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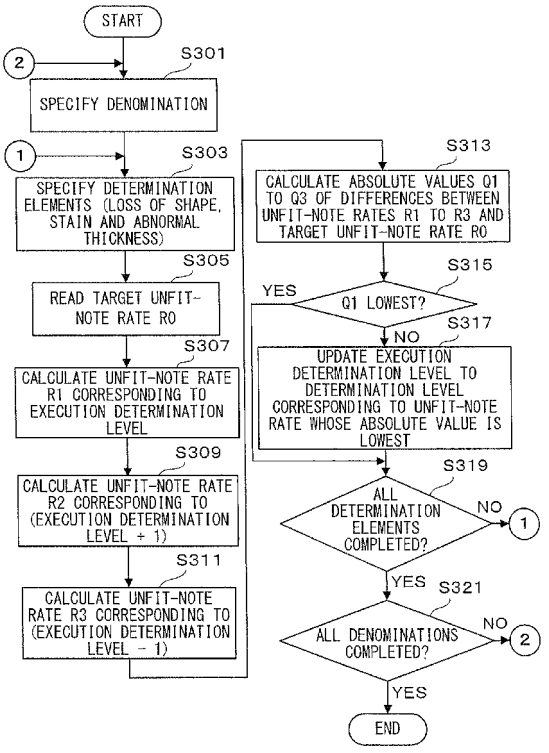
(54) BILL PROCESSING DEVICE AND BILL PROCESSING METHOD

(57) A CPU (31) of a banknote handling apparatus includes a virtual reference value setting portion (312) that sets and stores, as virtual determination criterion values which are unfit-note determination criterion values that have been virtually set, at least two unfit-note determination criterion values other than an execution determination criterion value from a predetermined number of three or more unfit-note determination criterion values. Furthermore, banknote deterioration information is detected for each of banknotes transported and accepted one by one, and is stored in a deterioration information storage portion (322). A first unfit note determination portion (313) checks the banknote deterioration information to determine whether or not the banknote is an unfit note based on the execution determination criterion value. A second unfit note determination portion (314) checks the deterioration information to determine whether or not the banknote is an unfit note based on the virtual determination criterion value that has been set by the virtual reference value setting portion (312). A unfit-note-rate calculation portion (315) determines both a unfit-note rate which is a ratio of the number of banknotes determined by the first unfit note determination portion (313) to be unfit notes to the total number of the banknotes accepted and a unfit-note rate which is a ratio of the number of banknotes determined by the second unfit note determination portion (314) to be unfit notes to the total number of the banknotes accepted.

FIG.13



EP 2 267 666 A1

Description

Technical Field

[0001] The present invention relates to a banknote handling apparatus that recognizes whether or not a banknote accepted is an unfit note based on a predetermined unfit-note determination criterion, and to a banknote handling method.

[0002] Conventionally, in a banknote handling apparatus recognizing whether or not a banknote accepted is an unfit note, in order to maintain the number of banknotes circulated in the market and dispose of unfit notes unsuitable for the circulation, it is necessary to set at a desired value (for example, 10%) an unfit-note rate that is a ratio of the number of banknotes determined to be unfit notes to the total number of banknotes accepted. Here, the unfit note refers to a so-called "damaged banknote" that is torn (loss of shape), is stained (stain) or has tape or the like attached thereto (abnormal thickness). The banknote handling apparatus determines whether or not a banknote is an unfit note based on a predetermined unfit-note determination criterion value.

[0003] In order to satisfy the above requirements, various apparatuses, methods and the like are proposed. For example, there is disclosed a paper sheet handling apparatus in which a fitness level of paper sheets for each of a predetermined number of paper sheets is stored in a ring buffer provided for each kind of banknotes, a fitness distribution is generated based on the fitness levels and then a fitness determination level, that is, a fitness ratio set for the fitness distribution is calculated. In this paper sheet handling apparatus, the fitness determination level is set based on the paper sheet fitness ratio that has been set, and thus it is possible to reduce variations in the paper sheet fitness ratio on which fitness sorting procedure is performed

Patent document 1: JP-A-2007-87219

Disclosure of the Invention

Problems to be Solved by the Invention

[0004] However, the paper sheet handling apparatus described above needs to include, for each kind of banknotes, the ring buffer storing the fitness level for each of the predetermined number of paper sheets, to further determine the fitness distribution and to calculate the fitness determination level, which is a fit and unfit ratio set for the fitness distribution. This causes a large load to be placed on a CPU (central processing unit) and the like.

[0005] In view of the above problem, the present invention is designed and has an object to provide both a banknote handling apparatus that can set an unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration and a banknote handling method.

Means for Solving the Problem

[0006] To achieve the above object, there is provided a banknote handling apparatus of claim 1 recognizing whether or not each of banknotes transported and accepted one by one is an unfit note based on an execution determination criterion value for determination of an unfit note that has been previously selected and set from a predetermined number of three or more unfit-note determination criterion values, the banknote handling apparatus including: a virtual determination criterion value setting unit that virtually sets, as virtual determination criterion values, one of the unfit-note determination criterion values at least one level away from the execution determination criterion value on a strict side and one of the unfit-note determination criterion values at least one level away from the execution determination criterion value on a relaxing side; a deterioration information storage unit that stores banknote deterioration information indicating a deteriorated state of a banknote detected for each of the banknotes accepted; a first unfit note determination unit that determines, for each of the banknotes accepted, whether or not the banknote is an unfit note based on the banknote deterioration information and the execution determination criterion value; a second unfit note determination unit that determines whether or not the banknote is an unfit note based on the banknote deterioration information for each of the banknotes accepted and the virtual determination criterion values that have been set; and an unfit-note-rate calculation unit that determines a current unfit-note rate which is a ratio of a number of banknotes determined by the first unfit note determination unit to be unfit notes to a total number of the banknotes accepted and a virtual unfit-note rate which is a ratio of a number of banknotes determined by the second unfit note determination unit to be unfit notes for each of the virtual determination criterion values to the total number of the banknotes accepted.

