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(54) **Paper leaves processor and paper leaves processing method**

(57) In a paper leaves processor, when a paper leaf is introduced in a storing direction, a sensor (1b) detects a position of the paper leaf in a direction of a width of a take-up roller (1a). A correction amount-calculating unit (1c) compares the position of the paper leaf detected by the sensor and a centering area of an inlet-outlet opening, and calculates a correction amount for accommodating the position of the paper leaf within a centering area when discharging the paper leaf. Further, the correction amount-calculating unit calculates a movement amount of the take-up roller based on a moving direction of the take-up roller and the correction amount, and stores the movement amount in a correction information-storing unit (1d). When discharging the paper leaf, a position controller controls a moving unit (1f) based on the movement amount to move a position of the take-up roller.

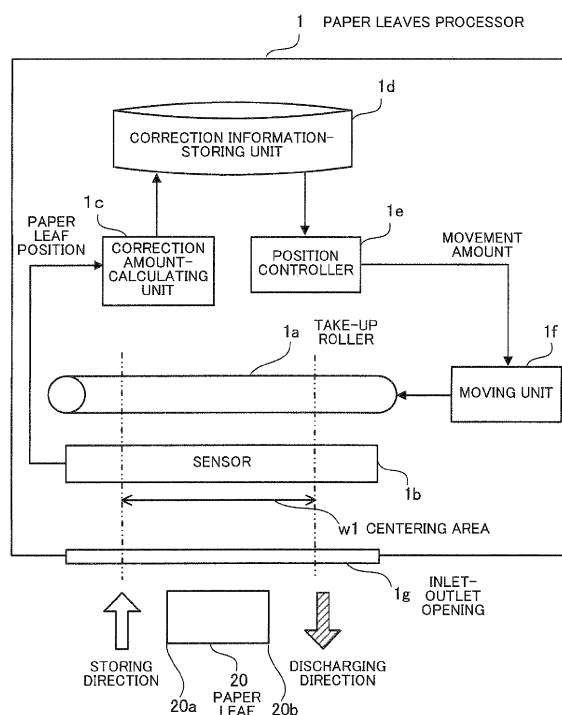


FIG. 1

Description

FIELD

[0001] The embodiment discussed herein is related to a paper leaves processor and a paper leaves processing method that store paper leaves by sandwiching each paper leaf between a pair of films and taking up the films by a take-up roller.

BACKGROUND

[0002] Conventionally, there has been known a paper leaves processor that receives and temporarily stores paper leaves, such as paper money bills, checks, cash vouchers, or the like, and dispenses the stored paper leaves. For example, a paper leaves processor that handles paper money bills as paper leaves is mounted on automated teller machines (ATM) or the like, as a cash money processor for a paper money receiving and dispensing machine.

[0003] Among conventional paper leaves processors, there is a paper leaves processor including a storage section based on a wind-up method which temporarily stores paper leaves by sandwiching each paper leaf, sent in via a conveying path, between a pair of films and taking up the pair of films sandwiching the paper leaf by a take-up roller. Paper leaves which are thus sandwiched between the films temporarily taken up by the take-up roller can be taken out by reversely rotating the take-up roller to unwind the films.

[0004] As the paper leaves processor employing the above-mentioned wind-up method, there has been proposed a paper leaves processor that takes up paper leaves such that the direction of width of paper leaves coincides with the taking-up direction of the take-up roller in order to increase the capacity for storing paper leaves (e.g. see Japanese Laid-Open Patent Publication No. 2006-69708). Further, there has also been proposed a paper leaves processor that stores information on intervals between paper leaves in the order of storage of the paper leaves, when taking up the paper leaves, and variably controls the speed of delivering the paper leaves based on the stored information on the intervals between the paper leaves, when delivering the paper leaves (e.g. see Japanese Laid-Open Patent Publication No. 2006-260078).

[0005] However, in the conventional paper leaves processors having the storage section based on the wind-up method, there is a problem that it is not easy to reduce the size and the price of the processor because it is necessary to reduce variation in the positions of paper leaves when discharging the same.

[0006] In the conventional paper leaves processors having the storage section based on the wind-up method, variation in the positions of paper leaves sandwiched by the films is caused depending on the direction of insertion of each paper leaf and processing subsequently per-

formed on the paper leaf. If the paper leaves stored between the films with such variation in the positions thereof are discharged as they are, the discharge positions of the paper leaves vary. As a result, this causes an inconvenience that the discharged paper leaves are difficult to take out or are not stored within a cassette for accommodating discharged paper leaves. To eliminate this inconvenience, a dedicate centering mechanism for moving paper leaves toward a central region of an inlet-outlet opening is provided on a conveying path, whereby the positions of the paper leaves to be sandwiched by the films are moved toward the central region. However, the provision of the dedicated centering mechanism brings about a problem that not only the size of the paper leaves processor but also the costs thereof are increased.

[0007] Particularly, in a case where the paper leaves temporarily stored in the state sandwiched by the films are moved through a plurality of conveying paths, and are discharged into a plurality of cassettes, it is necessary to provide centering mechanisms corresponding in number to the number of the cassettes or conveying paths, and hence it is impossible to prevent the paper leaves processor from being increased in size.

SUMMARY

[0008] The present invention has been made in view of the above-described problems, and an object thereof is to provide a paper leaves processor which is capable of accommodating discharge positions of paper leaves within a predetermined area without having a dedicated centering mechanism, and a paper leaves processing method therefor.

[0009] According to an aspect of the invention, there is provided a paper leaves processor that stores paper leaves by sandwiching each paper leaf between a pair of films and taking-up the films by a take-up roller. The paper leaves processor includes a sensor configured to detect a position of each paper leaf in a direction of a width of the take-up roller which is orthogonal to a direction of taking up the films, when the paper leaf is moved on a conveying path for conveying the paper leaves, which extends between the take-up roller and an inlet-outlet opening for the paper leaves, a correction amount-calculating unit configured to be operable when storing paper leaves on the take-up roller, to calculate a protrusion amount by which each paper leaf protrudes from a predetermined area set in advance with respect to the inlet-outlet opening by comparing the position of the paper leaf detected by the sensor and the predetermined area, determine a movement amount of the take-up roller by calculating a correction amount for accommodating the paper leaf within the predetermined area based on the protrusion amount and determining a moving direction of the take-up roller, and form correction information by associating the movement amount of the take-up roller with a storage order of the paper leaf, a correction information-storing unit configured to store the correction in-

formation, a moving unit configured to move the take-up roller in the direction of the width of the take-up roller, and a position control unit configured to be operable when discharging paper leaves stored on the take-up roller, to read out the correction information from the correction information-storing unit, extract the movement amount of the take-up roller which is associated with a paper leaf to be discharged next, based on the storage order, control the moving unit based on the movement amount to thereby cause a discharge position of the paper leaf to be accommodated within the predetermined area.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is a diagram showing a concept of the present invention that is applied to an embodiment;
 FIGS. 2A and 2B are diagrams schematically illustrating operations of a paper leaves processor;
 FIG. 3 is a cross-sectional view illustrating an example of the arrangement of a paper money temporary storage device according to the embodiment;
 FIG. 4 is a top view of the paper money temporary storage device illustrated in FIG. 3;
 FIG. 5 is a block diagram illustrating a hardware configuration of a controller of the paper money temporary storage device;
 FIG. 6 is a block diagram illustrating a software configuration of the controller of the paper money temporary storage device;
 FIG. 7 illustrates protrusion amounts detected by a protrusion amount-calculating section;
 FIG. 8 illustrates centering of a paper leaf on a center of a conveying path;
 FIG. 9 is a table of correction information for use when paper leaves are centered within a centering area;
 FIG. 10 is a table of correction information for use when paper leaves are centered on the center of the conveying path;
 FIG. 11 illustrates position control processing;
 FIG. 12 is a flowchart of a storage process for storing paper money bills;
 FIG. 13 is a flowchart of a discharge process for discharging paper money bills;
 FIG. 14 illustrates centering of paper money bills performed when storing paper money bills; and
 FIG. 15 is a flowchart of a storage process for centering paper money bills when storing the paper money bills.

DESCRIPTION OF EMBODIMENT(S)

[0011] Embodiments of the present invention will be explained below with reference to the accompanying drawings, wherein like reference numerals refer to like elements throughout. FIG. 1 is a diagram of a concept

of the present invention that is applied to the present embodiment

[0012] A paper leaves processor 1 includes a take-up roller 1a for taking up paper leaves by sandwiching each paper leaf between films, a sensor 1b for detecting the position of each paper leaf, a correction amount-calculating unit 1c for calculating a correction amount, a correction information-storing unit 1d for storing correction information, a position controller 1e which controls the position of the take-up roller 1a based on the correction information, and a moving unit 1f for moving the take-up roller 1a.

[0013] A paper leaf 20 is introduced from an inlet-outlet opening 1g provided in the paper leaves processor 1 and is stored within the paper leaves processor 1, and the stored paper leaf 20 is discharged from the inlet-outlet opening 1g. It should be noted that when discharging the paper leaf 20, for the purpose of facilitating the taking-out of the discharged paper leaf 20, the discharge position of the paper leaf 20 is limited within a predetermined area. The predetermined area, which is set with reference to a width of the inlet-outlet opening 1g, is hereinafter referred to as the centering area w1.

[0014] The take-up roller 1a is disposed in the paper leaves processor 1 in a manner opposed to the inlet-outlet opening 1g, and performs taking-up and unwinding of a pair of films sandwiching the paper leaf 20. Taking-up of the films is an operation for storing the paper leaf 20, and the paper leaf 20 is moved into the paper leaves processor 1 in a storing direction illustrated in FIG. 1. Unwinding of the films is an operation for discharging the stored paper leaf 20, and the paper leaf 20 is moved out of the paper leaves processor 1 in a discharging direction illustrated in FIG. 1. Further, the take-up roller 1a can be moved in a direction of the width thereof by the moving unit 1f. In the example illustrated in FIG. 1, the take-up roller 1a can be moved in a left-right direction as viewed in FIG. 1.

[0015] The sensor 1b is disposed on a path for conveying the paper leaf 20, which connects between the take-up roller 1a and the inlet-outlet opening 1g. Then, the sensor 1b detects a position of the paper leaf 20 in the direction of the width of the take-up roller 1a, which is passing on the conveying path. For example, assuming that a position coordinate system extends from the left toward the right as viewed in FIG. 1, if the paper leaf 20 passing on the conveying path is detected, a minimum point (leftmost point) 20a and a maximum point (rightmost point) 20b of the paper leaf 20 are detected. The detected position of the paper leaf 20 is notified to the correction amount-calculating unit 1c.

[0016] When the paper leaf 20 introduced from the inlet-outlet opening 1g is stored on the take-up roller 1a, the correction amount-calculating unit 1c acquires the position of the paper leaf 20 detected by the sensor 1b, and calculates an amount by which the paper leaf 20 protrudes from the centering area w1. For example, the correction amount-calculating unit 1c compares the min-

imum point (minimum position coordinate) 20a and the maximum point (maximum position coordinate) 20b of the paper leaf 20 in a horizontal direction, detected by the sensor 1b, and the range of the centering area w1 (respective position coordinates of opposite ends), and determines whether or not the minimum point 20a or the maximum point 20b is displaced from the centering area w1. If the minimum point 20a or the maximum point 20b is displaced from the centering area w1, the distance from the minimum point 20a or the maximum point 20b, which is displaced from the centering area w1, to a closest end of the centering area w1 is calculated as the protrusion amount, and at the same time a centering correction amount necessary to accommodate the protruding portion within the centering area is calculated. In the simplest case, the protrusion amount forms the centering correction amount. Further, a direction of moving the take-up roller 1a in order to accommodate the protruding portion within the centering area is set as a moving direction of the take-up roller 1a. For example, when the minimum point 20a of the paper leaf 20 is positioned outside the centering area w1, the distance from the minimum point to the closest end of the centering area w1 is set as the centering correction amount. Then, a direction from the minimum point 20a toward the centering area w1 is set as the moving direction of the take-up roller 1a. It should be noted that when the minimum point 20a and the maximum point 20b of the paper leaf 20 are both within the centering area w1, the centering correction amount is 0. Thus, based on the calculated centering correction amount and the moving direction of the take-up roller 1a, a take-up roller movement amount is calculated. The take-up roller movement amount indicates that the take-up roller 1a is to be moved by the centering correction amount in the moving direction of the take-up roller 1a from its centered position. The correction information is created by associating the calculated centering correction amount and the take-up roller movement amount with the order of storage of the associated paper leaf 20, and is stored in the correction information-storing unit 1d.

[0017] Further, instead of setting the protrusion amount to the amount in which the paper leaf 20 protrudes from the centering area w1, the protrusion amount may be set to an amount of displacement between the center of the paper leaf 20 and the center of the centering area w1. In this case, based on coordinates indicative of a position of the paper leaf 20 detected by the sensor 1b and coordinates indicative of the centering area w1, a correction amount based on the distance between the center of the paper leaf 20 and the center of the centering area w1 is calculated as the centering correction amount. Further, a direction of moving the take-up roller 1a in order to perform centering is set as the moving direction of the take-up roller 1a. Then, similarly to the above, the take-up roller movement amount is calculated. It should be noted that in calculating the protrusion amount, a predetermined threshold may be set, and only when the dis-

placement between the aforementioned centers exceeds the threshold, the centering correction amount may be caused to be calculated. The calculated centering correction amount and take-up roller movement amount are registered in the correction information in association with the order of storage of the associated paper leaf 20.

[0018] The correction information-storing unit 1d stores the correction information created by the correction amount-calculating unit 1c.

[0019] When the paper leaf 20 stored in the take-up roller 1a is discharged, the position controller 1e reads out the correction information stored in the correction information-storing unit 1d to extract the take-up roller movement amount of the paper leaf 20 to be discharged next. Since discharge is performed in reverse order from that of storage, it is possible to specify the paper leaf 20 to be discharged next based on the order of storage. Then, the position controller 1e drives the moving unit 1f that moves the take-up roller 1a in the direction of width thereof based on the take-up roller movement amount of the paper leaf 20 to be discharged next to thereby move the take-up roller 1a to a desired position.

