to this trouble.

(Configuration 4: Control configuration of regulating storage of composite banknotes into storage module)

[0133] As described earlier, displacement of ban-

knotes in the storage module 31 is caused by the rotation of the drum 312 in the winding direction in a state where the outer diameter of the drum 312 is large. When there are many composite banknotes wound around the drum 312, the tightening of the tapes 310 may become weak in the radially intermediate part. Given these situations, it is considered that, when the number of composite banknotes stored in the storage module 31 becomes large, the maximum capacity of this storage module 31 may be reduced, whereby increase in the outer diameter of the drum 312 may be prevented.

[0134] However, the above configuration will decrease the stored amount of the storage module 31 causing degradation in the performance (specifications) of the banknote depositing and dispensing machine 1, and therefore is not a preferable countermeasure. Since banknotes that cannot be stored in the storage modules 31 are paid out to the outlet 231 as rejected banknotes, the number of rejected banknotes will increase if the maximum capacity of the storage modules 31 is small. This worsens the usability of the banknote depositing and dispensing machine 1.

[0135] Incidentally, as shown in FIG. 5, the difficulty in bending along the surface of the drum 312 varies depending on the front/back and orientation of a composite banknote to be stored into the storage module 31. This is also a cause of the tightening of the tapes 310 becoming weak resulting in displacement of banknotes. As a result of examinations by the present inventor, however, it has been found that displacement of banknotes occurs due to, not only the number of composite banknotes stored and the front/back and orientation of the composite banknotes simply, but also other various factors in combination.

[0136] In the configuration 4 disclosed herein, considering the combination of various factors, only composite banknotes having a high possibility of really causing displacement of banknotes are not stored in the storage modules 31, and the other banknotes are stored in the storage modules 31, thereby preventing reduction in the stored amount of the storage modules 31. Various factors that may cause displacement of banknotes will be described hereinafter in order. Thereafter, control of regulating storage of composite banknotes into the storage modules 31 will be described.

<Radial position of composite banknote on drum with banknotes wound around>

[0137] As shown in FIG. 6, when composite banknotes are wound around the drum 312, the tapes 310 and the banknotes wound around the drum 312 may have a truncated cone shape. In relation to this, the present inventor has found that, although the numbers of composite banknotes wound around the drum 312 are the same and the tapes 310 and banknotes wound around the drum 312 are similarly in a truncated cone shape, displacement of banknotes occurs easily in some cases, but it does

not occur easily in other cases.

[0138] That is, the left-side view of FIG. 12 illustrates a case where many composite banknotes are wound in a radially inner part of the drum 312 and non-composite normal banknotes are wound in a radially outer part thereof. In this state, the banknotes wound around the drum 312 tend to tilt as a whole. Therefore, when the tightening of the tapes 310 becomes weak, displacement of banknotes easily occur. On the contrary, the right-side view of FIG. 12 illustrates a case where many non-composite normal banknotes are wound in a radially inner part of the drum 312 and composite banknotes are wound in a radially outer part of the drum 312. In this state, while the outer circumference of the drum 312 is tilted, with the tapes 310 and the banknotes wound around the drum 312 being in a truncated cone shape, banknotes are not tilted in a radially intermediate part. Therefore, even when the tightening of the tapes 310 becomes weak in a radially intermediate part of the drum 312, displacement of banknotes does not occur easily. In this way, not only the magnitude of the number of composite banknotes wound around the drum 312, but also the radial position of the composite banknotes wound around the drum 312 affect occurrence of displacement of banknotes.

[0139] Therefore, by ensuring not to store composite banknotes into the storage module 31 when the composite banknotes are to be located radially inside, rather than limiting the maximum capacity of the storage module 31 based on only the number of composite banknotes stored in the storage module 31, it is possible to increase the maximum capacity of the storage module 31 while preventing or reducing occurrence of displacement of banknotes.

<Relative position between depression/projection of composite banknotes and tapes>

[0140] As shown in FIG. 5, the difficulty in bending of a composite banknote along the surface of the drum 312 varies depending on the front/back and the orientation of the composite banknote. When the composite banknote is in position A and position B, the composite banknote have difficulty in bending along the surface of the drum 312, and thus a gap easily appears between the composite banknote and the tapes 310 when the composite banknote is wound around the drum 312. However, the present inventor has found that, depending on the relative position between the depression/projection of the composite banknote and the tapes 310, it will be possible to bend the composite banknote sufficiently along the surface of the drum 312, whereby a gap will not easily appear between the composite banknote and the tapes 310. That is, when the depression/projection of the composite banknote is located near either of the tapes 310, it will be possible to press the banknote by the tension of the tape 310, though the depression/projection has difficulty in bending, whereby a gap will not easily appear between the composite banknote and the tapes 310.

[0141] FIG. 13 illustrates the relative positions between a depression/projection of a composite banknote and the tapes 310. The banknote depositing and dispensing machine 1 is configured to accept displacements of banknotes in the direction perpendicular to the transport direction (i.e., center alignment, left alignment, and right alignment) for acceptance of various sizes of different currencies and denominations.

[0142] When a composite banknote being transported in position A is center-aligned or left-aligned, the depression/projection of the composite banknote is close to either of the tapes 310. The depression/projection is thus bent by the tape 310, whereby a gap does not easily appear between the composite banknote and the tape 310. Therefore, even when this composite banknote is stored in the storage module 31, displacement of banknotes will not easily occur. On the contrary, when a composite banknote being transported in position A is right-aligned, the depression/projection of the composite banknote is away from the tapes 310. The composite banknote thus has difficulty in bending, whereby a gap easily appear between the composite banknote and the tapes 310. Therefore, storing this composite banknote in the storage module 31 may cause displacement of banknotes. Similarly, when a composite banknote being transported in position B is left-aligned, the depression/projection of the composite banknote is away from the tapes 310. The composite banknote thus has difficulty in bending, whereby a gap easily appear between the composite banknote and the tapes 310. In this case, also, storing this composite banknote in the storage module 31 may cause displacement of banknotes.

[0143] If any banknote that is simply in position A or position B is prohibited from being stored into the storage module 31, a number of banknotes will not be stored into the storage module 31. This increases rejected banknotes, worsening the usability of the banknote depositing and dispensing machine 1. By prohibiting storage of a composite banknote into the storage module 31 only when the composite banknote is in position A and right-aligned and when it is in position B and left-aligned as described above, it is possible to prevent increase in the number of rejected banknotes and yet avoid the situation that the tapes 310 and banknotes wound around the drum 312 may have a truncated cone shape as shown in FIG. 6. As a result, it is possible to effectively prevent displacement of banknotes and also avoid worsening of the usability of the banknote depositing and dispensing machine 1.

<Storage control based on combination of various factors>

[0144] The control unit 513 of the banknote depositing and dispensing machine 1 determines whether storage of a composite banknote into the storage module 31 is permitted or not based on the combination of various factors described above. By doing this, it is possible to

prevent displacement of banknotes wound around the drum 312 while storing as many composite banknotes as possible into the storage module 312. Specifically, the control unit 513 determines whether storage of a composite banknote is permitted or not based on the combination shown in FIG. 14. When the number of banknotes stored in the storage module 31 is equal to or less than a predetermined value (e.g., 100) and a composite banknote in position A is right-aligned, and when the number of banknotes stored in the storage module 31 is equal to or less than the predetermined value and a composite banknote in position B is left-aligned, the composite banknote will not be stored in the storage module 31. This composite banknote is paid out to the outlet 213 as a rejected banknote.

[0145] When the stored amount of the storage module 31 is small, a composite banknote will be located in a radially inner part of the drum 312 when wound around the drum 312 (see the left-side view of FIG. 12). Also, when a composite banknote in position A is right-aligned or when a composite banknote in position B is left-aligned, the depression/projection of the composite banknote will have difficulty in bending and thus a gap will easily appear between the tapes 310 and the banknote (see FIG. 13). Consequently, storage of a composite banknote is prohibited only when these plural factors are combined.

[0146] By doing as described above, it is possible to prevent the situation that the tapes 310 and banknotes wound around the drum 312 may have a truncated cone shape and also prevent occurrence of displacement of banknotes, in the storage module 31, while reducing banknotes paid out to the outlet 213 as rejected banknotes.