[0007] A banknote handling apparatus of claim 2 is the banknote handling apparatus of claim 1 further including: a target unfit-note-rate storage unit that previously stores a target unfit-note rate to be achieved; an update determination unit that determines whether or not the virtual determination criterion value needs to be set as an execution determination criterion value for subsequent rounds based on the current unfit-note rate, the virtual unfit-note rate and the target unfit-note rate each time a predetermined time period that has been previously set elapses or a predetermined number of banknotes that have been previously set are accepted; and an update execution unit that updates the execution determination criterion value when the update determination unit determines that the virtual determination criterion value needs to be set.

[0008] A banknote handling apparatus of claim 3 is the banknote handling apparatus of claim 2 in which, when either of the virtual unfit-note rates is closer to the target unfit-note rate than the current unfit-note rate, the update

determination unit determines that the virtual determination criterion value corresponding to the virtual unfit-note rate needs to be set as an execution determination criterion value for subsequent rounds.

[0009] A banknote handling apparatus of claim 4 is the banknote handling apparatus of claim 3 in which, when a plurality of the virtual unfit-note rates that are closer to the target unfit-note rate than the current unfit-note rate are present, the update execution unit selects the virtual unfit-note rate closest to the target unfit-note rate from the plurality of the virtual unfit-notes, and updates the execution determination criterion value such that a virtual determination criterion value corresponding to the selected virtual unfit-note rate is set as an execution determination criterion value for subsequent rounds.

[0010] A banknote handling apparatus of claim 5 is the banknote handling apparatus of claim 1 further including: a display unit that displays character information such that the character information can be viewed from outside; a display control unit that displays the current unfit-note rate and the virtual unfit-note rate through the display unit such that the current unfit-note rate and the virtual unfit-note rate can be viewed from outside; an update determination unit that receives an operation input from outside and determines whether or not the virtual determination criterion value needs to be set as an execution determination criterion value for subsequent rounds based on the operation input received; and an update execution unit that updates the execution determination criterion value when the update determination unit determines that the virtual determination criterion value needs to be set.

[0011] A banknote handling apparatus of claim 6 is the banknote handling apparatus of claim 1 in which the virtual reference value setting unit sets, as the virtual determination criterion values, two or more of the unfit-note determination criterion values at least one level away from the execution determination criterion value on the strict side and two or more of the unfit-note determination criterion values at least one level away from the execution determination criterion value on the relaxing side.

[0012] A banknote handling apparatus of claim 7 is the banknote handling apparatus of claim 1 further including: a deterioration detection unit that receives the banknote from outside, generates the banknote deterioration information indicating the deteriorated state of the banknote accepted and records the banknote deterioration information in the deterioration information storage unit, in which the first unfit note determination unit and the second unfit note determination unit determine whether or not the banknote accepted is an unfit note each time the deterioration detection unit generates the banknote deterioration information.

[0013] A banknote handling apparatus of claim 8 is the banknote handling apparatus of claim 1 in which the execution determination criterion value corresponds to each of loss of shape, stain and abnormal thickness, the deterioration information storage unit stores the banknote deterioration information detected according to each of the loss of shape, the stain and the abnormal thickness of the banknote, the virtual reference value setting unit sets the virtual determination criterion values respectively corresponding to each of the loss of shape, the stain and the abnormal thickness, the first unfit note determination unit and the second unfit note determination unit determine whether or not the banknote is an unfit note on each of the loss of shape, the stain and the abnormal thickness; and the unfit-note-rate calculation unit determines the current unfit-note rate and the virtual unfit-note rate on each of the loss of shape, the stain and the abnormal thickness.

[0014] A banknote handling apparatus of claim 9 is the banknote handling apparatus of claim 1 in which the execution determination criterion value corresponds to each of denominations of the banknotes, the deterioration information storage unit stores the banknote deterioration information according to denomination information on the banknote, the virtual reference value setting unit sets the virtual determination criterion values respectively corresponding to each of denominations of the banknotes, the first unfit note determination unit and the second unfit note determination unit determine whether or not the banknote is an unfit note for each of denominations of the banknotes and the unfit-note-rate calculation unit determines the current unfit-note rate and the virtual unfit-note rate for each of denominations of the banknotes.

[0015] A banknote handling apparatus of claim 10 is the banknote handling apparatus of claim 1 further including: an unfit-note-rate transmission unit which is connected to an upper terminal such that the unfit-note-rate transmission unit can communicate with the upper terminal and which transmits to the upper terminal unfit-note-rate information, that is, information on the current unfit-note rate and the virtual unfit-note rate, in which the upper terminal includes an unfit-note-rate storage unit storing the unfit-note-rate information received form the unfit-note-rate transmission unit.

[0016] A banknote handling apparatus of claim 11 is the banknote handling apparatus of claim 10 in which the upper terminal includes a transition display unit which produces a graph showing transition of the current unfit-note rate and the virtual unfit-note rate based on the unfit-note-rate information stored in the unfit-note-rate storage unit and which displays the graph such that the graph can be viewed from outside.