[0020] The moving unit 1f moves the take-up roller 1a in the direction of the width of the take-up roller 1a based on the movement amount (magnitude and direction of movement) instructed by the position controller 1e.

[0021] Next, a description will be given of operations of the paper leaves processor. FIGS. 2A and 2B schematically illustrate operations of the paper leaves processor. FIG. 2A illustrates an operation performed when storing paper leaves, and FIG. 2B illustrates an operation performed when discharging paper leaves.

[0022] FIG. 2A: When papers 21 and 22, which are paper leaves, are stored, they are moved through a conveying path in a storing direction (direction from the inlet-outlet opening 1g toward the take-up roller 1a) in the mentioned order. The sensor 1b detects a position of each of the paper 21 and the paper 22, which are sequentially introduced in the mentioned order, in the direction of the width of the take-up roller 1a (in the horizontal direction as viewed in FIG. 2A). In the example illustrated in FIG. 2, the position of the leftmost minimum point 22a and the rightmost maximum point 22b of the paper 22 in the direction of the width of the take-up roller 1a are detected. The correction amount-calculating unit 1c acquires the respective positions of the minimum point 22a and the maximum point 22b from the sensor 1b as the position of the paper 22, and compares the positions with the centering area w1 to calculate the protrusion amount. In the case of the illustrated example, the distance between the right end of the centering area w1 and the maximum point 22b is calculated as a protrusion amount 32. Then, as the centering correction amount necessary for accommodating the paper 22 within the centering area w1, a value at least equal to the protrusion amount 32 or a value having a margin added to the protrusion amount 32 is calculated. Further, to accommodate the paper 22 stored in the take-up roller 1a in a state protruding in the

right direction from the centering area w1, within the centering area w1, when it is discharged, it is only necessary to discharge the paper 22 after moving the take-up roller 1a in the left direction with respect to the conveying path. To thus discharge the paper 22, the moving direction of the take-up roller 1a is set to the left direction from the maximum point 22b toward the centering area w1. A combination of this centering correction amount (magnitude of the distance of movement) and the moving direction of the take-up roller 1a forms the take-up roller movement amount. The centering correction amount and the take-up roller movement amount are registered in the correction information in association with the order of storage. For example, if the storage order of the paper 21 is "1", the centering correction amount and the take-up roller movement amount are registered in association with the storage order "2" of the paper 22. The paper 22 is sandwiched by the films with its position maintained in the direction of the width of the take-up roller 1a, and is taken up by the take-up roller 1a for storage thereon.

[0023] FIG. 2B: When discharging the papers 21 and 22, they are moved through the conveying path in a discharging direction (direction from the take-up roller 1a toward the inlet-outlet opening 1g) in the order of the paper 22 and the paper 21. In the present example, it is assumed that the papers 21 and 22 are stored in the mentioned order, and then they are subjected to the discharge processing. Before discharging the paper 22, the position controller 1e reads out the correction information to specify a paper of which the value of the order of storage is largest (most newly stored). In the example illustrated in FIG. 2, the correction information of the paper 22 is read out. Then, based on the take-up roller movement amount 42 extracted from the correction information, the position controller 1e instructs the moving unit 1f to move the take-up roller 1a. Thus, the position of the take-up roller 1a is moved in the left direction with respect to the conveying path and the inlet-outlet opening 1g, whereby the paper 22 is moved into the centering area of the inlet-outlet opening 1g and is discharged.

[0024] As described above, according to the paper leaves processor 1, a take-up roller movement amount is calculated by detecting each of the respective positions of the paper leaves when storing them, and when discharging each of the paper leaves, the take-up roller 1a is moved by an amount corresponding to the associated take-up roller movement amount, whereby the discharge positions of the paper leaves are accommodated within the centering area. By doing this, it is possible to reduce variation of the respective positions of the paper leaves when the paper leaves are discharged from the paper leaves processor 1 without providing a dedicated centering mechanism. Further, since it is not necessary to provide a dedicated centering mechanism, it is possible to reduce the size and costs of the paper leaves processor.

[0025] Hereinafter, a detailed description will be given of a case where the embodiment is applied to a paper money temporary storage device incorporated in an

ATM, by way of example, with reference to associated drawings.

[0026] FIG. 3 is a cross-sectional view illustrating an example of the arrangement of the paper money temporary storage device of the present embodiment.

[0027] A paper money temporary storage device 10 includes a controller 100 which controls the overall operation of the paper leaves processor 1, a temporary stacker 200 for temporarily storing paper money bills by sandwiching them between films, a conveying unit for conveying paper money bills, and a moving mechanism unit for moving the temporary stacker 200.

[0028] The controller 100 controls the overall operation of the paper leaves processor 1. The controller 100 controls the operations of various kinds of rollers disposed in the paper leaves processor 1 according to signals delivered from various sensors disposed in the paper leaves processor 1 and instructions from an operator (not illustrated), and performs position control for controlling the position of the temporary stacker 200. Details will be described hereinafter.

[0029] The temporary stacker 200 includes a paper money take-up roller 210, and take-up film rollers 220a and 220b. When storing paper money, the take-up film rollers 220a and 220b are rotated in a direction of drawing out films 230a and 230b, respectively, and the paper money take-up roller 210 is rotated in a direction of taking up a film 230 formed by layering the films 230a and 230b one upon the other. In the temporary stacker 200, a paper money bill conveyed through a conveying path 310 is sandwiched between the films 230a and 230b drawn out from the take-up film rollers 220a and 220b, respectively. Then, the film 230 formed by the pair of the films 230a and 230b sandwiching the paper money bill is taken up by the paper money take-up roller 210. Thus, the paper money bill thus received into the film 230 is stored on the paper money take-up roller 210. When discharging the paper money bill, the paper money take-up roller 210 and the take-up film rollers 220a and 220b are rotated in respective reverse directions so as to move the film 230 formed by the pair of the films 230a and 230b sandwiching the paper money bill toward the conveying path 310. The film 230 containing the paper money bill is moved toward the conveying path 310, and is separated into the film 230a and the film 230b, whereby the paper money bill is discharged onto the conveying path 310. Further, the temporary stacker 200 is movably mounted on a rail 410 which extends in a direction identical to the direction of the width of the paper money take-up roller 210 for moving the temporary stacker 200, and is moved along the rail 410 by the moving mechanism unit.

[0030] The conveying unit includes the conveying path 310, rollers 320a and 320b, a paper money position-detecting sensor 330, and an inlet-outlet sensor 340. A paper money bill inserted from an external end of the conveying path 310 is conveyed on the conveying path 310 by the rollers 320a and 320b in the storing direction. The paper money position-detecting sensor 330 disposed at

an intermediate portion of the conveying path 310 detects a position of the paper money bill passing before the paper money position-detecting sensor 330 in the direction of the width of the paper money take-up roller 210 to notify the controller 100 of the detected position. The inlet-outlet sensor 340 detects the paper money bill having reached the temporary stacker 200 to notify the controller 100 of the detection result. When discharging the paper money bill, the rollers 320a and 320b are rotated in respective reverse directions, whereby the paper money bill is moved on the conveying path 310 from the temporary stacker 200 toward the outside of the paper leaves processor 1.

[0031] The moving mechanism unit includes the rail 410, a motor 420, a belt 430, and a stacker position-detecting sensor 440. Details will be described with reference to FIG. 4. FIG. 4 is a top view of the paper money temporary storage device illustrated in FIG. 3. Component elements identical to those in FIG. 3 are designated by the identical reference numerals.

[0032] The rail 410 extends in the direction of the width of the paper money take-up roller 210, and is disposed within a moving range of the temporary stacker 200. The motor 420 moves the belt 430 in the moving direction (direction of the width of the paper money take-up roller 210) illustrated in FIG. 4. The belt 430 is connected to the temporary stacker 200, and is moved by the motor 420 to thereby move the temporary stacker 200 in the moving direction. The stacker position-detecting sensor 440 detects a center position of the temporary stacker 200. Further, the stacker position-detecting sensor 440 detects an amount of displacement of the temporary stacker 200 from its original position in which the center of the temporary stacker 200 is aligned with the center of the stacker position-detecting sensor 440. The detected amount of displacement is notified to the controller 100. It should be noted that the arrangement of the moving mechanism unit is not limited to that illustrated in FIGS. 3 and 4. For example, the moving mechanism unit may be configured by using a rack mechanism or a link as a unit for moving the temporary stacker 200 in the moving direction. Further, as a driving unit, a solenoid can be used instead of the motor.

[0033] FIG. 5 is a block diagram illustrating a hardware configuration of the controller of the paper money temporary storage device.

[0034] The controller 100 controls the whole apparatus by a CPU (Central Processing Unit) 101. To the CPU 101 are connected a RAM (Random Access Memory) 102, a hard disk drive (HDD) 103, an input interface 104, and a motor controller 105, via a bus 106.

[0035] The RAM 102 temporarily stores at least part of a program of an OS (Operating System) and application programs which the CPU 101 is caused to execute. Further, the RAM 102 stores various kinds of data which are necessary for processing executed by the CPU 101. The HDD 103 stores the program of the OS and the application programs. The paper money position-detecting

sensor 330 and the stacker position-detecting sensor 440 are connected to the input interface 104, and signals delivered from the paper money position-detecting sensor 330 and the stacker position-detecting sensor 440 are transmitted to the CPU 101 via the bus 106. The motor controller 105 is connected to the motor 420, and drives the motor 420 to move the belt 430 (not illustrated in FIG. 5).

[0036] With the hardware configuration described above, it is possible to realize processing functions of the paper money temporary storage device.

[0037] FIG. 6 is a block diagram illustrating a software configuration of the controller of the paper money temporary storage device.

[0038] The controller 100 includes processing sections such as a correction amount-selecting section 110, a protrusion amount-calculating section 120, a correction amount-calculating section 130, a position controller 140, a storage and discharge controller 150, and a correction information-storing section 160. The processing function of each processing section is realized by the CPU 101 executing a paper money processing program.

[0039] The correction amount-selecting section 110 selects a correction amount calculated by the correction amount-calculating section 130 when the paper leaves processor 1 is started. The correction amount includes a first correction amount calculated for centering a paper money bill within the centering area and a second correction amount calculated for centering a paper money bill on the center of the centering area (center of the conveying path). The second correction amount makes it possible, e.g. in a case where paper money bills to be handled have a variation in size, to improve the ease of taking out discharged paper money bills. However, the movement amount of the temporary stacker 200 tends to become larger than the first correction amount. The moving of the temporary stacker 200 is carried out between delivering a paper money bill and delivering the next one. Paper money bills are delivered to the conveying path 310 one by one, and a minimum interval (distance) between paper money bills is determined in advance. Then, a delivery time to be taken after each paper money bill is delivered until each next paper money bill is delivered, which is based on the interval of delivering paper money bills, and a maximum time to be taken for the temporary stacker 200 to complete movement are compared. Then, if the movement of the temporary stacker 200 over a maximum distance can be completed within the delivery time, the second correction amount is selected. The once selected method of calculating the correction amount is maintained until conditions under which the paper leaves processor 1 operate are changed. It should be noted that the user may select and instruct the paper money temporary storage device 10 which correction amount to be used. The correction amount-selecting section 110 notifies the correction amount-calculating section 130 to apply the correction amount selected according to the instruction.

[0040] The protrusion amount-calculating section 120 compares the position of the paper money bill in the direction of the width of the paper money take-up roller 210, which is detected by the paper money position-detecting sensor 330, and the positions of the opposite ends of the centering area, to thereby calculate the respective protrusion amounts. It should be noted that a result of detection by the paper money position-detecting sensor 330 is based on the position of the temporary stacker 200 in its initial state, i.e. in a state fixed to the original center position. A method of calculating the protrusion amounts will be described hereinafter. The calculated protrusion amounts are registered in the correction information stored in the correction information-storing section 160 in association with a sequential storage order number of the paper money bill.

[0041] The correction amount-calculating section 130 calculates the centering correction amount and the temporary stacker movement amount using the protrusion amounts calculated by the protrusion amount-calculating section 120, and registers the same in the correction information. The calculation is carried out by using either of the calculation methods for "centering a paper money bill within the centering area" and for "centering a paper money bill on the center of the conveying path", which is selected by correction amount-selecting section 110. The methods of calculating the centering correction amount and the temporary stacker movement amount will be described hereinafter.

[0042] The position controller 140 is operable when discharging the paper money bills stored in the temporary stacker 200 to read out the correction information from the correction information-storing section 160, and control the position of the temporary stacker 200 based on the temporary stacker movement amount of a paper money bill to be discharged next. Based on the position information of the temporary stacker 200, detected by the stacker position-detecting sensor 440, the position controller 140 drives the motor 420 based on the temporary stacker movement amount registered in the correction information to thereby move the belt 430 from the current position of the temporary stacker 200.

[0043] The storage and discharge controller 150 determines which processing the paper money temporary storage device 10 is to perform, processing for storing paper money bills or processing for discharging paper money bills, and starts other processors according to a result of the determination. When an instruction for storing paper money bills from the operator or the like is detected, or when the paper money bills are conveyed to the paper money temporary storage device 10, the storage and discharge controller 150 starts the processing for storing paper money bills. The storage and discharge controller 150 causes the paper money take-up roller 210 and the take-up film rollers 220a and 220b to be rotated in the direction of storing the paper money bills, and at the same time starts the protrusion amount-calculating section 120. On the other hand, when an instruction for

discharging paper money bills from the operator or the like is detected, the storage and discharge controller 150 starts the position controller 140, and at the same time causes the paper money take-up roller 210 and the take-up film rollers 220a and 220b to be rotated in the direction of discharging the paper money bills.

[0044] The correction information-storing section 160 stores the correction information. Details of the correction information will be described hereinafter.