[0147] Note that a composite banknote paid out as a rejected banknote due to the above factors can be stored into the storage module 31 by placing the banknote again on the inlet 211 after adjusting the orientation, position, and location thereof.

(Banknote depositing and dispensing machine provided with stacking storage unit)

[0148] The technology disclosed herein is applicable, not only to the banknote depositing and dispensing machine 1 provided with a winding storage unit, but also to a banknote depositing and dispensing machine provided with a stacking storage unit.

[0149] FIG. 15 illustrates a banknote depositing and dispensing machine 10 provided with a stacking storage unit. This banknote depositing and dispensing machine 10 has a plurality (in the illustrated example, first to fourth) stacking storage cassettes 33₁ to 33₄. Each of the stacking storage cassettes 33 has a vertically movable stage 331 inside. Banknotes are vertically stacked on the stage 331. These stacking storage cassettes 33 are configured to allow feeding of stored banknotes. The configuration of the stacking storage cassettes 33 is known, and thus detailed description thereof is omitted.

[0150] In the stacking storage cassettes 33, also, it is not preferable to repeat storage and feeding of banknotes in a near-full state. That is, during feeding, the topmost banknote is to be fed by pressing stacked banknotes in the stacking direction. In a near-full state, where banknotes are stacked high, the pressing becomes unstable. Also, feeding of banknotes cannot be performed stably. In particular, when composite banknotes are stacked, the stacked banknotes tend to tilt on the stage 331 because composite banknotes are nonuniform in thickness, increasing the instability described above. Moreover, storage of banknotes can become unstable when the stacking storage cassette 33 is in a near-full state.

[0151] In consideration of the above, in the banknote depositing and dispensing machine 10 provided with stacking storage cassettes 33, also, the above-described configuration 1 is adopted. That is, to avoid repetition of storage and feeding of banknotes in a state where the stored amount of the storage cassette 33 is near full, when the stored amount of the storage cassette (e.g., the first storage cassette 33₁) reaches a preset first stored amount, the control unit 513 prohibits storage of banknotes into the first storage cassette 33₁ until the stored amount reaches a preset second stored amount. Feeding of banknotes from the first storage cassette 33₁ is permitted. The first storage cassette 33₁ is set as a feeding-dedicated storage cassette.

[0152] At this time, the control unit 513 sets the second storage cassette 33₂ that stores the same kind of banknotes as the first storage cassette 33₁ as a storage-dedicated storage cassette. That is, for the second storage cassette 33₂, while storage of banknotes is permitted, feeding of banknotes is prohibited.

[0153] When the stored amount of the first storage cassette 33₁ reaches the second stored amount as banknotes are fed from this storage cassette, the control unit 513 switches the first storage cassette 33₁ from a feeding-dedicated storage cassette to a storage-dedicated storage cassette. The control unit 513 also switches the second storage cassette 33₂ from a storage-dedicated storage cassette to a feeding-dedicated storage cassette. In the first storage cassette 33₁, storage of banknotes is permitted and feeding of banknotes is prohibited. In the second storage cassette 33₂, feeding of banknotes is permitted and storage of banknotes is prohibited. In this way, in the banknote depositing and dispensing machine 10 provided with stacking storage cassettes 33, also, repetition of storage and feeding of banknotes in a state where the storage cassette 33 is near full is prevented.

[0154] Note that, as described earlier, when the second storage cassette 33₂ set as storage-dedicated reaches the first stored amount before the first storage cassette 33₁ set as feeding-dedicated reaches the second stored amount, it is possible to switch the first storage cassette 33₁ to a storage-dedicated storage cassette and the second storage cassette 33₂ to a feeding-dedicated storage cassette at this timing.

[0155] Otherwise, each of the plurality of storage cassettes 33 may be configured to be available for both storage and feeding of banknotes. Once any one of the storage cassettes 33 reaches the first stored amount, storage of banknotes may be prohibited, while feeding of banknotes is permitted, for this storage cassette 33. For the other storage cassette 33, both storage and feeding of banknotes may be permitted.

[0156] The banknote depositing and dispensing machine 10 provided with stacking storage cassettes 33 may also adopt the above-described configuration 4. In the stacking storage cassette 33, when many composite banknotes are included in a lower part of the stack of banknotes, the tilt of the stacked banknotes will be great, easily becoming unstable. Also, when depressions/projections of composite banknotes overlap at the same position, the tilt of the stacked banknotes will become further great. In consideration of this, in the banknote depositing and dispensing machine 10 provided with stacking storage cassettes 33, also, the control unit 513 may determine not to store a composite banknote depending on the number of banknotes stored in the storage cassette 33, the front/back and orientation of the composite banknote, and the location of the composite banknote.

[0157] Note that, while the storage cassettes 33 that store banknotes by vertically stacking banknotes are illustrated, storage cassettes that store banknotes by horizontally placing banknotes in a line may be used.

[0158] The technology disclosed herein is not necessarily applied only to the banknote depositing and dispensing machines described above, but is widely applicable to banknote handling devices that include a winding storage unit and/or a stacking storage unit for storing banknotes and perform storage and feeding of banknotes.

[0159] The object stored into and fed from the storage unit is not limited to banknotes, but covers paper sheets in general including securities such as checks and exchange coupons, and the technology disclosed herein is applicable to paper sheet handling devices.

DESCRIPTION OF REFERENCE CHARACTERS

[0160]

1, 10	Banknote depositing and dispensing machine (paper sheet handling device)
31	Storage module (storage unit)
33	Storage cassette (storage unit)
513	Control unit

Claims

1. A paper sheet handling device, comprising:

at least one storage unit configured to store paper sheets therein and feed stored paper sheets

- therefrom; and
 a control unit configured to control storage and feeding of paper sheets into and from the at least one storage unit,
 wherein
 when a stored amount of a respective storage unit is within a preset range, the control unit prohibits one of storage of paper sheets into the respective storage unit and feeding of paper sheets from the respective storage unit and permits the other of storage of paper sheets into the respective storage unit and feeding of paper sheets from the respective storage unit.
2. The paper sheet handling device of claim 1, wherein the control unit is configured to:
- prohibit storage of paper sheets into the respective storage unit and permit feeding of paper sheets from the respective storage unit when the stored amount of the respective storage unit reaches a predetermined first stored amount, until the stored amount reaches a predetermined second stored amount, wherein the second stored amount is smaller than the predetermined first stored amount; and
 permit storage of paper sheets within the respective storage unit when the stored amount of the respective storage unit reaches the predetermined second stored amount by way of feeding of paper sheets from the respective storage unit.
3. The paper sheet handling device of claim 1 or 2, wherein the control unit is configured to:
- prohibit feeding of paper sheets from the respective storage unit and permit storage of paper sheets within the respective storage unit when the stored amount of the respective storage unit reaches a predetermined third stored amount, until the stored amount reaches a predetermined fourth stored amount, wherein the predetermined fourth stored amount is larger than the predetermined third stored amount; and
 permit feeding of paper sheets from the respective storage unit when the stored amount of the respective storage unit reaches the predetermined fourth stored amount by way of storage of paper sheets into the respective storage unit.
4. The paper sheet handling device of any one of claims 1 to 3, wherein the at least one storage unit includes a plurality of storage units, and
 when storage of paper sheets is permitted for any of the plurality of storage units, the control unit stores
- paper sheets into a storage unit having a lower stored amount.
5. The paper sheet handling device of claim 2, wherein the at least one storage unit includes at least a first storage unit and a second storage unit, and
 when the stored amount of either one of the first storage unit and the second storage unit reaches the predetermined first stored amount, the control unit designates the storage unit in question as a feeding-dedicated storage unit that performs only feeding of paper sheets and designates the other storage unit as a storage-dedicated storage unit that performs only storage of paper sheets.
6. The paper sheet handling device of claim 5, wherein when the stored amount of the feeding-dedicated storage unit reaches the predetermined second stored amount, the control unit designates the storage unit in question as a storage-dedicated storage unit and designates the other storage unit as a feeding-dedicated storage unit.
7. The paper sheet handling device of any one of claims 1 to 6, wherein the at least one storage unit is a winding-type storage unit, in which paper sheets are wound around a drum together with a tape.
8. The paper sheet handling device of any one of claims 1 to 6, wherein the at least one storage unit is a stacking-type storage unit, in which paper sheets are placed in contact with each other.
9. A paper sheet handling method comprising the steps of:
- storing paper sheets into at least one storage unit;
 feeding paper sheets from the at least one storage unit; and
 prohibiting either storage of paper sheets into a respective storage unit or feeding of paper sheets from the respective storage unit when a stored amount of the respective storage unit is within a preset range.
10. A paper sheet handling method comprising the steps of:
- when a stored amount of a storage unit configured to store paper sheets and feed stored paper sheets reaches a predetermined first stored amount, prohibiting storage of paper sheets into the storage unit and permitting feeding of paper sheets from the storage unit, until the stored amount reaches a predetermined second stored

amount, wherein the predetermined second stored amount is smaller than the predetermined first stored amount; and
permitting storage of paper sheets into the storage unit when the stored amount of the storage unit reaches the predetermined second stored amount by way of feeding of paper sheets from the storage unit. 5