[0017] A banknote handling method of claim 12 is a banknote handling method of recognizing whether or not each of banknotes transported and accepted one by one is an unfit note based on an execution determination criterion value that is an unfit note determination criterion value which has been previously selected and set from a predetermined number of three or more unfit note determination criterion values, the banknote handling method including: a virtual determination criterion value setting step of virtually setting, as virtual determination cri-

terion values, one of the unfit note determination criterion values at least one level away from the execution determination criterion value on a strict side and one of the unfit note determination criterion values at least one level away from the execution determination criterion value on a relaxing side; a storage step of storing banknote deterioration information indicating a deteriorated state of a banknote detected for each of the banknotes accepted; a first unfit note determination step of determining, for each of the banknotes accepted, whether or not the banknote is an unfit note based on the banknote deterioration information for each of the banknotes accepted and the execution determination criterion value; a second unfit note determination step of determining, for each of the banknotes accepted, whether or not the banknote is an unfit note based on the banknote deterioration information for each of the banknotes accepted and the virtual determination criterion values that have been set; and an unfit-note-rate calculation step of determining a current unfit-note rate which is a ratio of a number of banknotes determined by the first unfit note determination unit to be unfit notes to a total number of the banknotes accepted and a virtual unfit-note rate which is a ratio of a number of banknotes determined by the second unfit note determination unit to be unfit notes for each of the virtual determination criterion values to the total number of the banknotes accepted.

Advantages of the Invention

[0018] When the banknote handling apparatus of claim 1 is used, whether or not a banknote is an unfit note is determined from the banknote deterioration information based on the execution determination criterion value, whether or not a banknote is an unfit note is virtually determined based on the virtual determination criterion value and unfit-note rates (= a current unfit-note rate determined based on the execution determination criterion value and a virtual unfit-note rate determined based on the virtual determination criterion value) which are a ratio of the number of banknotes determined to be unfit notes to the total number of the banknotes accepted.

[0019] Hence, if the virtual unfit-note rate is compared with the current unft-note rate and is determined to be close to the target unfit-note rate, the execution determination criterion value is updated with the virtual determination criterion value, and thus it is possible to set the execution determination criterion value for achieving an unfit-note rate closer to the target unfit-note rate. It is therefore possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0020] When the banknote handling apparatus of claim 2 is used, whether or not the current virtual determination criterion value needs to be updated to the execution determination criterion value is determined based on the current unfit-note rate, the virtual unfit-note rate and the target unfit-note rate each time when a predetermined time period (for example, one month) that has been previously set elapses or a predetermined number of banknotes (for example, 10000 banknotes) that have been previously set are received. When it is determined that the virtual determination criterion value is to be updated, the current virtual determination criterion value is set and updated to the execution determination criterion value.

[0021] Hence, the execution determination criterion value can be updated such that an unfit-note rate closer to the target unfit-note rate is achieved, without the execution determination criterion value being updated by a user such as the teller (that is, automatically). Consequently, the unfit-note determination criterion value for achieving a desired unfit-note rate can be set with a simple configuration.

[0022] When the banknote handling apparatus of claim 3 is used, it is possible to update the execution determination criterion value such that the unfit-note rate is brought closer to the target unfit-note rate than the current unfit-note rate. When the banknote handling apparatus of claim 4 is used, if a plurality of the virtual unfit-note rates that are closer to the target unfit-note rate than the current unfit-note rate are present, it is possible to set the execution determination criterion value such that the unfit-note rate is brought closest to the target unfit-note.

[0023] When the banknote handling apparatus of claim 5 is used, the teller or the like references each unfit-note rate displayed on the display unit and can give an instruction as to whether or not the execution determination criterion value is updated. Thus, it is possible to set the execution determination criterion value for achieving a desired unfit-note rate with a simpler configuration.

[0024] When the banknote handling apparatus of claim 6 is used, at least two or more unfit-note determination criterion values on each of the stronger and weaker sides of the execution determination criterion values are set, as the virtual determination criterion values, from a predetermined number of five or more unfit-note determination criterion values. Thus, the unfit-note rates corresponding to each of, for example, the unfit-note determination criterion value only two levels away from the execution determination criterion value on the strict side, the unfit-note determination criterion value only one level away from the execution determination criterion value on the strict side, the execution determination criterion value, the unfit-note determination criterion value only one level away from the execution determination criterion value on the relaxing side and the unfit-note determination criterion value only two levels away from the execution determination criterion value on the relaxing side are determined. When the unfit-note rate corresponding to the unfit-note determination criterion value only two levels away from the execution determination criterion value on the strict side, the unfit-note rate corresponding to the unfit-note determination criterion value only one level away from the execution determination criterion value on the strict side, the unfit-note rate corresponding to the unfit-note determination criterion value only one level

away from the execution determination criterion value on the relaxing side or the unfit-note rate corresponding to the unfit-note determination criterion value only two levels away from the execution determination criterion value on the relaxing side is closer to the target unfit-note rate than the unfit-note rate corresponding to the execution determination criterion value, it is possible to update the execution determination criterion value with a more proper unfit-note determination criterion value. Thus, it is possible to reliably set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0025] When the banknote handling apparatus of claim 7 is used, the first unfit note determination unit and the second unfit note determination unit determine whether or not the banknote is an unfit note each time the banknote deterioration information is generated. Hence, whether or not the banknote is an unfit note is determined without a large load being placed on the CPU and the like. Thus, it is possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a much simpler configuration.

[0026] When the banknote handling apparatus of claim 8 is used, with a simple configuration, it is possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate on each of the loss of shape, the stain and the abnormal thickness. When the banknote handling apparatus of claim 9 is used, with a simple configuration, it is possible to obtain the unfit-note rate for each of denominations of the banknotes at the time of the application of the unfit-note determination criterion value that has been set. With the obtained unfit-note rate, it is possible to set the execution determination criterion value for obtaining a closer target unfit-note rate.

[0027] When the banknote handling apparatus of claim 10 is used, it is possible to perform, with the upper terminal, various types of processes (such as displaying a graph showing the transition of the unfit-note rate) based on the unfit-note-rate information stored in the unfit-note-rate storage unit. Thus, it is possible to, for example, evaluate whether or not or the unfit-note determination criterion value for achieving a desired unfit-note rate has been set as the execution determination criterion value. Moreover, when the banknote handling apparatus of claim 11 is used, it is possible to, for example, evaluate whether or not or the unfit-note determination criterion value for achieving a desired unfit-note rate has been set as the execution determination criterion value.