[0045] Next, a description will be given of operations of the paper money temporary storage device 10. In the following description, it is assumed that the paper money temporary storage device 10 receives an instruction for storing paper money bills and an instruction for discharging paper money bills, and starts the associated processing, respectively. Further, it is assumed that centering the paper money bills within the centering area or on the center of the centering area (center of the conveying path) is selected in advance by the correction amount-selecting section 110. It should be noted that the size of paper money bills is necessarily smaller than the width of the centering area.

[0046] When the storage and discharge controller 150 receives an instruction from the operator or a higher level program, the controller 100 determines whether the instruction is for the processing for storing paper money bills or for the processing for discharging paper money bills. If the instruction is for the processing for storing paper money bills, the storage and discharge controller 150 causes the rollers 320a and 320b on the conveying path 310 to be rotated in the direction of storing paper money bills. The term "direction of storing paper money bills" or "storing direction" is intended to mean a "direction of taking up paper money bills by the paper money take-up roller 210". Each inserted paper money bill is moved on the conveying path 310 in the storing direction toward the temporary stacker 200. It should be noted that the rotation may be started when feeding of the paper money bill from the inlet-outlet opening 1g of the paper money temporary storage device 10, the paper money position-detecting sensor 330, or the paper money inlet is detected. The paper money position-detecting sensor 330 detects the position of the paper money bill passing thereby to notify the controller 100 of the detected position.

[0047] In the controller 100, the protrusion amount-calculating section 120 calculates the protrusion amounts of the paper money bill.

[0048] FIG. 7 illustrates the protrusion amounts calculated by the protrusion amount-calculating section 120. Component elements identical to those in FIGS. 3 and 4 are denoted by identical reference numerals. Further, it should be noted that X1 represents a position coordinate at the left end of the centering area w1, X2 represents a position coordinate at the right end of the same, and Xc represents a position coordinate at the center of the same.

[0049] In FIG. 7, as for a left direction, a protrusion amount is defined as a distance between the left most

point of the paper money bill and the left end X1 of the centering area w1. Further, as for the direction of the protrusion amount, when the position of the leftmost point of the paper money bill is at a location leftward of the left end X1 of the centering area, the direction is a positive direction (+). In contrast, when the position of the leftmost point of the paper money bill is at a location rightward of the left end of the centering area (within the centering area), the direction is a negative direction (-). Similarly, also as for the right direction, a protrusion amount is defined as a distance between the rightmost point of the paper money bill and the right end X2 of the centering area w1. When the position of the rightmost point of the paper money bill is at a location rightward of the right end X2 of the centering area, the direction is a positive direction (+), whereas when the position of the rightmost point of the paper money bill is at a location leftward of the right end X2, the direction is a negative direction (-). Therefore, when one end of the paper money bill protrudes from the centering area, the direction of the protrusion amount is indicated by "+". When the one end of the paper money bill is within the centering area, the direction of the protrusion amount is indicated by "-".

[0050] When storing, paper money bills p1, p2, p3, and p4 are received on the paper money take-up roller 210 in the order of p1, p2, p3, and p4. In the case of the paper money bill p1, based on the position thereof detected by the paper money position-detecting sensor 330, as for the left direction, the protrusion amount formed by a combination of a distance "a1" between the leftmost point of the paper money bill and the left end X1 of the centering area w1, and "-" indicative of being within the centering area is obtained. As for the right direction, the protrusion amount formed by a combination of a distance "a2" between the rightmost point of the paper money bill and the right end X2 of the centering area w1 and "+" indicative of being outside the centering area is obtained. Hereinafter, the protrusion amounts are denoted as "-a1" and "+a2" by combining the magnitude and direction of each protrusion amount.

[0051] Similarly to the paper money bill p1, the protrusion amount of the paper money bill p2 is "-b1" in the left direction and "+b2" in the right direction. This indicates that the paper money bill p2 protrudes from the centering area in the right direction. The protrusion amount of the paper money bill p3 is "+c1" in the left direction and "-c2" in the right direction. This indicates that the paper money bill p3 protrudes from the centering area in the left direction. The protrusion amount of the paper money bill p4 is "-d1" in the left direction and "-d2" in the right direction. This indicates that the paper money bill p4 is accommodated within the centering area. The protrusion amounts calculated as above are registered in the correction information in association with a sequential storage order number of the paper money bill.

[0052] Subsequently, the correction amount-calculating section 130 calculates a centering correction amount and a temporary stacker movement amount based on

protrusion amounts calculated by the protrusion amount-calculating section 120.

[0053] To center a paper money bill within the centering area, it is only necessary to displace the paper money take-up roller 210 by at least the magnitude of the protrusion amount in a direction opposite to a direction in which the paper money bill protrudes, when discharging the paper money bill. Therefore, if the protrusion amount of each paper money bill in either direction has a sign "+", the correction amount-calculating section 130 determines that the paper money bill is to be centered. The correction amount-calculating section 130 sets the protrusion amount of the protruding side (protrusion amount indicated by the direction "+") as the centering correction amount. Further, as for the direction of moving the temporary stacker 200, the left direction is set as "-", the right direction is set as "+", and when a paper money bill protrudes from the left end X1 of the centering area w1, the direction is set to "+", whereas when a paper money bill protrudes from the right end X2 of the centering area w1, the direction is set to "-". For example, as for the paper money bill p1, the protrusion amount in the right direction is "+a2", that is, the paper money bill p1 protrudes from the right end X2 of the centering area w1, so that the centering correction amount is "a2", and the direction of moving the temporary stacker 200 is "-". Based on the centering correction amount and the direction of moving the temporary stacker 200, determined as above, the temporary stacker movement amount is calculated. The temporary stacker movement amount forms information indicative of the direction and distance according to which the temporary stacker 200 is to be moved for centering paper money bills. More specifically, the temporary stacker movement amount is set by adding the moving direction to the centering correction amount. In the case of the paper money p1, the temporary stacker movement amount formed by a combination of the centering correction amount "a2" and the moving direction "-" is "-a2". This indicates "to move the temporary stacker 200 to a position displaced by the distance a2 in the left direction from its center point" for centering the paper money bill p1.

[0054] Similarly, as for the paper money bill p2, since the paper money bill p2 protrudes from the right end X2 of the centering area w1, the centering correction amount is "b2", and the direction of moving the temporary stacker 200 is "-", so that the temporary stacker movement amount becomes "-b2". As for the paper money bill p3, since the paper money bill p3 protrudes from the left end X1 of the centering area w1, the centering correction amount is "c1", and the direction of moving the temporary stacker 200 is "+", so that the temporary stacker movement amount becomes "+c1". As for the paper money p4, since both of the protrusion amounts are "-", i.e. the paper money bill p4 does not protrude from the centering area w1, correction is not performed. Therefore, the correction amount is 0.

[0055] Next, a description will be given of a case where

paper money bills are centered on the center of the conveying path. Since the inlet-outlet opening 1g is provided at a location forward (inward) of the conveying path 310, if it is possible to center paper money bills on the center of the conveying path 310, the paper money bills can be discharged such that the center of each paper money bill is aligned with the center of the inlet-outlet opening 1g.

[0056] FIG. 8 illustrates a case where a paper money bill is centered on the center of the conveying path. To center a paper money bill on the center of the conveying path 310, it is only necessary to make respective vacant areas in the right and left directions within the centering area equal to each other when placing the paper money bill on the center. Here, a total of vacant areas formed when each paper money bill is accommodated within the centering area has a magnitude obtained by subtracting an area corresponding to the protrusion amount indicated by "+" from the current vacant area (area in which the paper money bill is not present) within the centering area w1 indicated by "-". In the illustrated example of the paper money bill p2 in FIG. 8, the total of vacant areas formed when the paper money bill p2 is within the centering area is equal to a value obtained by subtracting the protrusion amount "b2" protruding from the centering area w1 from the protrusion amount "b1" shifting into the centering area. In this case, since "+" and "-" are set in accordance with the direction, the values may be directly added to each other. For example, the absolute value of "-b1 + b2" as the sum of "-b1" in the left direction and "+b2" in the right direction represents the total of the vacant areas. To center a paper money bill on the center of the conveying path 310, it is only necessary that the temporary stacker 200 is moved by the protrusion amount of the protruding side ("b2" in the case of the paper money p2) and further until the distance between the paper money bill and the end of the centering area becomes equal to the half of the total of the vacant areas calculated as above ($| -b1 + b2 | / 2$ in the case of the paper money bill p2). Since the direction of moving the temporary stacker 200 is opposite to the direction of the protrusion amount, when the protrusion amount on the X1 side at the left end is "+", the direction of moving the temporary stacker 200 is "+", and when the protrusion amount on the X2 side at the right end is "+", the direction of moving the temporary stacker 200 is "-". In the illustrated example of the paper money p2, the direction of moving the temporary stacker 200 is "-". It should be noted that to set the direction of moving the temporary stacker 200 to "-" for the left direction, and "+" for the right direction is similar to the case of centering a paper money bill within the centering area. From the above, in the case of the paper money bill p2, the centering correction amount is " $b2 + | -b1 + b2 | / 2$ ", and the direction of moving the temporary stacker 200 (hereinafter referred to as "the temporary stacker moving direction") is "-". Further, the temporary stacker movement amount is calculated. The temporary stacker movement amount is the centering correction amount as measured from the center point, and hence it is repre-

sented by " $-b2 - | -b1 + b2 | / 2$ " which is a combination of the temporary stacker moving direction and the centering correction amount.

[0057] Similarly, the centering correction amount of the paper money bill p1 is " $a2 + | -a1 + a2 | / 2$ ", the temporary stacker moving direction of the same is "-", and hence the temporary stacker movement amount of the same is " $-a2 - | -a1 + a2 | / 2$ ". The centering correction amount of the paper money bill p3 is " $c1 + | c1 - c2 | / 2$ ", the temporary stacker moving direction of the same is "+", and hence the temporary stacker movement amount of the same is " $c1 + | c1 - c2 | / 2$ ".

[0058] As for the paper money bill p4, the protrusion amounts are both "-", so that the vacant area is represented by the absolute value of the sum of d1 and d2. The centering correction amount is " $d1 - | d1 + d2 | / 2$ ", the temporary stacker moving direction is "+", and the temporary stacker movement amount is " $d1 - | d1 + d2 | / 2$ ". It should be noted that when one protrusion amount is "-", and the other is "0", the above-mentioned calculations can be performed in the same manner as in the case where the protrusion amounts are both "-".

[0059] The centering correction amount, the temporary stacker moving direction, and the temporary stacker movement amount, calculated as above, are registered in the correction information in association with the sequential storage order number of the paper money bill.

[0060] FIG. 9 is a table of correction information for use when paper money bills are centered within a centering area.

[0061] Correction information 1610 (for centering within the centering area) includes information items, such as paper money bill 1611, storage order 1612, discharge order 1613, X1 line protrusion amount 1614, X2 line protrusion amount 1615, centering correction amount 1616, and temporary stacker movement amount 1617.

[0062] The paper money bill 1611 is identification information for identifying each paper money bill. The storage order 1612 represents a sequential order of storage of each paper money bill, and indicates a sequential order number of each paper money bill taken in from the inlet-outlet opening 1g. The discharge order 1613 represents a sequential order of discharge of each paper money bill, which is a reverse of the storage order. The X1 line protrusion amount 1614 indicates a protrusion amount with respect to the left end X1 of the centering area w1, which is calculated by the protrusion amount-calculating section 120. The X2 line protrusion amount 1615 indicates a protrusion amount with respect to the right end X2 of the centering area w1, which is calculated by the protrusion amount-calculating section 120. The centering correction amount 1616 is a correction amount for centering each paper money bill, which is calculated by the correction amount-calculating section 130. When centering a paper money bill within the centering area, a protrusion amount on a side where the sign of the protrusion amount is "+" is set as the centering correction amount. The temporary stacker movement amount 1617 is a movement

amount of the temporary stacker 200 which is calculated by the correction amount-calculating section 130.

[0063] FIG. 10 is a table of correction information for use when paper money bills are centered on the center of the conveying path.

[0064] Correction information 1620 (centering on the center of the conveying path) includes information items, such as paper money bill 1621, storage order 1622, discharge order 1623, X1 line protrusion amount 1624, X2 line protrusion amount 1625, centering correction amount 1626, and temporary stacker movement amount 1627.

[0065] The paper money 1621 is identification information for identifying each paper money bill. The storage order 1622 represents a sequential order of storage of each paper money bill, and indicates a sequential order number of each paper money bill taken in from the inlet-outlet opening 1g. The discharge order 1623 represents a sequential order of discharge of each paper money bill, which is a reverse of the storage order. The X1 line protrusion amount 1624 indicates a protrusion amount with respect to the left end X1 of the centering area w1, which is calculated by the protrusion amount-calculating section 120. The X2 line protrusion amount 1625 indicates a protrusion amount with respect to the right end X2 of the centering area w1, which is calculated by the protrusion amount-calculating section 120. The centering correction amount 1626 is a correction amount for centering paper money bills, which is calculated by the correction amount-calculating section 130. The temporary stacker movement amount 1627 is a movement amount of the temporary stacker 200 which is calculated by the correction amount-calculating section 130.

[0066] When discharging paper money bills, the position controller 140 reads out the correction information associated with each paper money bill to be discharged, and performs position control based thereon.

[0067] FIG. 11 illustrates position control processing.

[0068] The position controller 140 moves the position of the temporary stacker 200 before a paper money bill is discharged from the temporary stacker 200 onto the conveying path 310, and thereby causes the temporary stacker 200 to discharge the paper money bill onto the centering area on the conveying path 310. Hereinafter, a description will be given of a case where centering of paper money bills within the centering area is designated.