11. The paper sheet handling method of claim 10, comprising the steps of: 10

prohibiting feeding of paper sheets from the storage unit and permitting storage of paper sheets into the storage unit when the stored amount of the storage unit reaches a predetermined third stored amount, until the stored amount reaches a predetermined fourth stored amount, wherein the predetermined fourth stored amount is larger than the predetermined third stored amount; and
permitting feeding of paper sheets from the storage unit when the stored amount of the storage unit reaches the predetermined fourth stored amount by way of storage of paper sheets into the storage unit. 25

12. The paper sheet handling method of any one of claims 9 to 11, wherein
the step of storing paper sheets into the storage unit includes winding paper sheets around a drum together with a tape, and
the step of feeding paper sheets from the storage unit includes sending out paper sheets from the drum together with the tape. 30

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FIG.1

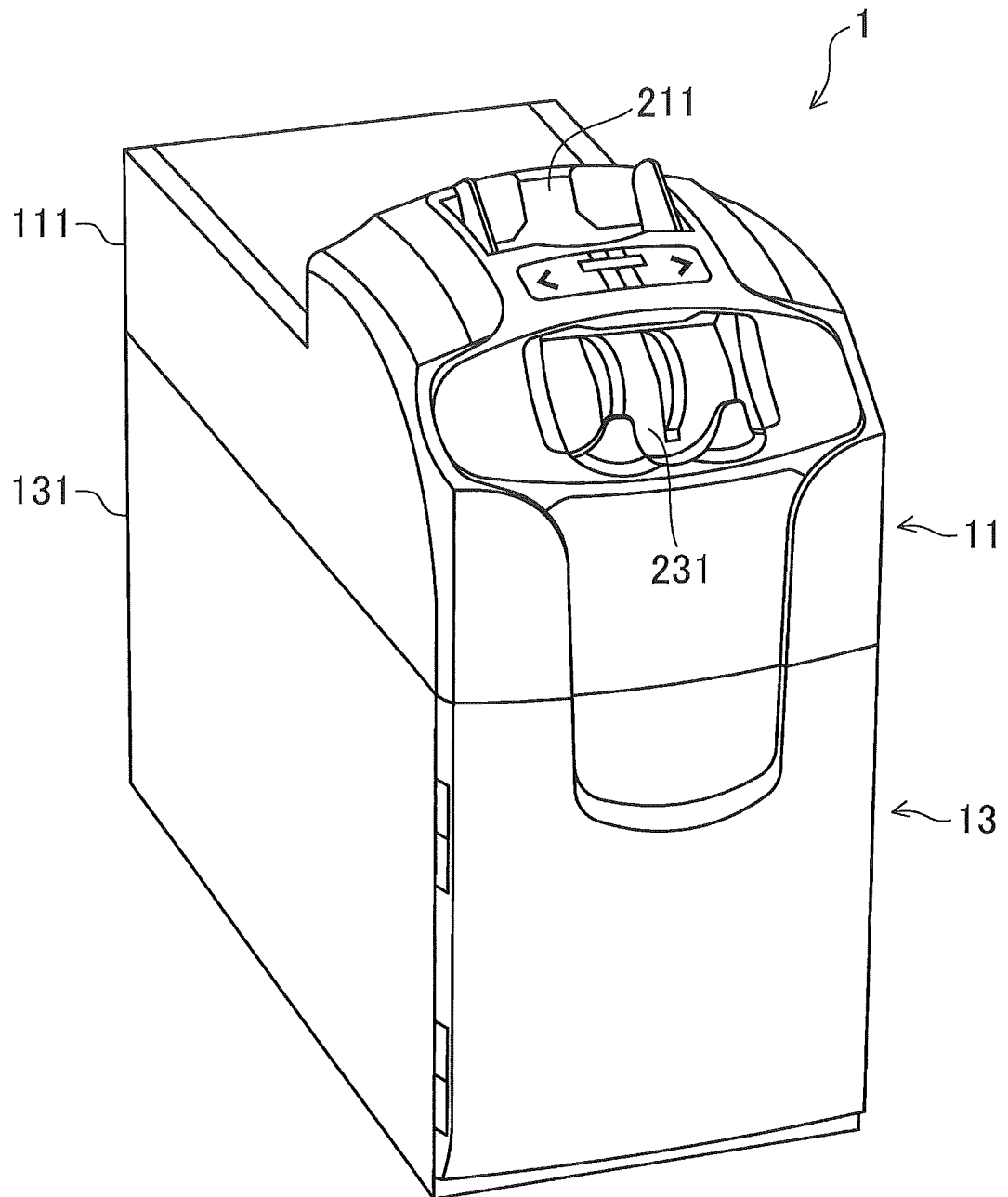


FIG.2