[0028] When the banknote handling method of claim 12 is used, whether or not the banknote is an unfit note is determined for each of the banknotes accepted based on the banknote deterioration information and the execution determination criterion value; whether or not the banknote is an unfit-note is determined based on the banknote deterioration information and the virtual determination criterion value; and the unfit-note rates (= the current unfit-note rate determined based on the execution determination criterion value and the virtual unfit-note rate determined based on the virtual determination criterion value) which are a ratio of the number of banknotes determined to be unfit notes to the total number of the banknotes accepted are determined

[0029] Hence, if the virtual unfit-note rate is compared with the current unfit-note rate and is judged to be close to the target unfit-note rate, the execution determination criterion value is updated with the virtual determination criterion value, and thus it is possible to set the execution determination criterion value for achieving an unfit-note rate closer to the target unfit-note rate. It is therefore possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

Brief Description of Drawings

[0030]

[Fig. 1] Fig. 1 is an example of an external view of a banknote handling apparatus according to an embodiment of the present invention;

[Fig. 2] Fig. 2 is an example of a cross-sectional view of the banknote handling apparatus according to the embodiment of the present invention;

[Fig. 3] Fig. 3 is a cross-sectional view showing the arrangement of sensors in a banknote recognition portion;

[Fig. 4] Fig. 4 is a plan view showing the arrangement of the sensors in the banknote recognition portion;

[Fig. 5] Fig. 5 is a block diagram showing an example of the electrical configuration of the banknote handling apparatus and upper terminal;

[Fig. 6] Fig. 6 is a block diagram showing an example of the configuration of main portions of the banknote handling apparatus according to the embodiment of the present invention;

[Fig. 7] Fig. 7 is a table showing an example of the update of an execution determination level by an update execution portion;

[Fig. 8] Fig. 8 is a block diagram showing an example of the configuration of main portions of the upper terminal;

[Fig. 9] Fig. 9 is an example of a graph displayed by a transition display portion on a display portion;

[Fig. 10] Fig. 10 is a screen display showing an example of a target unfit-note-rate setting screen displayed by a target value setting portion on the display portion;

[Fig. 11] Fig. 11 is a flowchart showing an example of unfit note determination process performed by the banknote handling apparatus (mainly by a CPU);

[Fig. 12] Fig. 12 is a detailed flowchart showing an example of loss of shape determination process performed in step S107 in the flowchart shown in Fig. 11;

[Fig. 13] Fig. 13 is a flowchart showing an example of process for updating the execution determination level performed by the banknote handling apparatus

(mainly by the CPU); and

[Fig. 14] Fig. 14 is a screen display showing an example of a determination level update screen on abnormal thickness displayed by a display control portion on the display portion.

List of Reference Symbols

[0031]

1	Banknote handling apparatus
125	Display portion (display unit)
125a	Operation portion (a part of an update determination unit)
150	Banknote recognition portion (a part of a deterioration detection unit)
3	Control portion
31	CPU
310	Target unfit-note-rate receiving portion
311	Deterioration detection portion (a part of a deterioration detection unit)
312	Virtual reference value setting portion (a virtual reference setting unit)
313	First unfit note determination portion (first unfit note determination unit)
314	Second unfit note determination portion (second unfit note determination unit)
315	Unfit-note-rate calculation portion (unfit-note-rate calculation unit)
316	Update determination portion (a part of an update determination unit)
317	Update execution portion (update execution unit)
318	Display control portion (display control portion)
319	Unfit-note-rate transmission portion (unfit-note-rate transmission unit)
32	RAM
321	Target unfit-note-rate storage portion (target unfit-note-rate storage unit)
322	Deterioration information storage portion (deterioration information storage unit)
323	Determination criterion value storage portion
324	Determination result storage portion
2 (2A and 2B)	Higher-ranking terminals
21	CPU
211	Unfit-note-rate receiving portion
212	Transition display portion (a part of a transition display unit)
213	Target value setting portion
214	Target value transmission portion
22	RAM
221	Unfit-note-rate storage portion (unfit-note-rate storage unit)
27	Operation portion
28	Display portion (part of the transition display unit)

Best Mode for Carrying Out the Invention

[0032] An example of a banknote handling apparatus according to an embodiment of the present invention will be described below with reference to the accompanying drawings. Fig. 1 is an external view of the banknote handling apparatus according to the embodiment of the present invention; Fig. 2 is a cross-sectional view of the banknote handling apparatus according to the embodiment of the present invention. The banknote handling apparatus 1, for example, is installed in the counter of a financial institution such as a bank, and is particularly installed between two tellers behind the counter; the banknote handling apparatus 1 is configured such that it can be used by either or both of the tellers on the left and right of the banknote handling apparatus 1.

[0033] In the banknote handling apparatus 1, a control portion 3 (see Fig. 5) for controlling the overall operation of the banknote handling apparatus 1 is provided in an appropriate position of the banknote handling apparatus 1. The banknote handling apparatus 1 is also provided with an interface portion 35 (see Fig. 5) through which upper terminals 2A and 2B operated by the two tellers on the left and right of the banknote handling apparatus 1 are connected. This allows two-way communication between the upper terminals 2A and 2B and the banknote handling apparatus 1. Three ways of using the banknote handling apparatus 1 are possible: the banknote handling apparatus 1 is used by only one of the upper terminals 2A and 2B; and the banknote handling apparatus 1 is used by both of the upper terminals 2A and 2B.