[0069] The position controller 140 reads out the correction information 1610, and performs processing according to the discharge order 1613. For example, as for the paper money bill p4 of which the discharge order is "1", a value of the centering correction amount 1616 is 0, so that the position is not moved. The temporary stacker 200 discharges the paper money bill p4 onto the conveying path 310 from its original center position. Since the paper money bill p4 was within the centering area when stored, the paper money bill p4 is discharged within the centering area of the conveying path 310. The inlet-outlet sensor 340 detects discharge of the paper money

bill p4 onto the conveying path 310, and the position controller 140 reads out the correction information 1610 of the paper money p3 of which the discharge order is "2". As for the paper money bill p3, "+c1" is set in the Correction information 1610 as the temporary stacker movement amount 1617. The position controller 140 instructs to drive the motor 420 such that the temporary stacker 200 is moved by "c1" in the "+" direction (right direction). As a result, the paper money take-up roller 210 is moved by only "c1" in the right direction together with the temporary stacker 200. As a result, the paper money bill p3 is discharged in a state where the paper money bill p3 has been moved by "c1" in the right direction with respect to the conveying path 310, and is thereby discharged within the centering area of the conveying path 310. Hereafter, in the same manner, the position controller 140 reads out the temporary stacker movement amount 1617 according to the discharge order and performs position control of the temporary stacker 200.

[0070] It should be noted that also in the case of centering paper money bills on the center of the conveying path, similarly, the position controller 140 reads out the correction information 1620, reads out the temporary stacker movement amount 1627 according to the discharge order 1623, and moves the temporary stacker 200 before discharging the paper money bills.

[0071] As described above, in the paper money temporary storage device 10, when storing the paper money bills, the centering correction amount and the sequential storage order number of each paper money bill is stored, and when discharging the paper money bills, the temporary stacker 200 is moved for each paper money bill based on the temporary stacker movement amount read therefor from the data of the centering correction amount and the sequential storage order number of each paper money bill stored when storing the paper money bills, and then the paper money bill is discharged.

[0072] Next, a description will be given of a processing procedure executed by the paper money temporary storage device 10 based on a paper money processing method. When a storing instruction or a discharging instruction is received, the storage and discharge controller 150 of the controller 100 starts a storage process or a discharge process in response to the instruction. In the storage process, the storage and discharge controller 150 starts processing for storing each of paper money bills inserted into the paper money temporary storage device 10 into the temporary stacker 200. On the other hand, in the discharge process, the storage and discharge controller 150 performs processing for discharging each of paper money bills stored in the temporary stacker 200 from the temporary stacker 200 into another storage section, such as a receiving and dispensing section or a fixed cashbox. Hereafter, a detailed description will be given of the storage process performed when storing paper money bills and the discharge process performed when discharging paper money bills.

[0073] FIG. 12 is a flowchart of the storage process for

storing paper money bills.

[0074] [step S01] The storage and discharge controller 150 starts the storage process, and causes the paper money take-up roller 210 and the take-up film rollers 220a and 220b of the temporary stacker 200 to be rotated each in the direction of taking up paper money bills.

[0075] [step S02] The protrusion amount-calculating section 120 acquires the position of a paper money bill detected by the paper money position-detecting sensor 330.

[0076] [step S03] The protrusion amount-calculating section 120 calculates the protrusion amounts of the paper money bill protruding from the centering area based on the position of the paper money bill detected in the step S02. The left end of the centering area as viewed in the advancing direction of the paper money bill and the detected leftmost point of the paper money bill are compared, and the distance therebetween is set as the protrusion amount in the left direction. Similarly, the right end of the centering area and the detected rightmost point of the paper money bill are compared, and the distance therebetween is set as the protrusion amount in the right direction. The calculated protrusion amounts are stored in the correction information in association with a sequential storage order number of the paper money bill.

[0077] [step S04] The correction amount-calculating section 130 determines whether or not "centering within the centering area" is selected as the centering processing. If "centering within the centering area" is selected, the process proceeds to a step S05, whereas if "centering on the center of the conveying path" is selected, the process proceeds to a step S06.

[0078] [step S05] If "centering within the centering area" is selected, the correction amount-calculating section 130 reads out the protrusion amounts from the correction information, and if a protrusion amount indicates that the paper money bill protrudes from the centering area, the correction amount-calculating section 130 sets the protrusion amount as the centering correction amount. Then, the temporary stacker movement amount is calculated according to the procedure described with reference to FIG. 7, and then the process proceeds to a step S07.

[0079] [step S06] If "centering on the center of the conveying path" is selected, the correction amount-calculating section 130 calculates a vacant area within the centering area when centering is performed based on the protrusion amounts, and sets the calculated vacant area as the centering correction amount. Then, the temporary stacker moving direction and the temporary stacker movement amount are calculated according to the procedure described with reference to FIG. 8.

[0080] [step S07] The correction amount-calculating section 130 additionally registers the centering correction amount and the temporary stacker movement amount calculated by either of the calculation methods, in the correction information 1610 and 1620 in association with the sequential storage order number of the paper money bill.

[0081] [step S08] The storage and discharge controller 150 determines whether or not an instruction for terminating the storage process is received. If the instruction for the termination is not received, the process returns to the step S02 to continue the storage process for storing the next paper money bill. If the instruction for the termination is received, the present process is terminated.

[0082] When storing paper money bills, the above-described storage process is executed, whereby the centering correction amounts, the temporary stacker movement amounts and so forth for centering the paper money bills are registered in association with the respective sequential storage order numbers.

[0083] FIG. 13 is a flowchart of the discharge process for discharging paper money bills.

[0084] [step S11] The storage and discharge controller 150 causes the paper money take-up roller 210 and the take-up film rollers 220a and 220b of the temporary stacker 200 to be rotated in the direction of discharging paper money bills to thereby start the discharge process for discharging the paper money bills.

[0085] [step S12] The position controller 140 reads out the correction information and determines whether or not a stored paper money bill is present. If a stored paper money bill is present, the process proceeds to a step S13. If a stored paper money bill is not present, the present process is immediately terminated.

[0086] [step S13] If a stored paper money bill is present, the position controller 140 reads out the correction information of the paper money bill of which the sequential storage order number is largest, i.e. which has been most recently stored.

[0087] [step S14] The position controller 140 extracts the temporary stacker movement amount from the read correction information of the paper money bill.

[0088] [step S15] The position controller 140 controls the motor 420 based on the temporary stacker movement amount read out in the step S14 to move the temporary stacker 200.

[0089] [step S16] After the inlet-outlet sensor 340 detects discharge of the paper money bill onto the conveying path 310, the position controller 140 deletes the registration of the correction information associated with the paper money bill.

[0090] [step S17] The position controller 140 determines whether or not an instruction for termination of discharging paper money bills is received. If the instruction for the termination is received, the present process is terminated, whereas if the instruction for the termination is not received, the process returns to the step S12 to continue the discharge process for discharging the next paper money bill.

[0091] When discharging paper money bills, the above-described discharge process is executed whereby the position of the temporary stacker 200 is moved based on the correction information set when storing the paper money bills such that each paper money bill is discharged within the centering area.

[0092] Although in the above description, the correction amount-calculating section 130 sets not only the centering correction amount but also the temporary stacker moving direction and the temporary stacker movement amount concerning the moving of the temporary stacker 200, the calculation of the movement amount of the temporary stacker 200 may be performed by the position controller 140.

[0093] Further, the moving of the temporary stacker 200 may be performed not when discharging the paper money bills, but when storing the paper money bills. In this case, the position controller 140 moves the temporary stacker 200 before sandwiching the paper money bill by the films based on the temporary stacker moving direction and the temporary stacker movement amount which are calculated by the correction amount-calculating section 130.

[0094] FIG. 14 illustrates a case where centering of paper money bills is performed when storing paper money bills.

[0095] The paper money position-detecting sensor 330 detects the position of the paper money bill p2, and the protrusion amount-calculating section 120 calculates the protrusion amount "-b1" in the left direction and the protrusion amount "+b2" in the right direction. It should be noted that the protrusion amounts are calculated in the same manner as in the procedure described with reference to FIG. 7.

[0096] Next, the correction amount-calculating section 130 calculates the centering correction amount. Here, the description will be given of a case where the paper money bill p2 is centered within the centering area. The correction amount-calculating section 130 calculates the protrusion amount "+b2" by which the paper money bill p2 protrudes from the centering area w1 in the right direction as the centering correction amount. Further, although the temporary stacker movement amount has the same magnitude of the movement amount as the centering correction amount, the temporary stacker moving direction is opposite to a direction in the case where the position control of the temporary stacker 200 is performed when discharging the paper money bill. That is, to take-up the paper money bill p2 within the centering area of the paper money take-up roller 210, it is necessary to move the paper money take-up roller 210 in the right direction. The temporary sticker movement amount becomes "+b2", so that the temporary stacker 200 is moved by a distance of "b2" in the right direction. By taking up the paper money bill p2 in this state, the paper money bill p2 is stored within the centering area of the paper money take-up roller 210. It should be noted that when the position control of the temporary stacker 200 is performed when storing the paper money bill, the temporary stacker 200 is fixed to the center when discharging the paper money bill.

[0097] FIG. 15 is a flowchart of a storage process for centering paper money bills when storing the paper money bills.

[0098] [step S21] The storage and discharge controller 150 determines which to execute, the storage process or the discharge process. If it is determined that the storage process is to be executed, the process proceeds to a step S22. If it is determined that the discharge process is to be executed, the process proceeds to a step S28.

[0099] [step S22] If it is determined that the storage process is to be executed, the storage and discharge controller 150 starts the storage process to thereby cause the paper money take-up roller 210 and the take-up film rollers 220a and 220b to be rotated in the storing direction, and determines whether or not the paper money bill is inserted into the paper money temporary storage device 10. If it is detected that the paper money bill has been inserted, the storage and discharge controller 150 starts the protrusion amount-calculating section 120, and then the process proceeds to a step S23. If it is not detected that the paper money has been inserted, the process returns to the step S21 to continue the processing for checking reception of the instruction and processing subsequent thereto.

[0100] [step S23] If it is detected that the paper money has been inserted, the protrusion amount-calculating section 120 acquires the position of the paper money bill detected by the paper money position-detecting sensor 330.

[0101] [step S24] The protrusion amount-calculating section 120 calculates protrusion amounts of the paper money bill protruding from the centering area based on the position of the paper money bill detected in the step S23. The left end of the centering area as viewed in the advancing direction of the paper money bill and the detected position of the leftmost point of the paper money bill are compared, and the distance therebetween is set as the protrusion amount in the left direction. Similarly, the right end of the centering area and the detected position of the rightmost point of the paper money bill are compared, and the distance therebetween is set as the protrusion amount in the right direction. The calculated protrusion amounts are stored in the correction information in association with a sequential storage order number of the paper money bill.

[0102] [step S25] The correction amount-calculating section 130 calculates the centering correction amount based on the protrusion amounts calculated in the step S24. Then, based on the calculated centering correction amount, the temporary stacker moving direction and the temporary stacker movement amount are calculated. The method of calculating the centering correction amount and the temporary stacker movement amount is the same as that in the storage process described with reference to FIG. 12. The temporary stacker moving direction is opposite to that in the storage process described with reference to FIG. 12. That is, when the paper money bill to be stored protrudes from the right end of the centering area, the temporary stacker moving direction is the right direction, whereas when the paper money bill to be stored protrudes from the left end of the centering

area, the temporary stacker moving direction is the left direction.

[0103] [step S26] The position controller 140 moves the temporary stacker 200 based on the temporary stacker movement amount calculated in the step S25.

[0104] [step S27] The storage and discharge controller 150 performs processing for storing the paper money bill. The temporary stacker movement amount is registered in the correction information 1610 or 1620 in association with a sequential storage order number of the paper money bill. The storage and discharge controller 150 confirms by the inlet-outlet sensor 340 that the paper money bill is sandwiched by the films 230, and then the process returns to the step S21.

[0105] [step S28] If it is determined that the discharge process is to be executed, the storage and discharge controller 150 reads out the correction information 1610 and 1620, and determines whether or not a stored paper money bill is present. If a stored paper money bill is present, the process proceeds to a step S29. If a stored paper money bill is not present, the process returns to the step S21 to continue the processing for checking reception of the instruction and processing subsequent thereto.

[0106] [step S29] The storage and discharge controller 150 discharges the paper money bill based on the correction information 1610 or 1620. The position of the temporary stacker 200 is fixed to the center at this time. Then, when it is detected by the inlet-outlet sensor 340 that the paper money bill has been discharged, the storage and discharge controller 150 deletes the registration of the corresponding paper money bill from the correction information 1610 or 1620.

[0107] By executing the above-described processing, paper money bills are centered by moving the temporary stacker 200 when storing the paper money bills, and are stored in the centering area of the paper money take-up roller 210. When discharging the paper money bills, the paper money bills are discharged in the state.

[0108] It should be noted that it is possible to realize the above-described function of processing by a computer. In this case, a program in which content of processing of function to be included in the paper leaves processor is written is provided. By carrying out the program by the computer, the above-described function of processing is realized on the computer. The program in which the content of processing is written can be recorded in a record medium which is capable of being read by the computer.

[0109] In case of distributing programs, for example, portable record mediums, such as DVD (Digital Versatile Disc), CD-ROM (Compact Disc Read Only Memory) or the like in which the program is recorded are marketed. Further, it is also possible to store the program in a storing device of a server computer, and transfer the program from the server computer to the other computer via a network.

[0110] The computer which carries out the program stores, for example, the program which is recorded in the

portable record medium, or is moved from the server computer in the storing device thereof. Then, the computer reads out the program from the storing device thereof, and carries out processes according to the program.

[0111] According to the disclosed paper leaves processor and the method of processing paper leaves, when storing paper leaves, the movement amount of the take-up roller for centering the paper leaves is calculated, and the position of the take-up roller is controlled based on the calculated roller movement amount. This makes it possible to accommodate the discharge position of the paper leaves within a predetermined range. As a result, it becomes possible to accommodate the discharge position of the paper leaves within the predetermined range without having a dedicated centering mechanism, which makes it possible to reduce the size and costs of an apparatus.