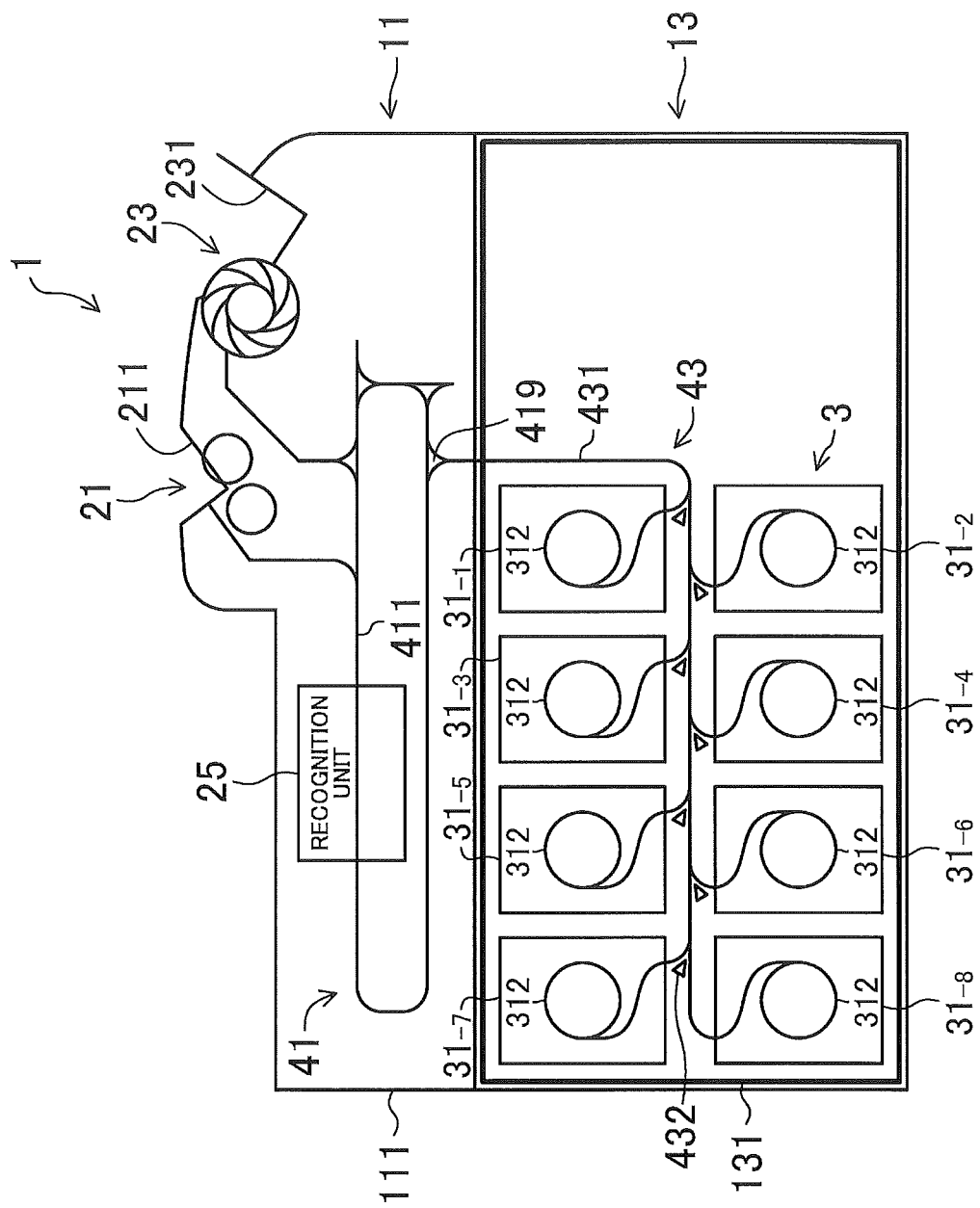


FIG.3

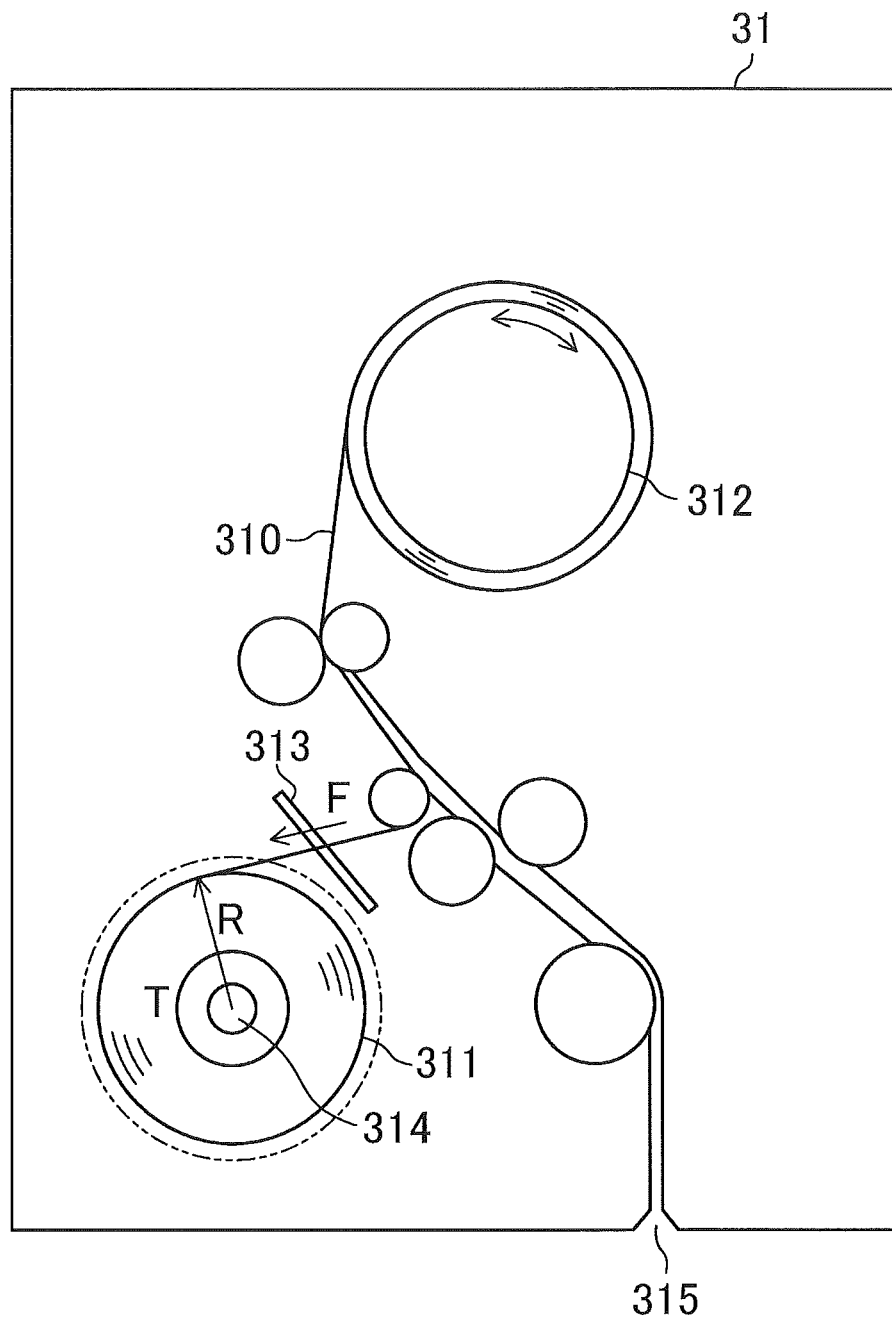


FIG.4

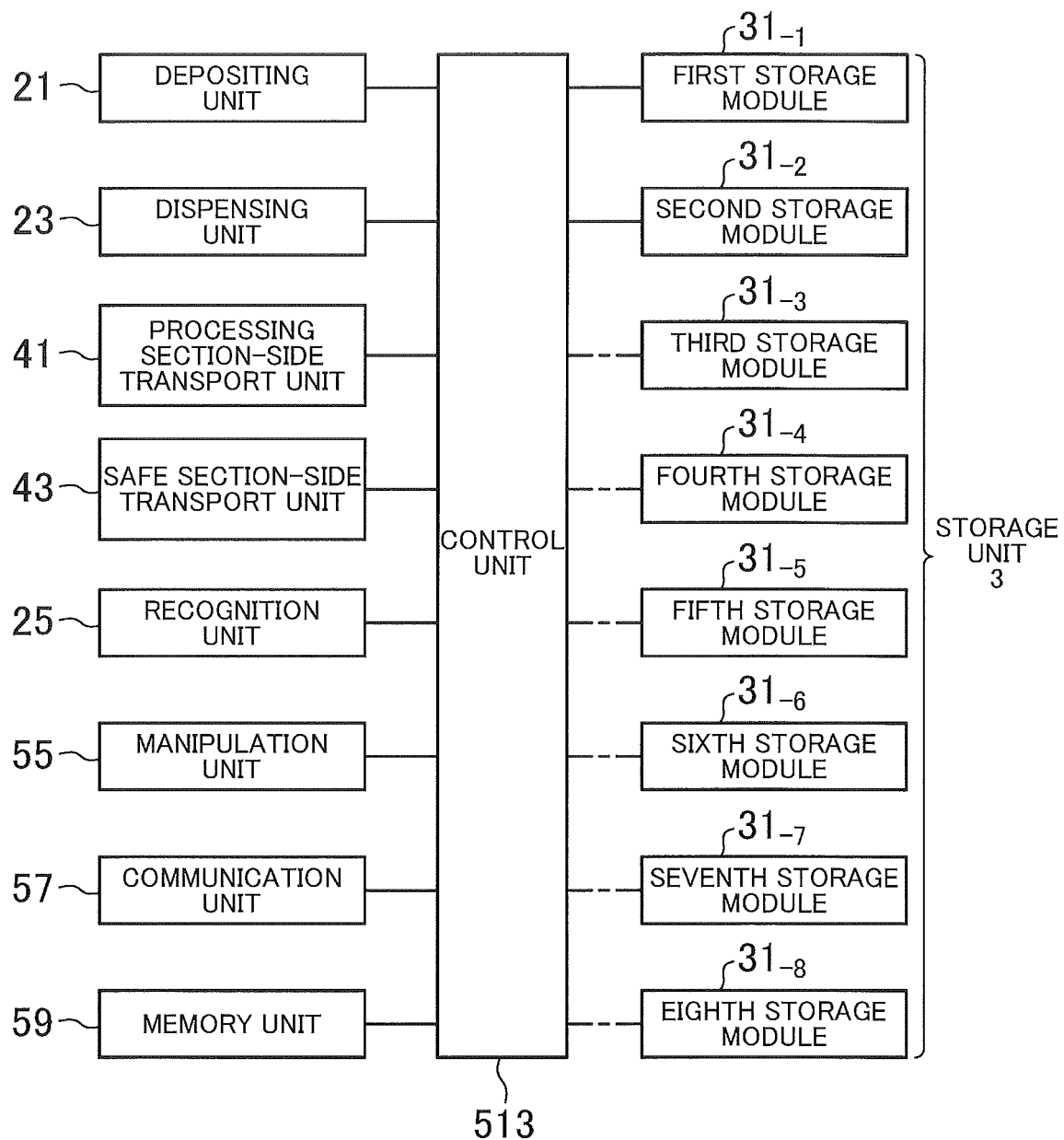


FIG.5

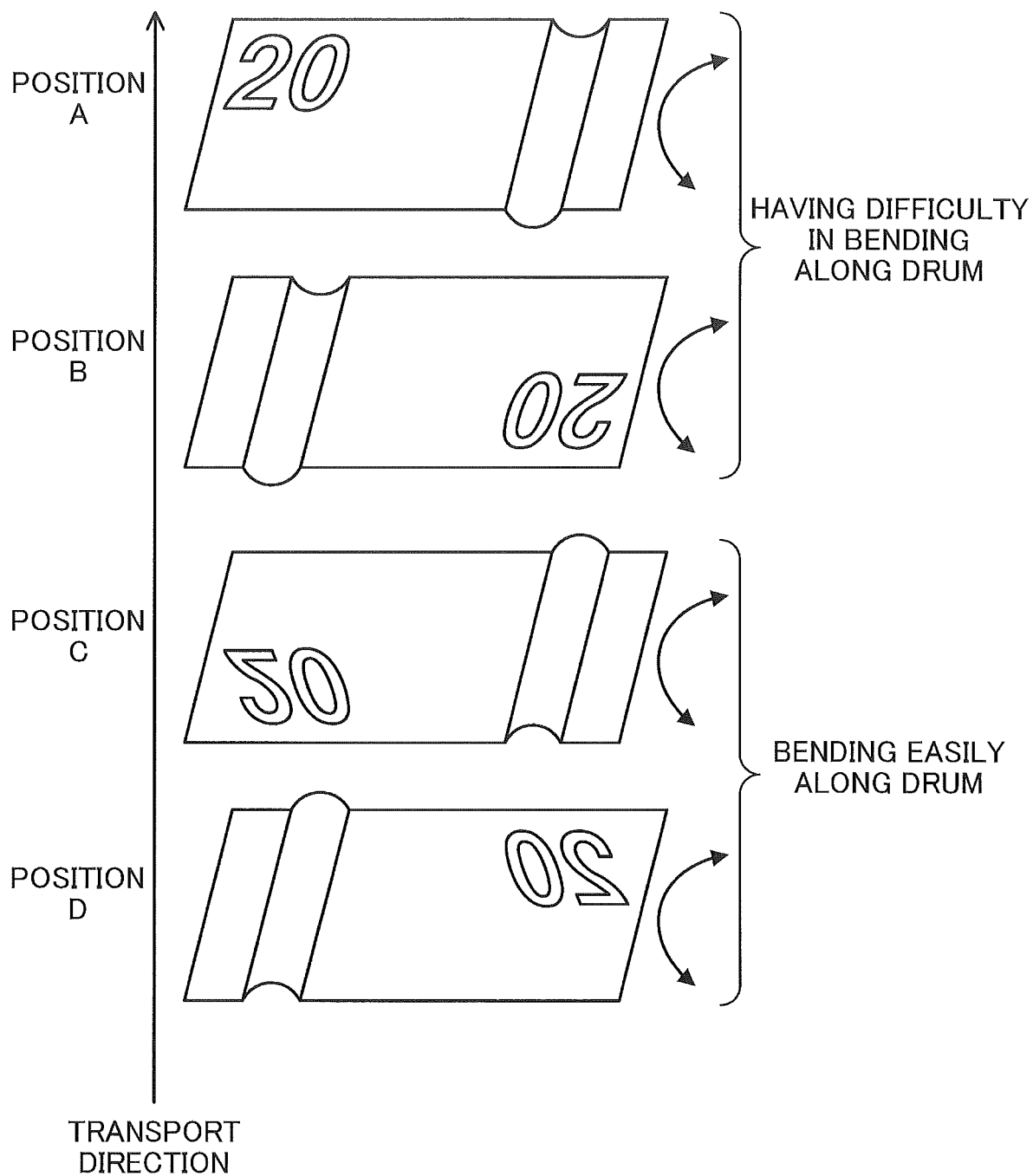


FIG.6

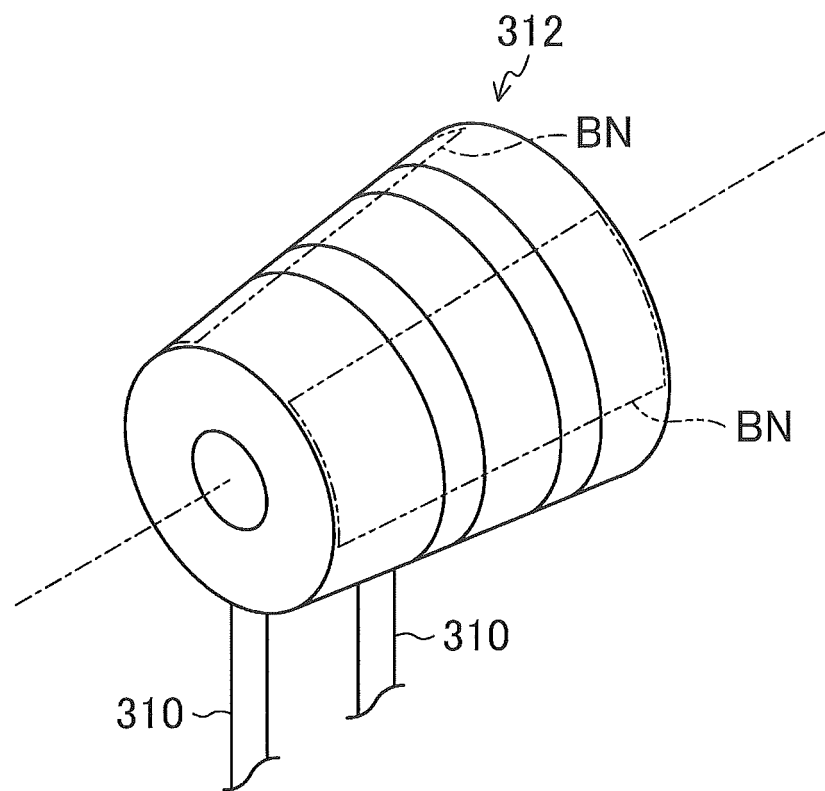


FIG. 7

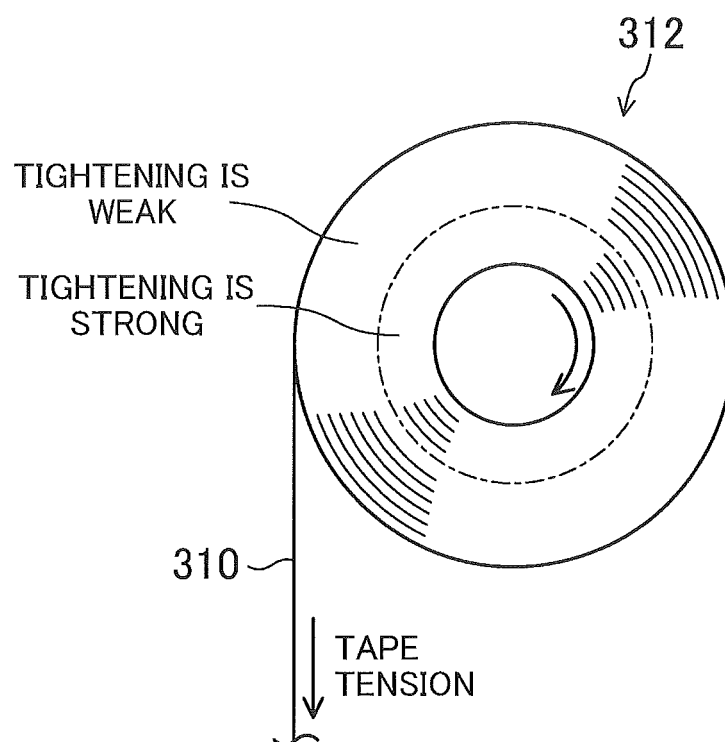


FIG.8

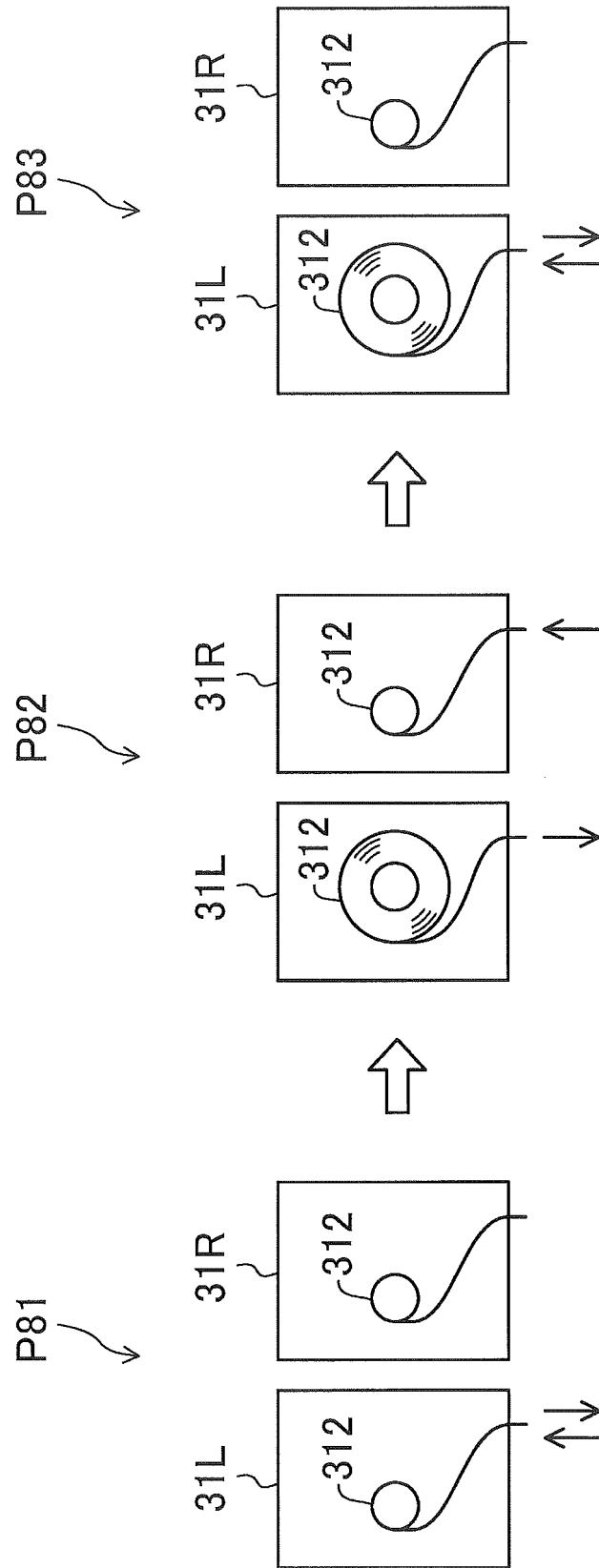


FIG.9

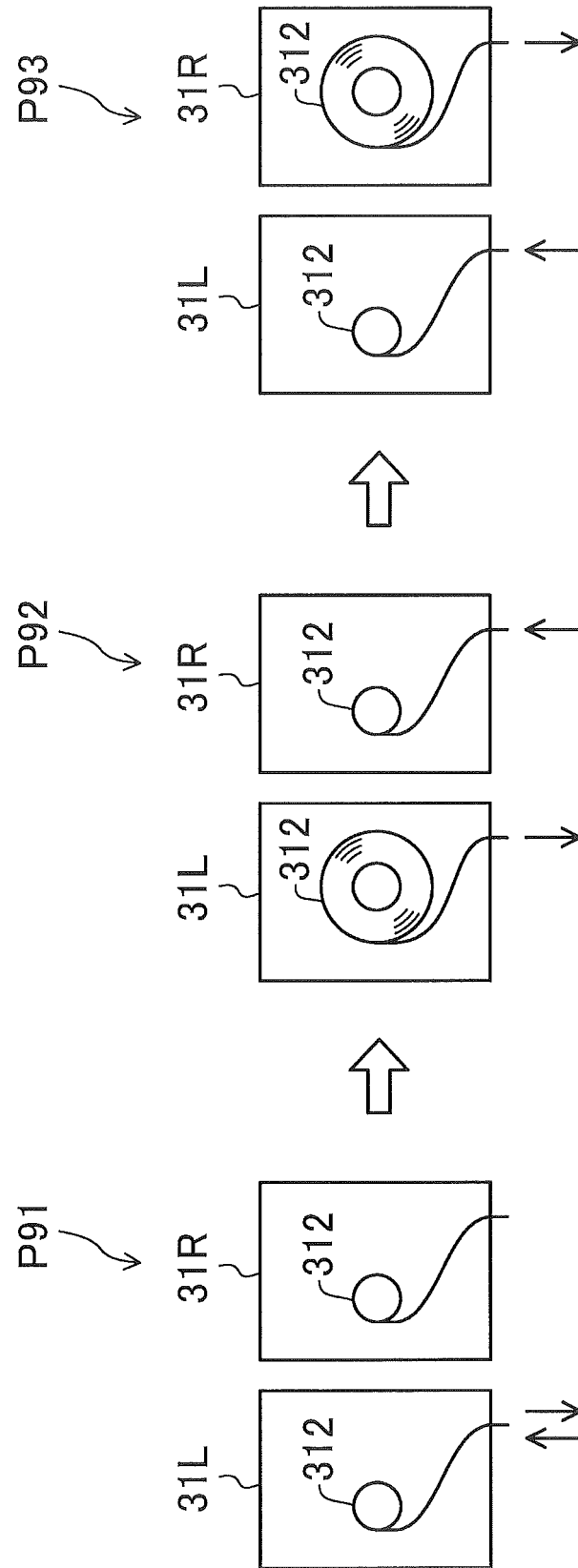


FIG.10

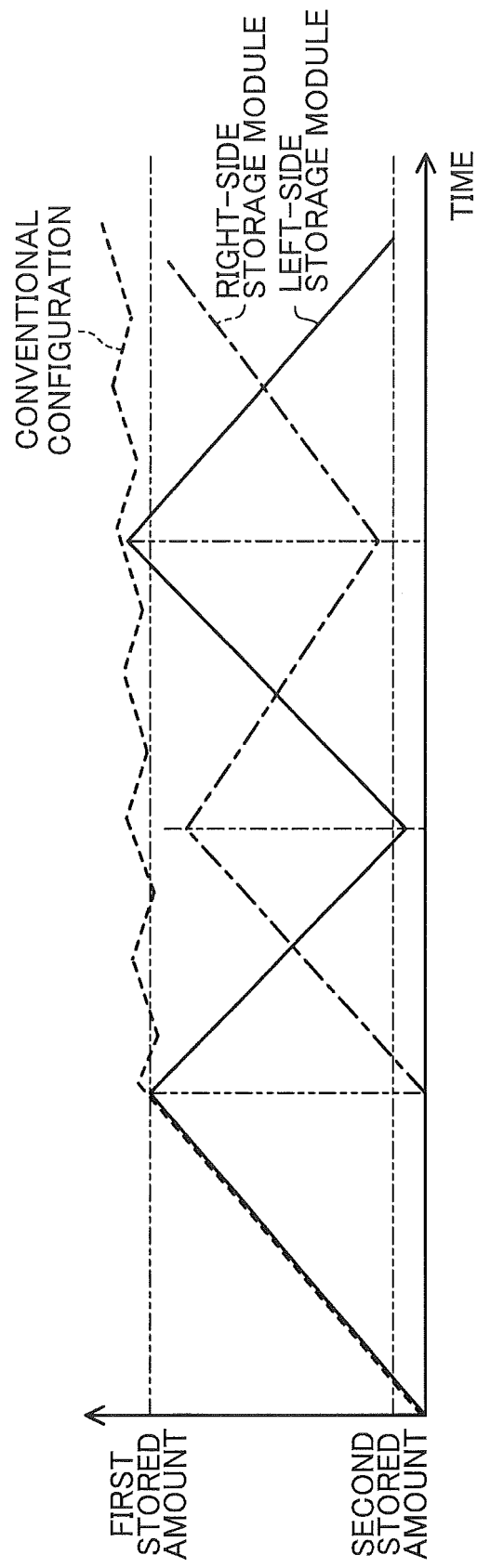


FIG.11

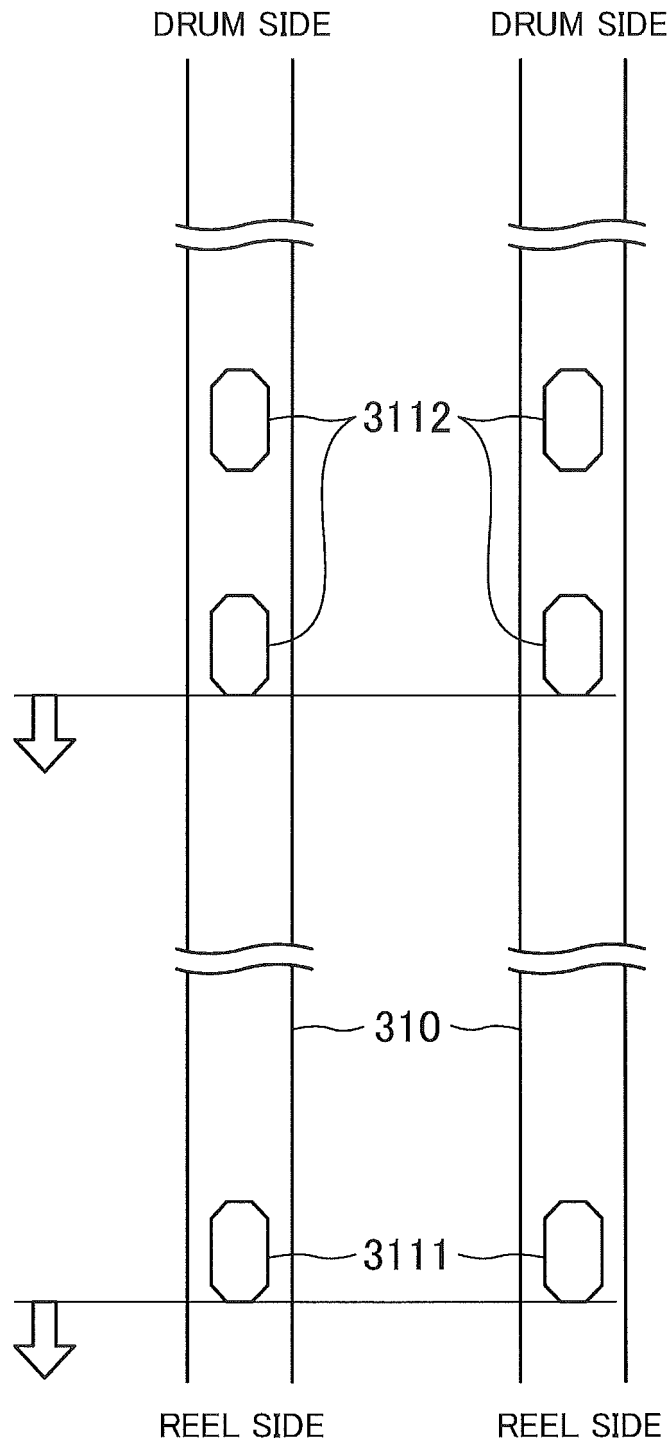


FIG.12

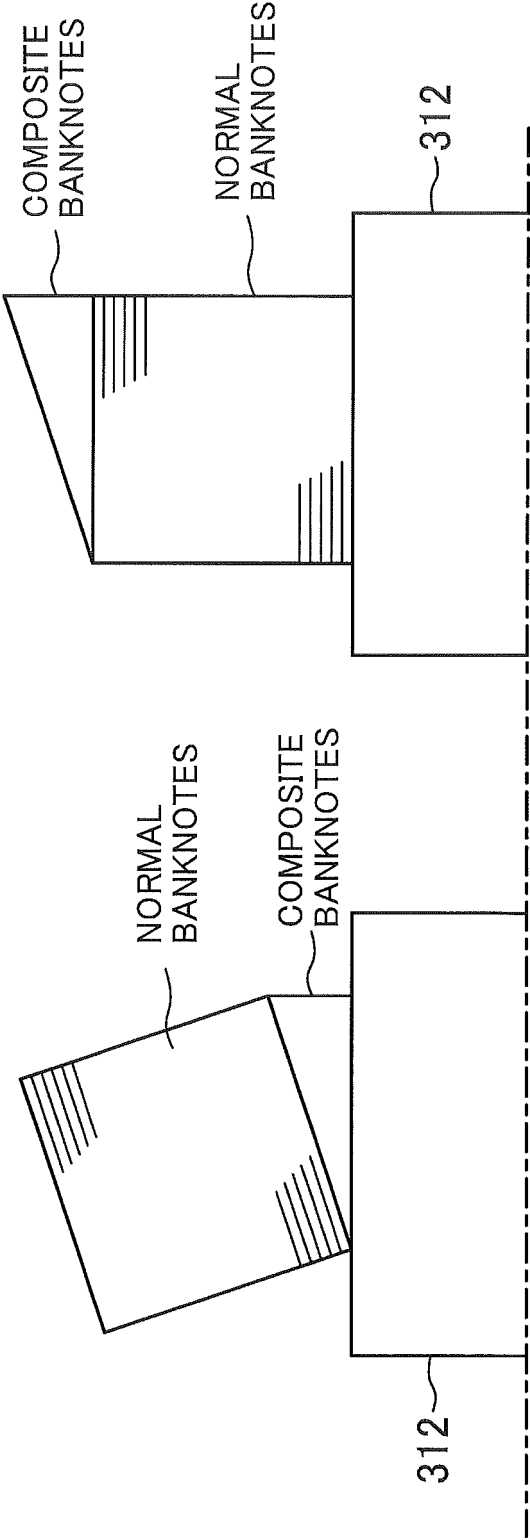


FIG.13