[0034] The upper terminals 2A and 2B each are formed with a teller machine; personal computers or the like may be used instead. These upper terminals 2A and 2B receive from the banknote handling apparatus 1 various types of information such as unfit-note-rate information and also receive operation inputs from the two tellers, and output various types of instruction information to the banknote handling apparatus 1. Since the upper terminals 2A and 2B have substantially the same configuration, particularly when it is unnecessary to distinguish them, they are collectively referred to as the upper terminal 2 in the following description.

[0035] The configuration of the banknote handling apparatus 1 will first be schematically described with reference to Fig. 1. The banknote handling apparatus 1 has an enclosure 11; the enclosure 11 is configured such that, if when an operation surface operated by the tellers is assumed to be a front surface 111 and the opposite surface of the front surface 111 (= the outside of the counter), that is, the surface facing a customer, is a rear surface 112, the enclosure 11 has a narrow width in a lateral direction, a wide depth in a forward and backward direction and a long height in a vertical direction. The enclosure 11 is provided with an upper unit 115 and a lower

unit 116 (see Fig. 2) so that they can be drawn out from the side of the front surface of the enclosure 11.

[0036] On the front side of the upper surface of and the upper side of the front surface of the upper unit 115, there are arranged an upper surface operation portion 117 and a front surface operation portion 118, respectively. In the upper surface operation portion 117 of the upper unit 115 (= in the front side of the upper surface of the enclosure 11), a slant surface 120 that extends forward while slanting downward and a substantially horizontal surface 121 are formed in this order from the front side. In the horizontal surface 121, a banknote dispensing outlet 122 through which banknotes are dispensed and a banknote depositing inlet 123 through which banknotes are deposited are formed in this order from the front side. On the left and right sides of the banknote dispensing outlet 122 and the banknote depositing inlet 123, there are arranged occupancy buttons 124 for indicating which one of the tellers on the left and right occupies the depositing process or the dispensing process. On the left side of the banknote dispensing outlet 122 and the banknote depositing inlet 123, there is arranged a display portion 125 (corresponding to a display unit) that displays a location where a banknote jam occurs and the number of remaining banknotes, a loss of shape rate and the like. The occupancy buttons 124 each incorporate a lamp; the lamp lights when the banknote handling apparatus 1 is occupied by being pressed.

[0037] The display portion 125 is formed with an LCD (liquid crystal display) or the like; in the screen of the display portion 125, an operation portion 125a (corresponding to a part of an update determination unit) is integrally formed with a touch panel or the like for receiving operation inputs from the tellers.

[0038] In the front surface operation portion 118 of the upper unit 115, there is formed an opening portion 126 through which banknotes determined to be returned due to the non-approval for money depositing after deposited banknotes are escrowed at the time of depositing process are taken out; the opening portion 126 is blocked by a front door 136.

[0039] Below the banknote dispensing outlet 122 and the banknote depositing inlet 123 of the upper unit 116, there are arranged a box-shaped banknote dispensing portion 132 and a box-shaped banknote depositing portion 133 (see Fig. 2), respectively, that house banknotes in an upright position with the short edge of the rectangular banknotes in parallel with a vertical direction. In the banknote dispensing outlet 122, a transparent shutter 134 that closes the banknote dispensing outlet 122 while money is dispensed and that opens it at the time of the completion of the dispensing of money is arranged such that the transparent shutter 134 can be opened and closed, and visual confirmation can be performed through the transparent shutter 134 closed while banknotes are being delivered into the banknote dispensing portion 132.

[0040] Inside the opening portion 126 of the front surface of the upper unit 115 (that is, in a front side region of the enclosure 11), there is arranged a deposited banknote escrow portion 135 (see Fig. 2) that receives deposited banknotes recognized to be fit notes (= genuine banknotes) and that collectively escrows the banknotes of different denominations. When the money depositing is not approved, the teller can take out the banknotes escrowed in the deposited banknote escrow portion 135 through the opening portion 126 by holding a knob 137 provided on the front door 136 and by opening the front door 136 forward from the opening portion 126..

[0041] The configuration of the banknote handling apparatus 1 will now be described in detail with reference to Fig. 2. In the upper unit 115, there is provided an upper unit banknote transport portion 140 that is connected to the banknote dispensing portion 132, the banknote depositing portion 133 and the deposited banknote escrow portion 135 and that transports banknotes. The upper unit banknote transport portion 140 is provided with: a dispensing transport path portion 141 that transports a banknote to the banknote dispensing portion 132; a depositing transport path portion 142 that transports a banknote fed from the banknote depositing portion 133; an escrow transport path portion 143 that is connected to a halfway portion of the dispensing transport path portion 141 and that transports a banknote between the halfway portion and the deposited banknote escrow portion 135; a recognition transport path portion 144 which is folded back from the back to the front into an approximate U-shape and whose one end on the upper side is connected to the banknote transport portion 142; a bypass transport path portion 145 that connects the one end on the upper side of the recognition transport path portion 144 and the other end on the lower side; an escrow dispensing transport path portion 146 that connects between the dispensing transport path portion 141 and the one end (the upper end of the bypass transport path portion 145) on the upper side of the recognition transport path portion 144; a rejected banknote transport path portion 147 that is connected to the escrow dispensing transport path portion 146 and that extends forward; and a storing/dispensing transport path portion 148 which is connected to the other end (the lower end of the bypass transport path portion 145) on the lower side of the recognition transport path portion 144, which extends forward and whose front end is connected to the rejected banknote transport path portion 147.