[0112] All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the invention and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority and inferiority of the invention. Although the embodiments of the present invention have been described in detail, it should be understood that various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

Claims

1. A paper leaves processor that stores paper leaves by sandwiching each paper leaf between a pair of films and taking-up the films by a take-up roller, comprising,
 - a sensor configured to detect a position of each paper leaf in a direction of a width of the take-up roller which is orthogonal to a direction of taking up the films, when the paper leaf is moved on a conveying path for conveying the paper leaves, which extends between the take-up roller and an inlet-outlet opening for the paper leaves;
 - a correction amount-calculating unit configured to be operable when storing paper leaves on the take-up roller, to calculate a protrusion amount by which each paper leaf protrudes from a predetermined area set in advance with respect to the inlet-outlet opening by comparing the position of the paper leaf detected by said sensor and the predetermined area, determine a movement amount of the take-up roller by calculating a correction amount for accommodating the paper leaf within the predetermined area based on the protrusion amount and determining a moving direction of the take-up roller, and form correction information by associating the movement amount of

the take-up roller with a storage order of the paper leaf;

a correction information-storing unit configured to store the correction information;

a moving unit configured to move the take-up roller in the direction of the width of the take-up roller; and a position control unit configured to be operable when discharging paper leaves stored on the take-up roller, to read out the correction information from the correction information-storing unit, extract the movement amount of the take-up roller which is associated with a paper leaf to be discharged next, based on the storage order, control said moving unit based on the movement amount to thereby cause a discharge position of the paper leaf to be accommodated within the predetermined area.

2. The paper leaves processor according to claim 1, wherein said correction amount-calculating unit compares a maximum point and a minimum point of the paper leaf in the direction of the width of the take-up roller, which are detected by said sensor, and the predetermined area, and when the maximum point or the minimum point of the paper leaf is outside the predetermined area, said correction amount-calculating unit calculates the correction amount based on the protrusion amount corresponding to a distance from the maximum point or the minimum point of the paper leaf outside the predetermined area to the predetermined area, sets a direction from the maximum point or the minimum point toward the predetermined area as the moving direction of the take-up roller, and determines the movement amount of the take-up roller based on the correction amount and the moving direction.
3. The paper leaves processor according to claim 1, wherein said correction amount-calculating unit compares a center position of the paper leaf determined according to the position of the paper leaf detected by said sensor, and a center position of the predetermined area, calculates the correction amount based on the protrusion amount corresponding to a distance from the center position of the paper leaf to the center position of the predetermined area, sets a direction from the maximum point or the minimum point toward the predetermined area as the moving direction of the take-up roller, and determines the movement amount of the take-up roller based on the correction amount and the moving direction.
4. The paper leaves processor according to claim 1, wherein said correction amount-calculating unit selects either a first correction amount for accommodating the paper leaf in the predetermined area or a second correction amount for aligning the center position of the paper leaf and the center position of the

predetermined area, based on a delivery time which is to be taken until a next paper leaf is delivered and is dependent on a predetermined minimum interval of delivery of paper leaves when the paper leaves are delivered onto the conveying path one by one, and a maximum moving time over which said position control unit causes the take-up roller to be moved in the direction of the width of the take-up roller.

5. A paper leaves processor that stores paper leaves by sandwiching each paper leaf between a pair of films and taking-up the films by a take-up roller, comprising,
 - a sensor configured to detect a position of each paper leaf in a direction of a width of the take-up roller which is orthogonal to a direction of taking up the films, when the paper leaf is moved on a conveying path for conveying the paper leaves, which extends between the take-up roller and an inlet-outlet opening for the paper leaves;
 - a correction amount-calculating unit configured to be operable when each paper leaf is moving on the conveying path in a storing direction for storing the paper leaf on the take-up roller, to calculate a protrusion amount by which the paper leaf protrudes from a predetermined area set in advance with respect to the inlet-outlet opening by comparing the position of the paper leaf detected by said sensor and the predetermined area, and determine a movement amount of the take-up roller by calculating a correction amount for accommodating the paper leaf within the predetermined area based on the protrusion amount and determining a moving direction of the take-up roller;
 - a moving unit configured to move the take-up roller in the direction of the width of the take-up roller; and
 - a position control unit configured to be operable before storing the paper leaf on the take-up roller, to control said moving unit based on the movement amount of the take-up roller which is calculated by said correction amount-calculating unit in association with the paper leaf, to thereby cause a storage position of the paper leaf to be accommodated within a predetermined area of the take-up roller which, when the paper leaf is to be discharged, corresponds to the predetermined area of the inlet-outlet opening.
6. A paper leaves processing method of storing paper leaves by sandwiching each paper leaf between a pair of films and taking-up the films by a take-up roller, comprising,
 - detecting a position of each paper leaf in a direction of a width of the take-up roller which is orthogonal to a direction of taking up the films, when the paper leaf is moved on a conveying path for conveying the paper leaves, which extends between the take-up roller and an inlet-outlet opening for the paper leaves;

when storing paper leaves on the take-up roller, calculating a protrusion amount by which each paper leaf protrudes from a predetermined area set in advance with respect to the inlet-outlet opening by comparing the position of the paper leaf detected by said sensor and the predetermined area, determining a movement amount of the take-up roller by calculating a correction amount for accommodating the paper leaf within the predetermined area based on the protrusion amount and determining a moving direction of the take-up roller, and storing correction information in which the movement amount of the take-up roller is associated with a storage order of the paper leaf in a correction information-storing unit; and when discharging paper leaves stored on the take-up roller, reading out the correction information from the correction information-storing unit, extracting the movement amount of the take-up roller which is associated with a paper leaf to be discharged next, based on the storage order, controlling a moving unit for moving the take-up roller in the direction of the width of the take-up roller, based on the movement amount to thereby cause a discharge position of the paper leaf to be accommodated within the predetermined area.

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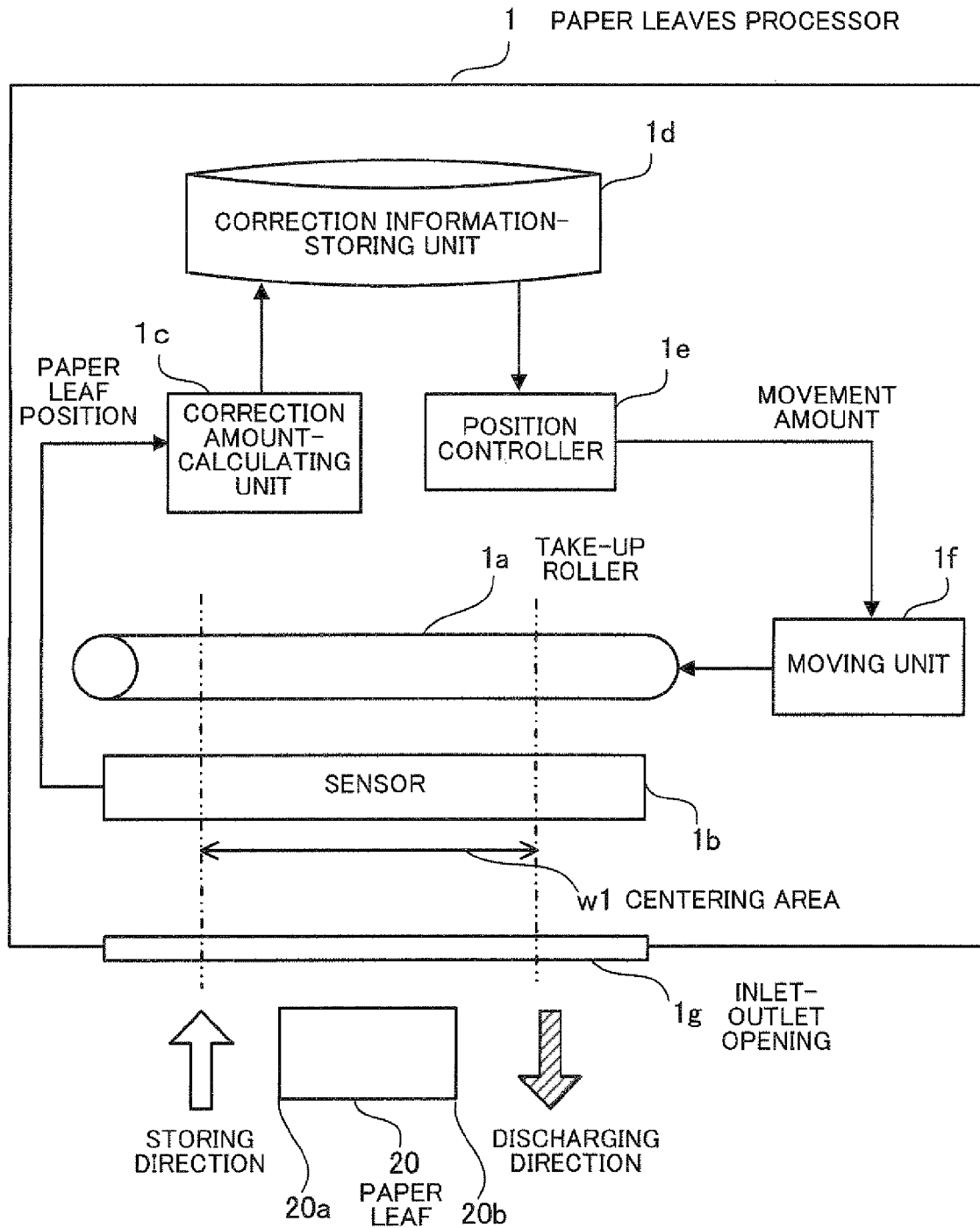
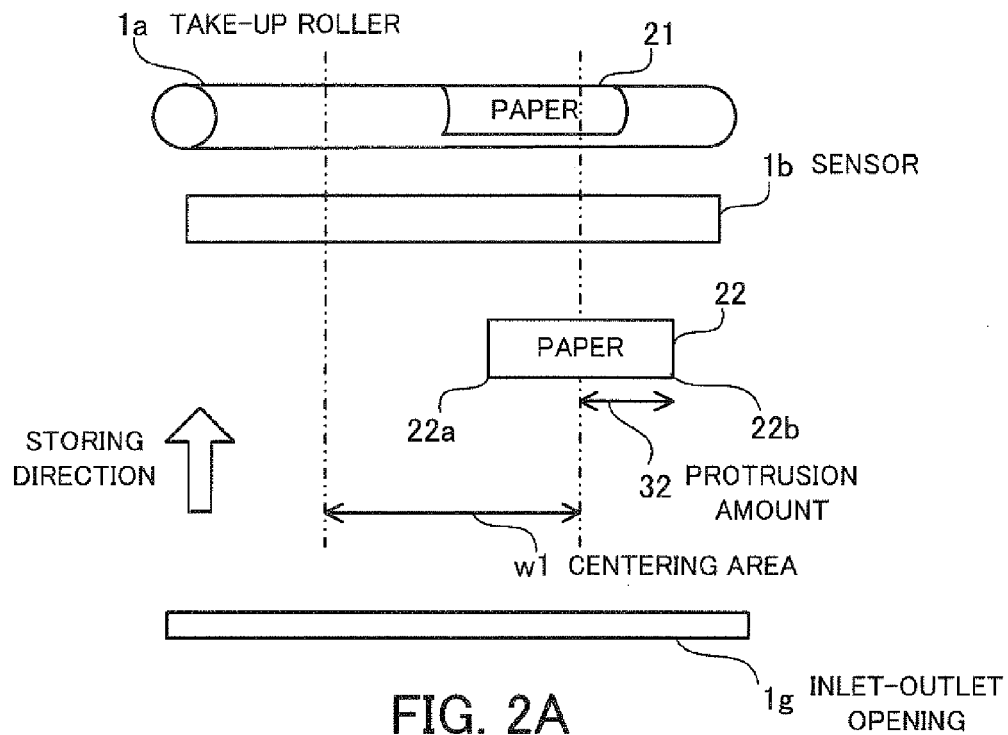
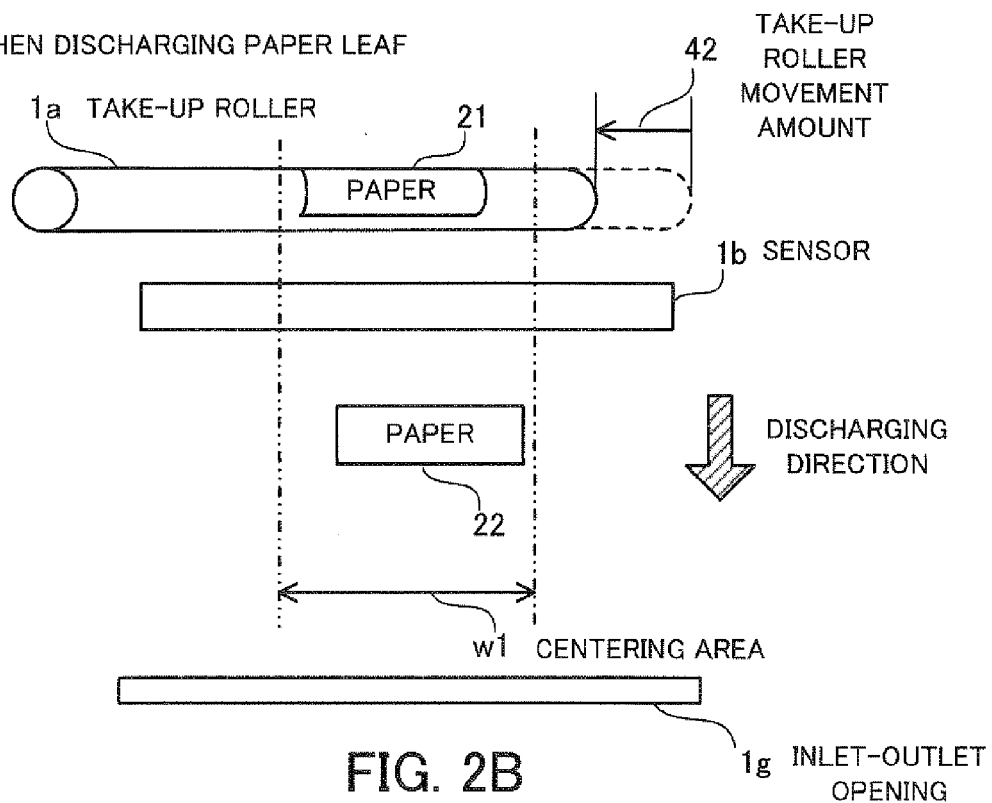