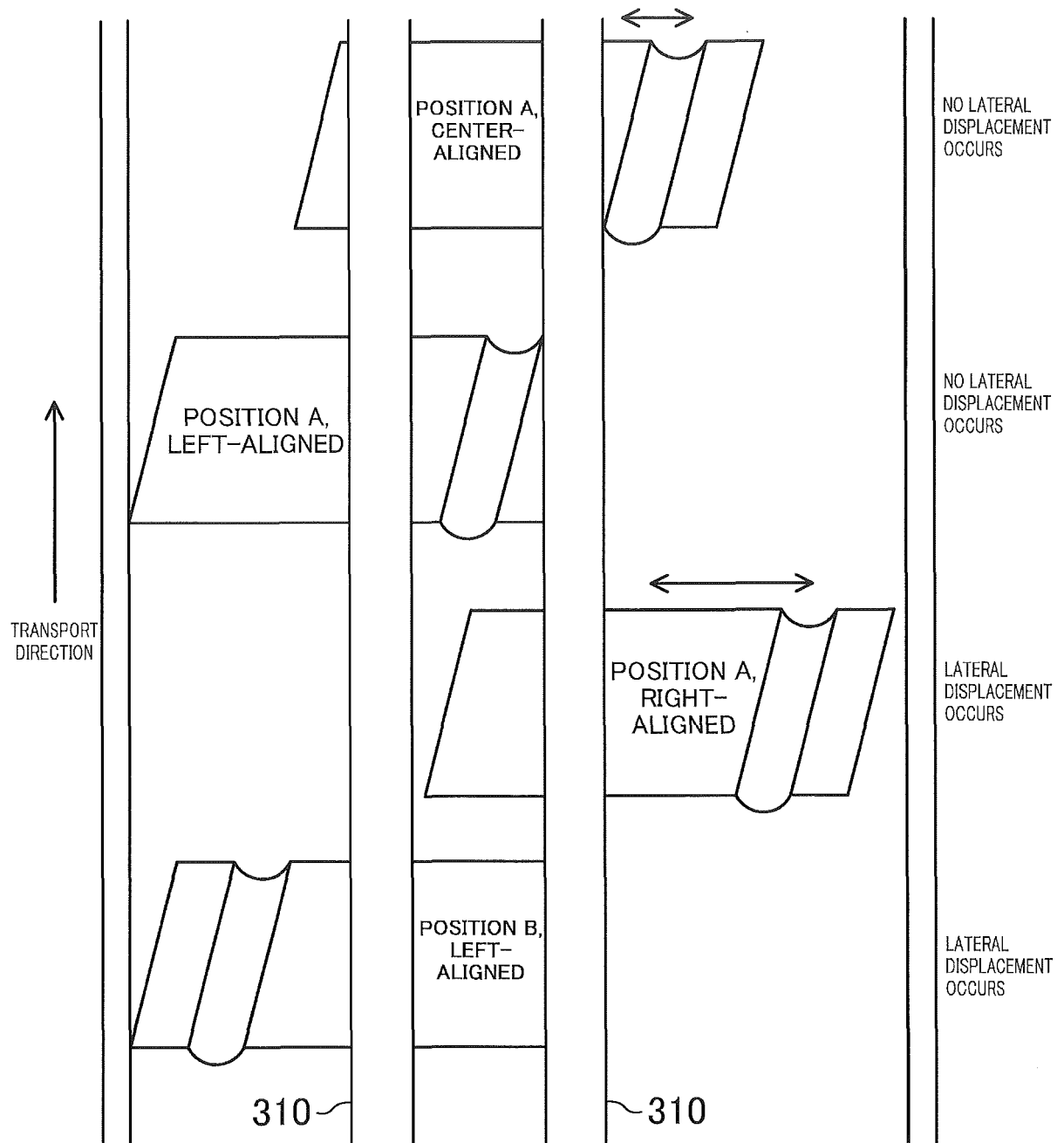
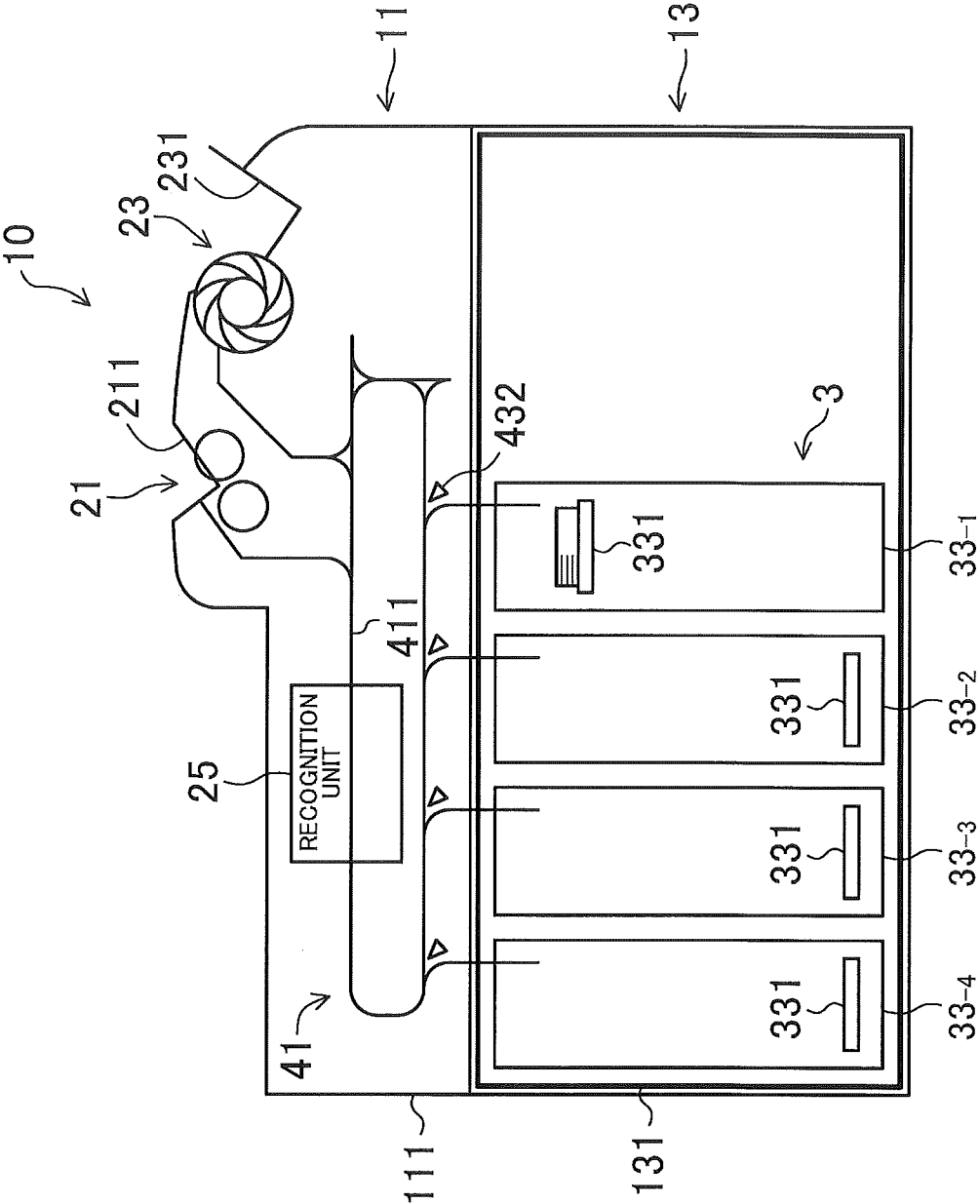


FIG.14

RADIAL POSITION	POSITION	CROSSWISE POSITION		
		LEFT	CENTER	RIGHT
UP TO PREDETERMINED NUMBER OF BANKNOTES	POSITION A	OK	OK	NG
	POSITION B	NG	OK	OK
	POSITION C	OK	OK	OK
	POSITION D	OK	OK	OK
MORE THAN PREDETERMINED NUMBER OF BANKNOTES	POSITION A	OK	OK	OK
	POSITION B	OK	OK	OK
	POSITION C	OK	OK	OK
	POSITION D	OK	OK	OK

FIG.15



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/004364

A. CLASSIFICATION OF SUBJECT MATTER

B65H29/51(2006.01)i, B65H5/28(2006.01)i, G07D9/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65H29/51, B65H5/28, G07D9/00, G07D11/00

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2017
Kokai Jitsuyo Shinan Koho	1971-2017	Toroku Jitsuyo Shinan Koho	1994-2017

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2005-084920 A (Toshiba Corp.), 31 March 2005 (31.03.2005), paragraphs [0041] to [0042], [0046]; fig. 8 to 13 (Family: none)	1-3, 7-12 4 5, 6
X Y	JP 2009-282582 A (Oki Electric Industry Co., Ltd.), 03 December 2009 (03.12.2009), paragraphs [0030] to [0033]; fig. 3, 5 & CN 101587610 A & KR 10-2009-0120391 A	1-3, 7-12 4
Y	JP 2002-042207 A (Glory Ltd.), 08 February 2002 (08.02.2002), paragraphs [0033] to [0034], [0067] to [0071] (Family: none)	4

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

* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
19 April 2017 (19.04.17)Date of mailing of the international search report
09 May 2017 (09.05.17)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

REFERENCES CITED IN THE DESCRIPTION

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- JP 5650317 B [0005]
- JP 2014109797 A [0005]