[0042] At least the dispensing transport path portion 141, the escrow transport path portion 143, the recognition transport path portion 144, the escrow dispensing transport path portion 146 and the storing/dispensing transport path portion 148 can change the banknote transport direction to either a forward or reverse direction. At the portions connected between the transport path portions 141 to 144 and 145 to 148, there are provided switching members 149 that switch the banknote movement direction. On the recognition transport path portion 144, there is provided a banknote recognition portion 150

that recognizes the denomination, the direction, the authenticity, the fitness and the like of a banknote that is transported to the recognition transport path portion 144. The "denomination" refers to the type of banknote, the "authenticity" indicates whether or not money is counterfeit (whether it is authentic or counterfeit) and the "fitness" indicates whether or not the banknote is a proper banknote that satisfies predetermined criteria (for example, criteria for the degrees of soil, damage and the like). The "direction" includes obverse or back face and forward or reverse orientations.

[0043] The configuration of the banknote recognition portion 150 will now be described in more detail with reference to Figs. 3 and 4. Fig. 3 shows a cross-sectional view of the banknote recognition portion 150; Fig. 4 shows a diagram of the arrangement of sensors in the banknote recognition portion 150, as seen from above. As shown in these figures, the banknote recognition portion 150 includes timing sensors 701 and 705, a line sensor 702, magnetic heads 703, a thickness detection roller 704a, an opposite roller 704b and a thickness detection lever 704c. The banknote recognition portion 150 transports a banknote transported from the entrance side (the left side of Fig. 3) to the exit side (the right side of Fig. 3).

[0044] The timing sensor 701 detects the banknote transported from the entrance side of the banknote recognition portion 150. When the banknote is detected, the capture of an image and the like by the line sensor 702 in the subsequent stage is started.

[0045] The line sensor 702 is arranged in the stage subsequent to the timing sensor 701, and eradiates visual light (greenish yellow light having a wavelength of about 570 nm) to the banknote transported. The line sensor 702 acquires data on the image of the banknote by using the reflected light. The data on the image is used to recognize the denomination of the banknote, the direction of the banknote and the like. Moreover, the line sensor 702 eradiates the visual light and IR light (infrared light having a wavelength of about 940 nm) to the banknote, and receives the transmitted light. The degree of loss of shape (such as a hole or lack) of and the degree of stain of the banknote are detected using the transmitted light.

[0046] As the degree of loss of shape of the banknote becomes high, the region of light (light that is not attenuated by transmission) that passes through the banknote without being blocked is increased in size. Hence, the detection of the size of the region allows the degree of loss of shape of the banknote to be detected. As the degree of stain of the banknote becomes high, the transmitted light is more likely to be attenuated by foreign matter and the like attached to the banknote. Hence, the detection of the degree of attenuation of the transmitted light enables to detect the degree of stain of the banknote to be detected.

[0047] As a specific method of evaluating the degree of shape loss of the banknote, a method is employed of assuming, for example, a plurality of regions (assuring that no loss of shape is present) obtained by dividing the banknote, detecting and digitizing the degree of attenuation of light in each region and totalizing the number of regions (regions where light is attenuated slightly) where the light actually passes through the banknote. As a specific method of evaluating the degree of stain of the banknote, a method is employed of assuming, for example, a plurality of regions obtained by dividing the banknote, detecting the degree of attenuation of light in each region and calculating the average of these detection results. Any other method may be used as long as the use of the method allows the degree of shape loss or stain of the banknote to be evaluated.

[0048] In the stage subsequent to the line sensor 702, two magnetic heads 703 are provided in each of the areas above and below the banknote transport path, and acquire data on the magnetic pattern of the banknote transported. The data on the magnetic pattern is used for determination of the denomination and authenticity of the banknote and the like.

[0049] The thickness detection roller 704a is provided in the stage subsequent to the magnetic heads 703. The opposite roller 704b is arranged opposite to the thickness detection roller 704a through the banknote transport path. Hence, when the banknote is transported between the rollers 704a and 704b, the thickness detection roller 704a is displaced upward according to the thickness of the banknote. The thickness detection lever 704c amplifies the magnitude of this movement by using the principle of leverage. The magnitude of the movement thus amplified is detected optically or magnetically. Sensors for detesting the amount of displacement are provided on the left and right of the thickness detection roller 704a, and can detect as length information in a case where tape is attached to the banknote, a case where a corner of the banknote is folded, a state where two banknotes are stacked and the like. Thus, it is possible to detect the degree of abnormal thickness of the banknote.

[0050] The timing sensor 705 is provided in the stage subsequent to the thickness detection roller 704a, and detects the banknote transported from the preceding stage.

[0051] The banknote dispensing portion 132 is provided with: a blade wheel 153 that feeds banknotes transported through the dispensing transport path portion 141 into the banknote dispensing portion 132 in an upright position on a one-by-one basis; and a lift 154 that receives, in an upright position, the banknotes received by the blade wheel 153 and that moves according to the number of banknotes received so that the position where the banknotes are received is stationery and that the banknotes are placed in the forward area in proper alignment while being kept in an upright position.

[0052] The banknote depositing portion 133 is provided with: a lift 157 that receives deposited banknotes in an upright position; a kick roller 158 that feeds downward one by one the banknotes that are placed in an upright position and in proper alignment by being pushed by the

lift 157 which moves at the start of the depositing process; and a feed roller 159 and a gate roller 160 that hold the banknotes fed by the kick roller 158 and feed them to the depositing transport path portion 142.

[0053] In the deposited banknote escrow portion 135, the escrow transport path portion 143 is connected to the upper side of the rear surface thereof, the upper side of the rear surface slants backward and downward and the banknotes are stacked, with the sides of the banknotes pointing in a vertical direction, on a stacking plate 165 that moves up and down within the deposited banknote escrow portion 135 between a front wall 163 serving as the front door 136 and a rear wall 164 that cover an escrow space portion 135a in the deposited banknote escrow portion 135.