FIG. 1

WHEN STORING PAPER LEAF



WHEN DISCHARGING PAPER LEAF



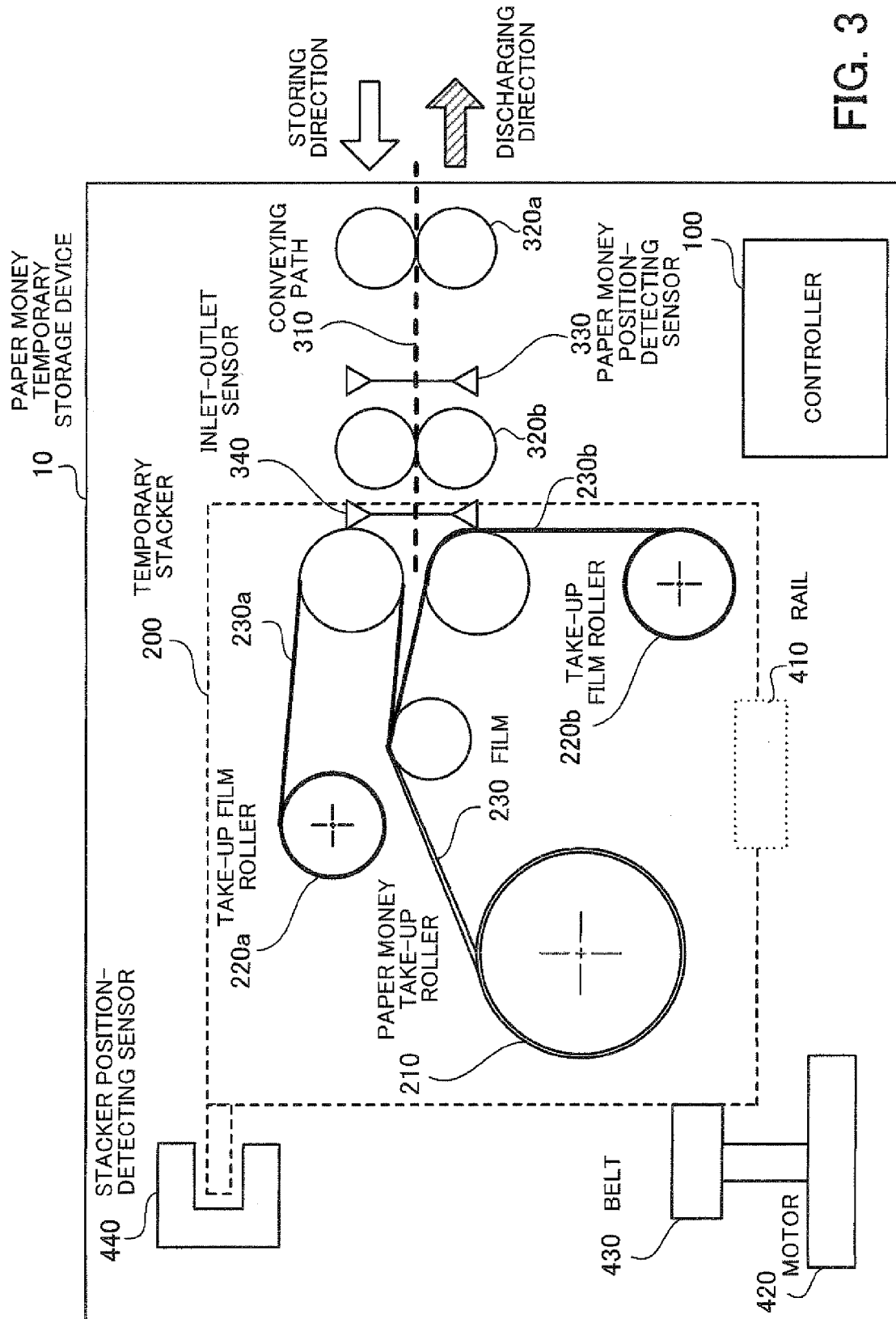


FIG. 3

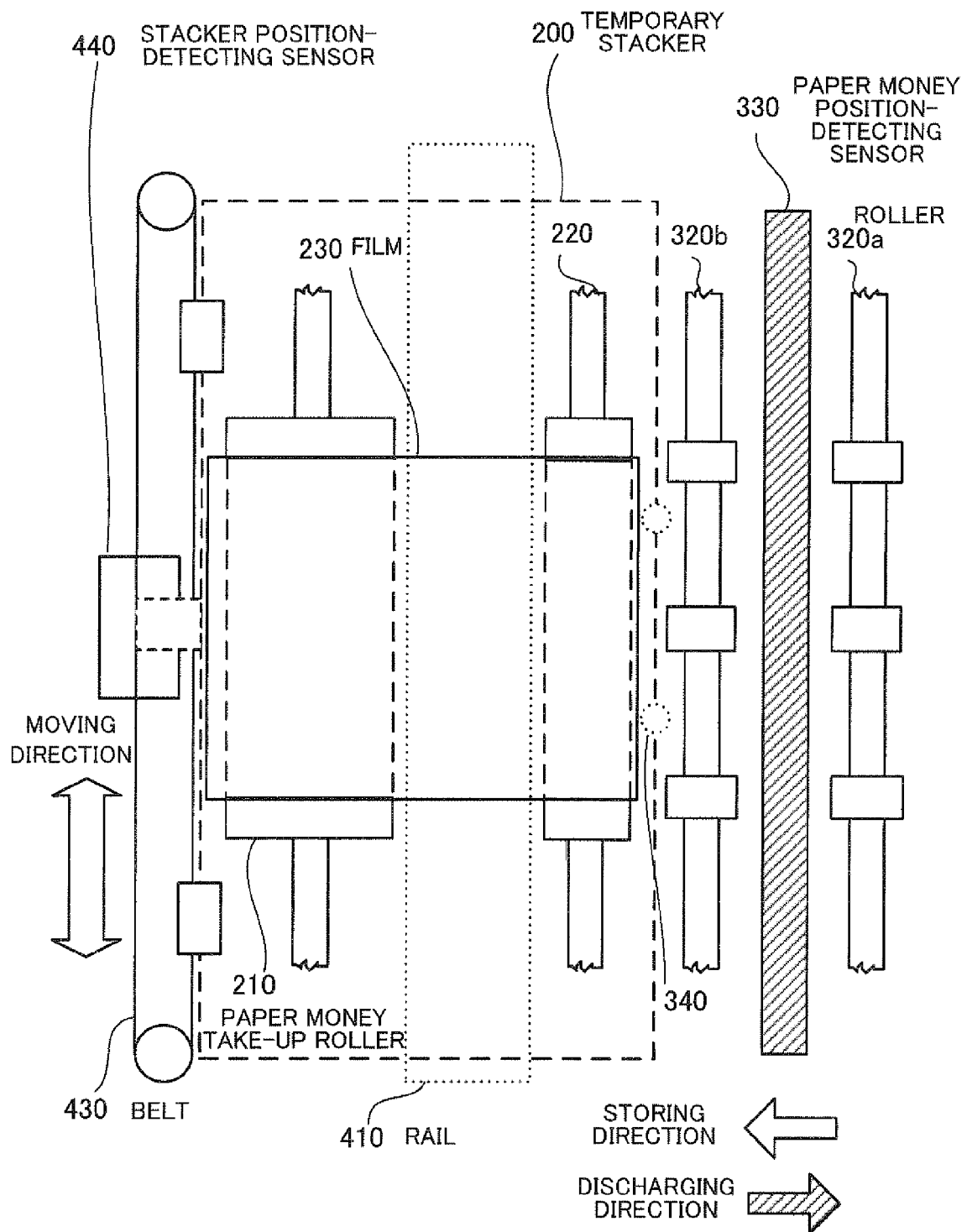


FIG. 4

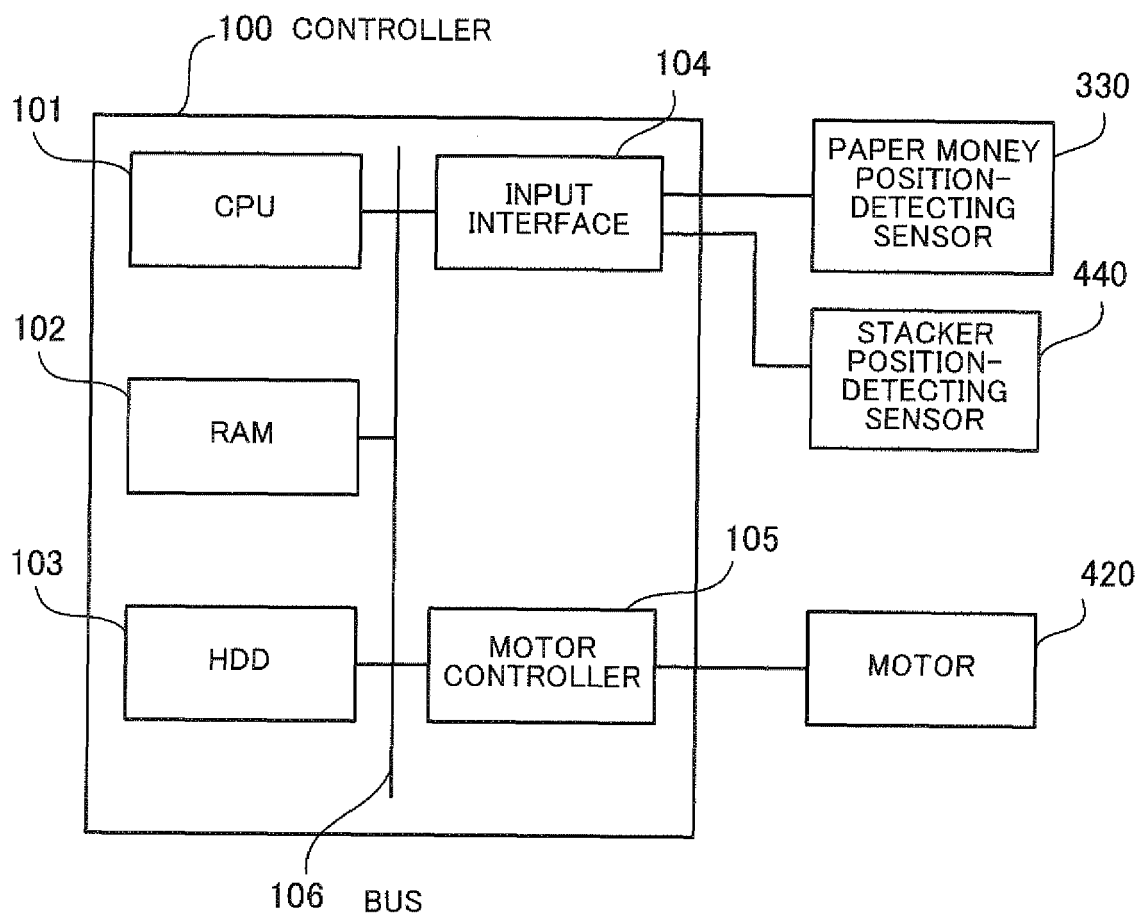


FIG. 5

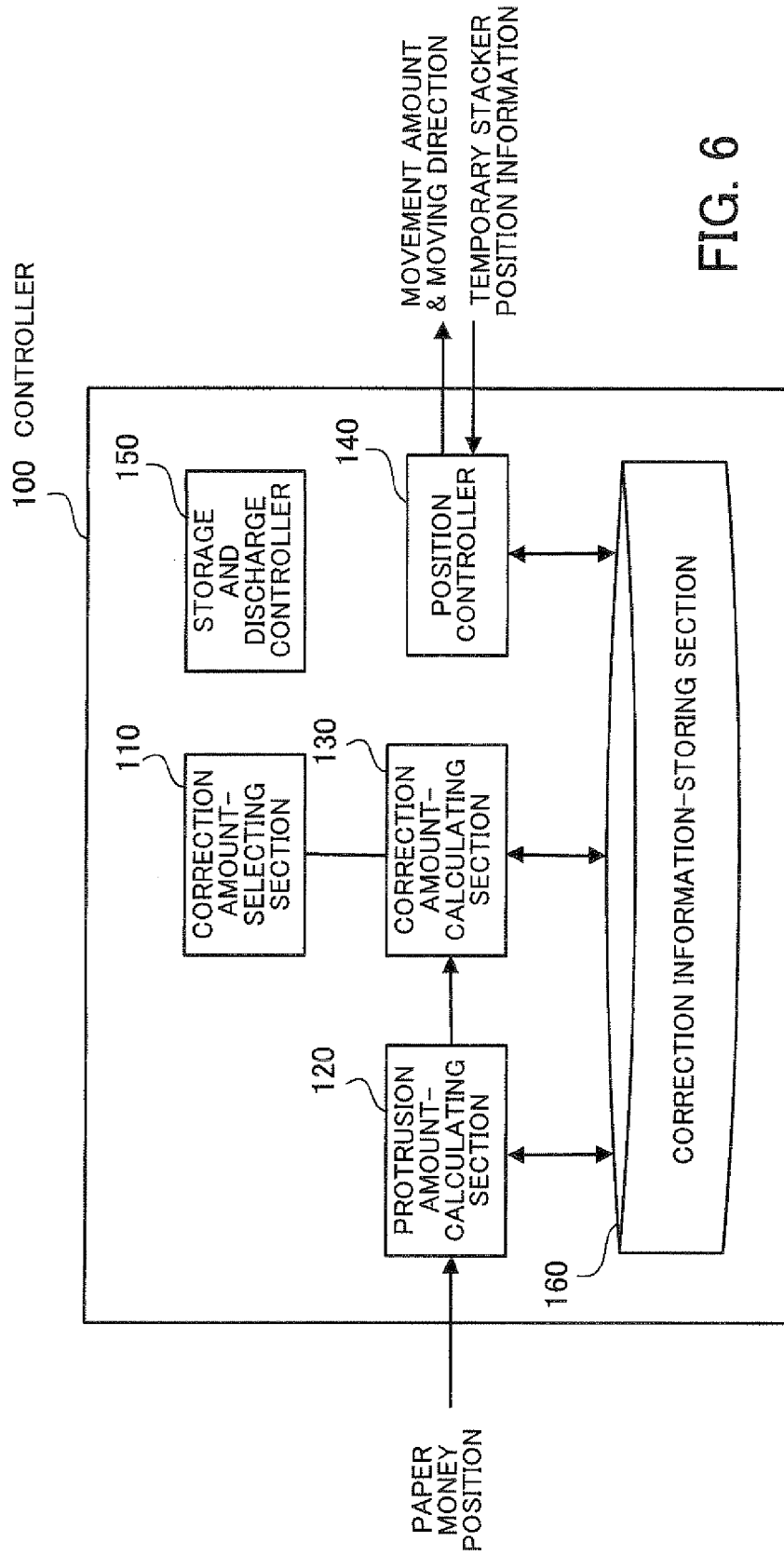


FIG. 6

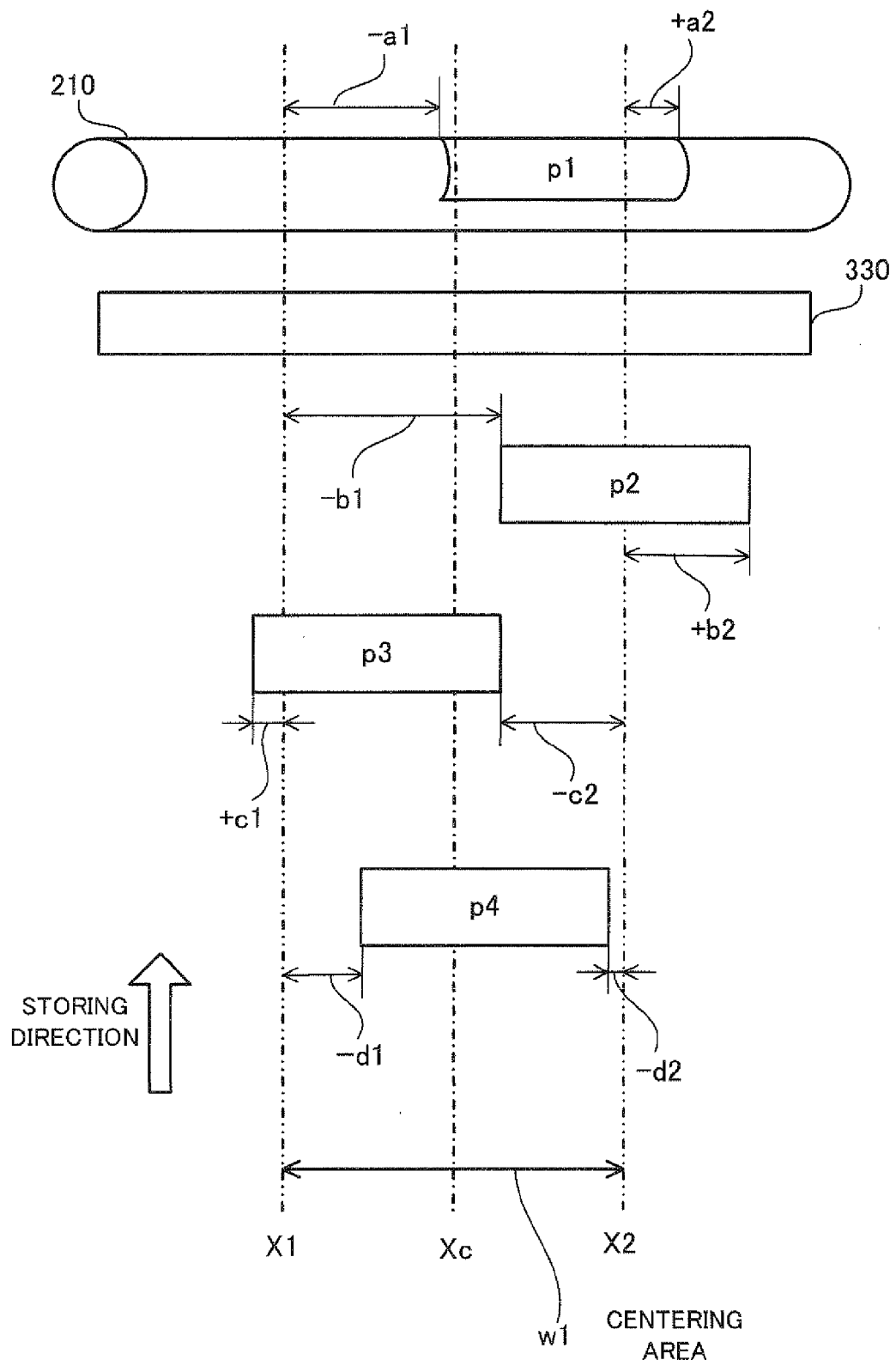


FIG. 7

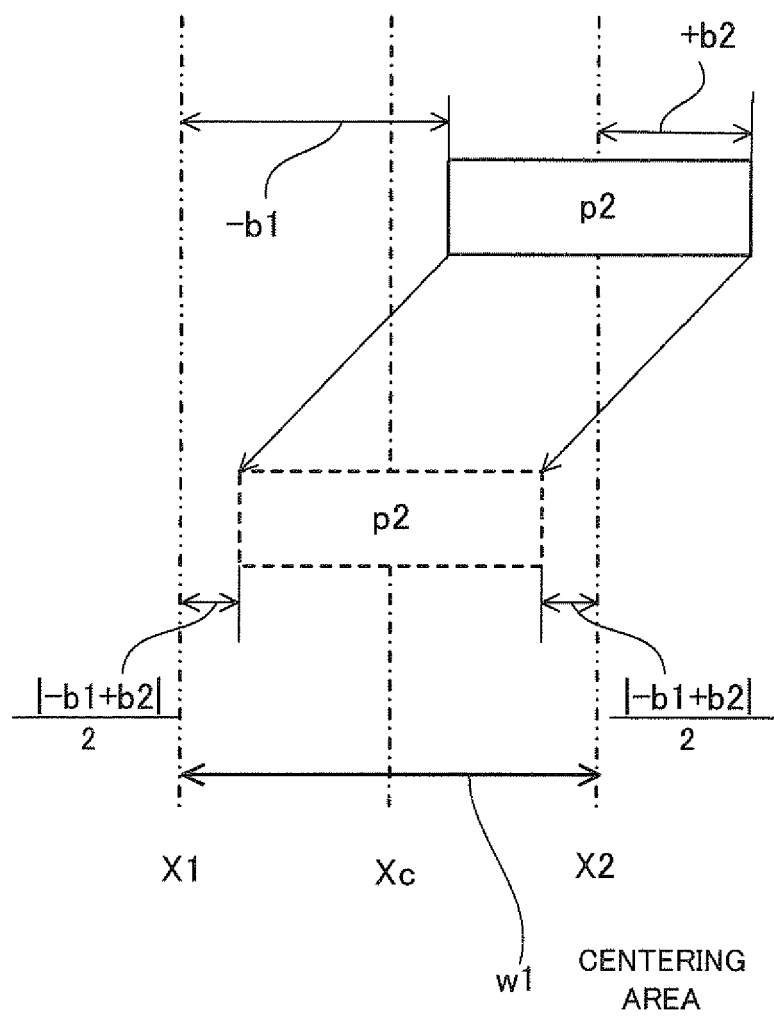


FIG. 8

1610

CORRECTION INFORMATION
(FOR CENTERING WITHIN CENTERING AREA)

PAPER MONEY BILL	STORAGE ORDER	DISCHARGE ORDER	X1 LINE PROTRUSION AMOUNT	X2 LINE PROTRUSION AMOUNT	CENTERING CORRECTION AMOUNT	TEMPORARY STACKER MOVEMENT AMOUNT
p1	1	4	-a1	+a2	a2	-a2
p2	2	3	-b1	+b2	b2	-b2
p3	3	2	+c1	-c2	c1	+c1
p4	4	1	-d1	-d2	0	0

1611 1612 1613 1614 1615 1616 1617

FIG. 9

1620 CORRECTION INFORMATION
(FOR CENTERING ON CENTER OF CONVEYING PATH)

PAPER MONEY BILL	STORAGE ORDER	DISCHARGE ORDER	X1 LINE PROTRUSION AMOUNT	X2 LINE PROTRUSION AMOUNT	CENTERING CORRECTION AMOUNT	TEMPORARY STACKER MOVEMENT AMOUNT
p1	1	4	-a1	+a2	$a2 + -a1 + a2 /2$	$-a2 - -a1 + a2 /2$
p2	2	3	-b1	+b2	$b2 + -b1 + b2 /2$	$-b2 - -b1 + b2 /2$
p3	3	2	+c1	-c2	$c1 + c1 - c2 /2$	$c1 + c1 - c2 /2$
p4	4	1	-d1	-d2	$d1 - d1 + d2 /2$	$d1 - d1 + d2 /2$

FIG. 10

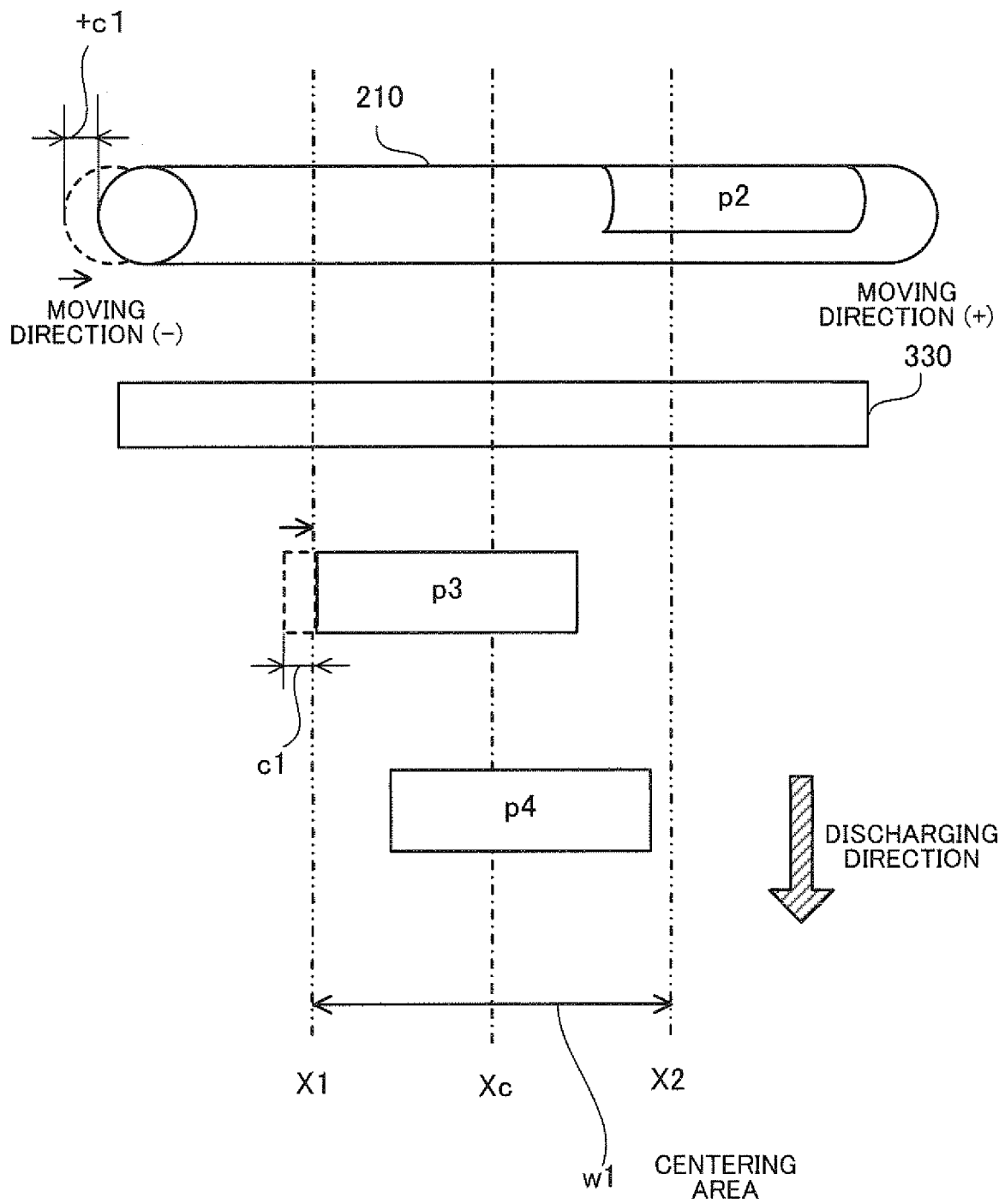


FIG. 11

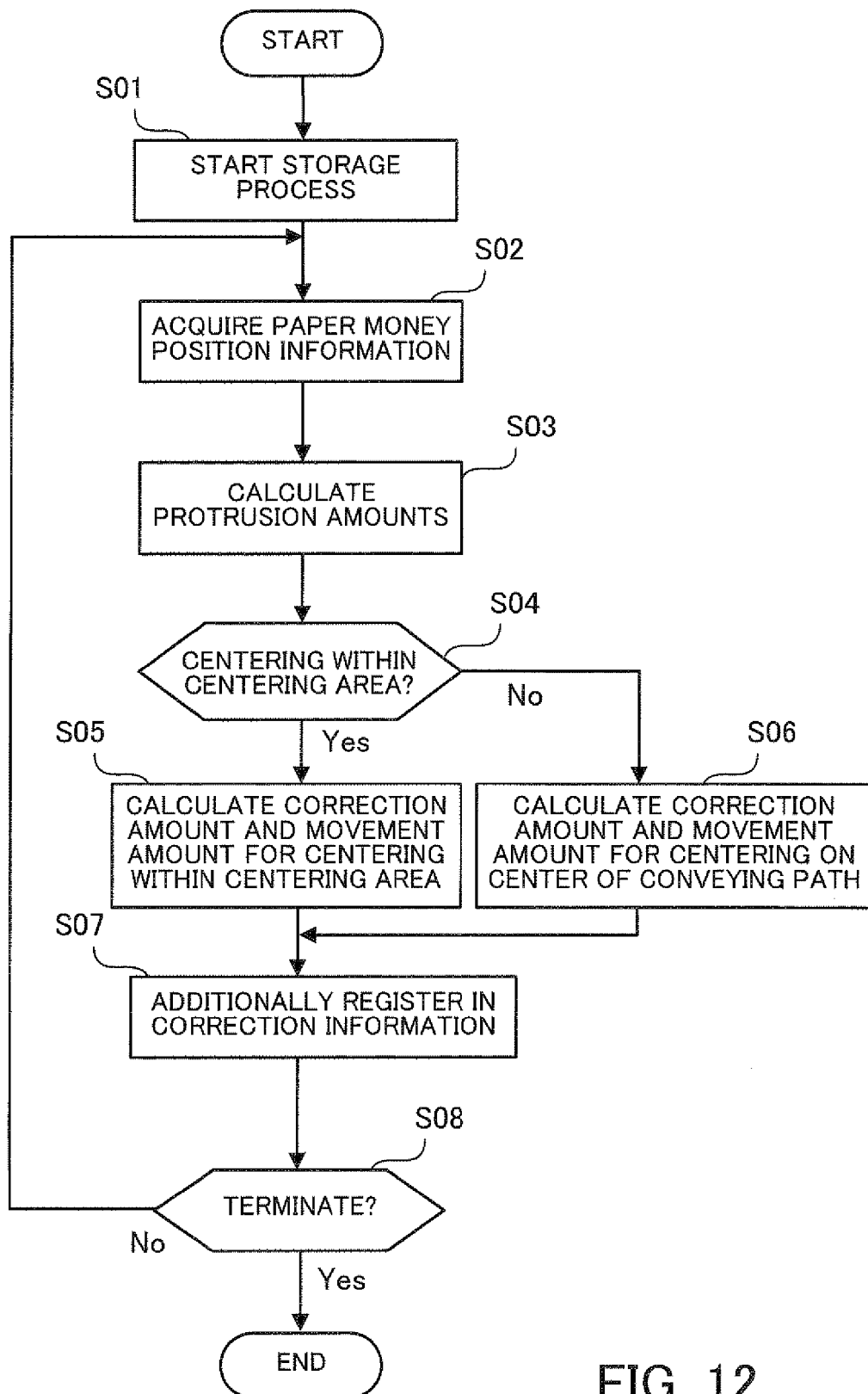


FIG. 12

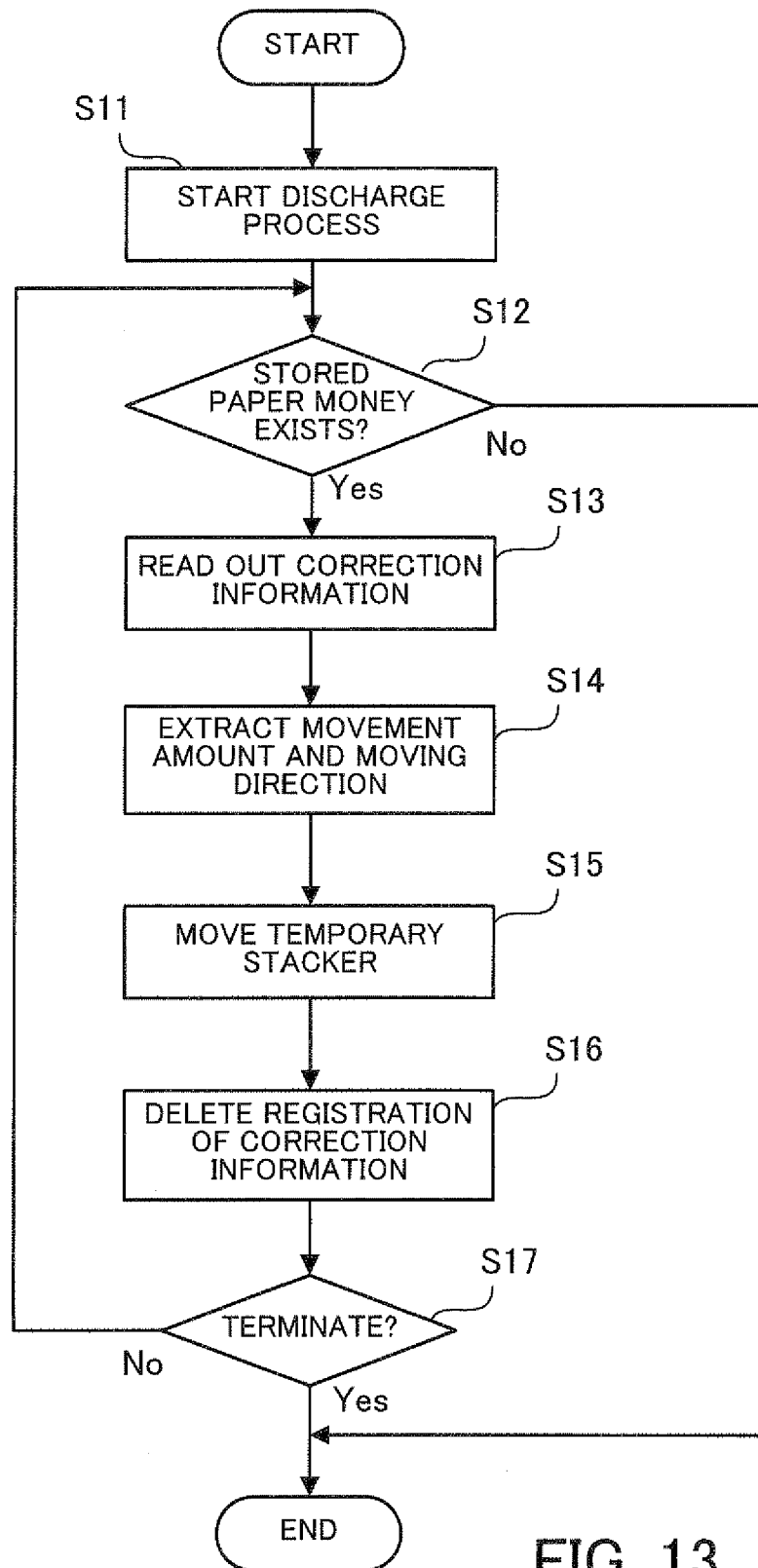


FIG. 13

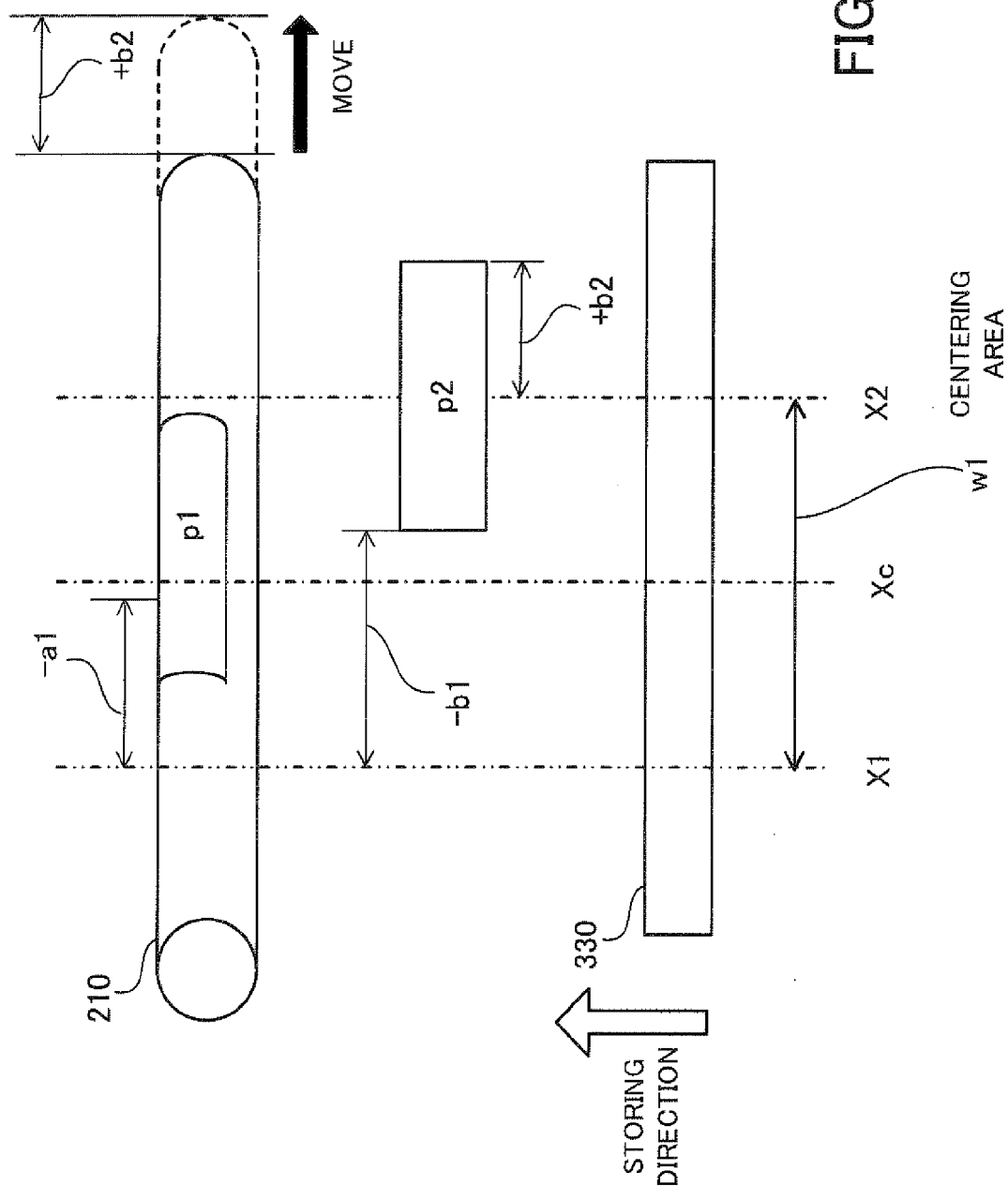


FIG. 14

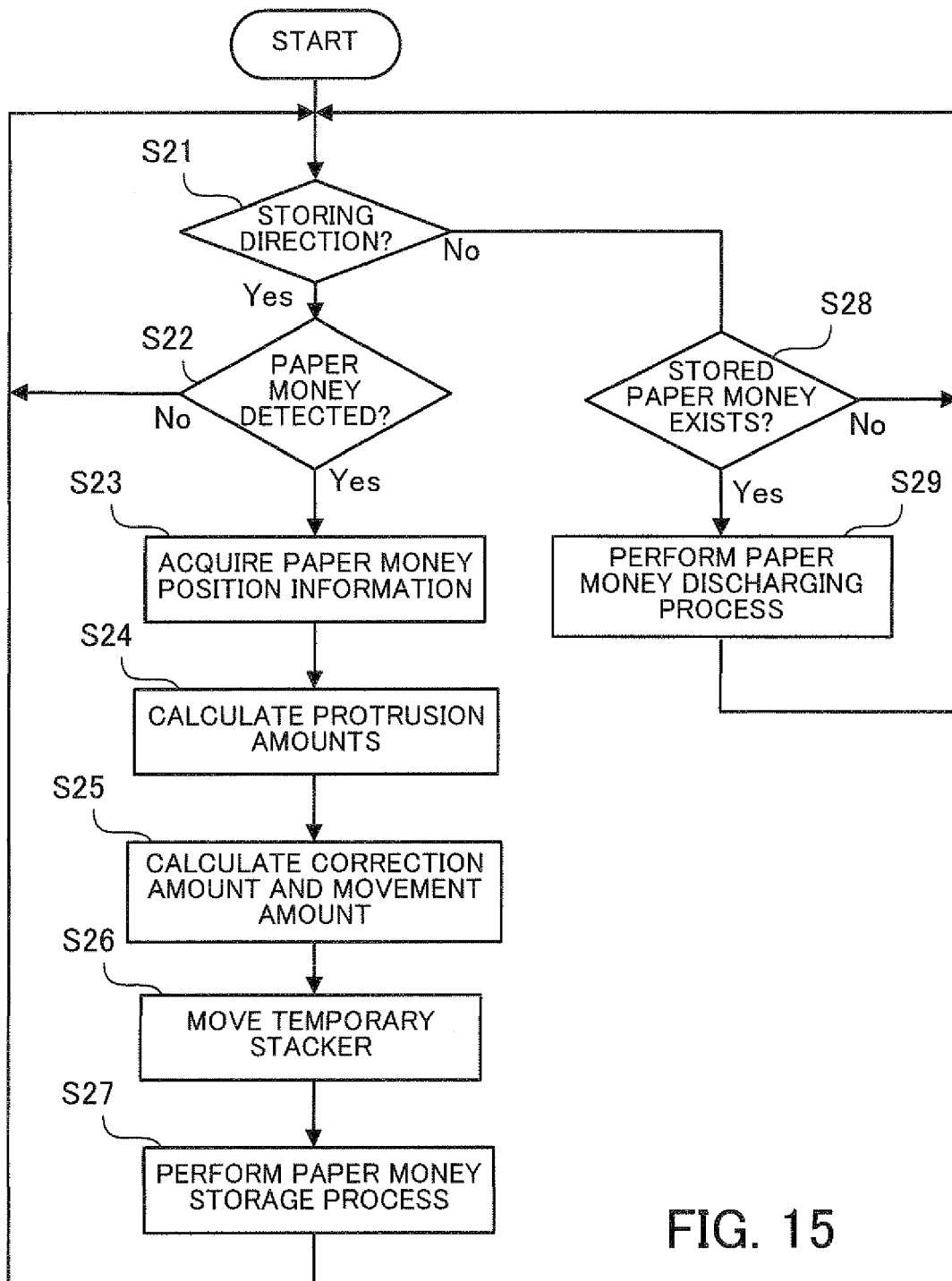


FIG. 15

REFERENCES CITED IN THE DESCRIPTION

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