[0054] The deposited banknote escrow portion 135 is provided with a feeding and receiving unit 166 that feeds, from the escrow transport path portion 143, deposited banknotes into the deposited banknote escrow portion 135 on a one-by-one basis and that receive, when the money depositing is approved, the escrowed banknotes to the escrow transport path portion 143 on a one-by-one basis. This feeding and receiving unit 166 operates together with the stacking plate 165, which moves up and down with the banknotes thereon. The feeding and receiving unit 166 is provided with: a plurality of feed rollers 167 and gate rollers 168 that are arranged in an axial direction, that receive banknotes from the escrow transport path portion 143 into the deposited banknote escrow portion 135 and that feed out banknotes form the deposited banknote escrow portion 135 to the escrow transport path portion 143; a kick roller 169 that feeds out, when banknotes are fed out, the escrowed banknotes placed on the stacking plate 165 to between the feed rollers 167 and the gate rollers 168 on a one-by-one basis; and the like.

[0055] In the lower unit 116, in the front side region of the enclosure 11, a removable box 171 that stores gift certificates and the like is removably arranged, and a reject box 172 that stores rejected banknotes is fixedly arranged.

[0056] In a region behind the reject box 172, type-by-type banknote storing portions 173 that store banknotes type by type are fixedly arranged in the forward and backward direction. Above the type-by-type banknote storing portions 173, there are arranged stacking mechanism portions 180 and banknote feeding mechanism portions 174 that feed banknotes one by one. In a region above the type-by-type banknote storing portions 173, there is arranged a lower unit banknote transport portion 175 that connects to the banknote feeding mechanism portions 174 to transport the banknotes. In a rearmost portion of the lower unit 116, there is formed an additional space 176 that allows a type-by-type banknote storing portion 173 to be additionally provided as necessary.

[0057] In the reject box 172, there is arranged a feed-in unit 177 that can feed in banknotes through an upper portion of the reject box 172 one by one. In the type-by-type banknote storing portion 173, a stacking plate 178 is provided such that it can move up and down; banknotes are stacked on the stacking plate 178 with the sides of the banknotes pointing in the vertical direction.

[0058] The lower unit banknote transport portion 175 is provided with: a main transport path portion 179 that is arranged along the upper regions of the type-by-type banknote storing portions 173 in the forward and backward direction; the stacking mechanism portions 180 that transport banknotes fed from the main transport path portion 179 into the type-by-type banknote storing portions 173; and feed-out transport path portions 181 that transport banknotes fed from the type-by-type banknote storing portions 173 to the main transport path portion 179. At the portions connected between the transport path portions 179 to 181, there are provided stitching members 182 that switch the direction in which the banknote moves. The main transport path portion 179 in the lower unit banknote transport portion 175 can reverse the banknote transport direction to either a forward direction or a reverse direction.

[0059] The banknote feeding mechanism portion 174 operates together with the stacking plate 178, which moves up and down with the banknotes thereon. The banknote feeding mechanism portion 174 is provided with: stack rollers 183 and 184 that collect, when banknotes are stored, banknotes from the stacking mechanism portions 180 onto the stacking plate 178; a kick roller 185 that feeds out, when banknotes are fed out, banknotes on the stacking plate 178 one by one; and a feed-out roller 186 and a gate roller 187 that feed out the banknote fed out by the kick roller 185 to the feed-out transport path portion 181.

[0060] When banknotes are fed into the type-by-type banknote storing portion 173, since the height of the upper surface of a stack of banknotes is increased each time a banknote is placed on the stacking plate 178, the stacking plate 178 is sequentially lowered to receive the banknote such that the height of the upper surface for collection and storage is kept within a predetermined range. When banknotes are fed from the type-by-type banknote storing portions 173, the stacking plate 178 is raised to press the banknote onto the kick roller 185, and the banknote is fed out by the rotation of the kick roller 185 one by one.

[0061] In the enclosure 11, a plate-shaped cover member 190 is fixed between the upper unit 115 and the lower unit 116 so as to cover the upper surface of the lower unit 116 housed in the enclosure 11 to block the lower unit 116. In the front end side of the cover member 190, there are formed a first opening portion 191 and a second opening portion 192. In the first opening portion 191, there is arranged a first connection passage portion 193 that connects the front end side of the storing/dispensing transport path portion 148 of the upper unit banknote transport portion 140 to the front end side of the lower unit banknote transport portion 175 and that transports banknotes; in the second opening portion 192, there is

formed a second connection passage portion 194 that connects the rejected banknote transport path portion 147 of the upper unit banknote transport portion 140 to the reject box 172 and that transports banknotes.

[0062] Fig. 5 is a block diagram showing an example of the electrical configuration of the banknote handling apparatus 1 and the upper terminals 2A and 2B. As described above, the banknote handling apparatus 1 includes the operation portion 125a, the display portion 125 and the control portion 3; the control portion 3 includes a CPU 31, a RAM 32, a ROM 33, a HDD 34, the interface portion 35, the banknote recognition portion 150 and a bus 36.

[0063] The CPU (central processing unit) 31 is connected through the bus 36 to the RAM 32, the ROM 33, the HDD 34 and the interface portion 35, and is connected through the interface portion 35 to various sensors, motors and the like (not shown) provided in the banknote handling apparatus 1 such that the CPU 31 can communicate with them; the CPU 31 controls the overall movement of the banknote handling apparatus 1.

[0064] The RAM (random access memory) 32 stores various types of freely readable and writable information such as that on the deterioration of a banknote. The ROM (read only memory) 33 stores a control program read by the CPU 31 and the like. The HDD (hard disk drive) 34 stores various types of information such that they can be freely read and written. The interface portion 35 is connected to be able to communicate with the upper terminals 2A and 2B, a banknote transport drive control portion 36, which control motors and the like (not shown) driving various sensors, various rollers, and a banknote recognition portion 150.

[0065] The upper terminal 2A (upper terminal 2B) includes an operation portion 27, a display portion 28 and a control portion 20; the control portion 20 includes a CPU 21, a RAM 22, a ROM 23, a HDD 24, an interface portion 25 and a bus 26. The operation portion 27 is composed of a keyboard, a mouse and the like, and receives operational inputs from the tellers. The display portion 28 (corresponding to part of a transition display unit) is composed of an LCD (liquid crystal display) and the like; the display portion 28 displays various types of information such as a graph showing the transition of an unfit-note rate described later such that the teller can view them.

[0066] The CPU (central processing unit) 21 is connected through the bus 26 to the RAM 22, the ROM 23, the HDD 24 and the interface portion 25, and is connected through the interface portion 25 to the operation portion 27, the display portion 28 and the like such that the CPU 21 can communicate with them; the CPU 21 controls the overall operation of the upper terminal 2A (upper terminal 2B).

[0067] The RAM (random access memory) 22 stores various types of freely readable and writable information such as unfit-note-rate information for banknotes such that they can be The ROM (read only memory) 23 stores a control program read by the CPU 31 and the like. The HDD (hard disk drive) 24 stores various types of information such that they can be freely read and written. The interface portion 25 is connected to the banknote handling apparatus 1, the operation portion 27, the display portion 28 and the like such that the interface portion 25 can communicate with them.

[0068] Fig. 6 is a block diagram showing an example of the configuration of main portions of the banknote handling apparatus 1 according to the present invention. The CPU 31 of the banknote handling apparatus 1 functionally includes a target unfit-note-rate receiving portion 310, a deterioration detection portion 311, a virtual reference value setting portion 312, a first unfit note determination portion 313, a second unfit note determination portion 314, an unfit-note-rate calculation portion 315, an update determination portion 316, an update execution portion 317, a display control portion 318 and an unfit-note-rate transmission portion 319. The RAM 32 functionally includes a target unfit-note-rate storage portion 321, a deterioration information storage portion 322, a determination criterion value storage portion 323 and a determination result storage portion 324.

[0069] Here, the CPU 31 reads and performs the control program previously stored in the ROM 33 and the like shown in Fig. 5, with the result that the CPU 31 functions as functional portions such as the target unfit-note-rate receiving portion 310, the deterioration detection portion 311, the virtual reference value setting portion 312, the first unfit note determination portion 313, the second unfit note determination portion 314, the unfit-note-rate calculation portion 315, the update determination portion 316, the update execution portion 317, the display control portion 318 and the unfit-note-rate transmission portion 319, and that the RAM 32 functions as functional portions such as the target unfit-note-rate storage portion 321, the deterioration information storage portion 322, the determination criterion value storage portion 323 and the determination result storage portion 324.

[0070] Of various types of data stored in the RAM 32 and the ROM 33 shown in Fig. 5, data that can be stored in a removable recording medium may be such that the data can be read by a driver such as the HDD 34 shown in Fig. 5, an optical disc drive, a flexible disc drive, a silicon disc drive or a cassette medium reading machine.

[0071] The target unfit-note-rate storage portion 321 (corresponding to a target unfit-note-rate storage unit) is a functional portion that previously stores a target unfit-note rate R0 which is the target of an unfit-note rate. The target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321 is recorded (written) by the target unfit-note-rate receiving portion 310 and is read by the update determination portion 316. Here, the target unfit-note rate R0 is set for each of denominations, and corresponds to each of the loss of shape, the stain and the abnormal thickness.

[0072] For example, when there are seven denomina-

tions, namely, 5 euro, 10 euro, 20 euro, 50 euro, 100 euro, 200 euro and 500 euro, 21 (= 7 × 3) target unfit-note rates R0 alone are set. Here, the "loss of shape" refers to damage in which part of a banknote is lost; the "stain" refers to damage in which a banknote is stained; and the "abnormal thickness" refers to damage in which tape or the like is attached to a banknote. In the following description, the loss of shape, the stain and the abnormal thickness are collectively referred to as "unfit-note factors."

[0073] The deterioration information storage portion 322 (corresponding to a deterioration information storage unit) is a functional portion that previously stores banknote deterioration information indicating the deteriorated state of each of banknotes accepted. The banknote deterioration information stored in the deterioration information storage portion 322 is recorded (written) by the deterioration detection portion 311 and is read by the first unfit note determination portion 313 and the second unfit note determination portion 314. The banknote deterioration information stored in the deterioration information storage portion 322 is deterioration information (= loss of shape information, stain information and abnormal thickness information) corresponding to each of the loss of shape, the stain and the abnormal thickness.

[0074] The determination criterion value storage portion 323 is a functional portion for storing an execution determination criterion value which is an unfit-note determination criterion value corresponding to one level that is previously input and set from a predetermined number of three or more unfit-note determination criterion values (here, assume an example of ten levels). Information on the execution determination criterion value stored in the determination criterion value storage portion 323 is updated by the update execution portion 317 and is read by the virtual reference value setting portion 312 and the first unfit note determination portion 313. The unfit-note determination criterion values corresponding to the ten levels are threshold information for determining whether or not a banknote is an unfit note; necessary values are input from outside and are stored in the determination criterion value storage portion 323. The first unfit note determination portion 313 and the second unfit note determination portion 314 determine whether or not a banknote is an unfit note based on the unfit-note determination criterion values.

[0075] The execution determination criterion value stored in the determination criterion value storage portion 323 is set for each of denominations and corresponds to each of the loss of shape, the stain and the abnormal thickness. For example, when the seven denominations described above are present, 21 (= 7 × 3) execution determination criterion values alone are set.

[0076] The determination result storage portion 324 is a functional portion that stores the result (= whether a banknote is an unfit note) obtained by determination through the first unfit note determination portion 313 and the second unfit note determination portion 314. The determination result stored in the determination result storage portion 324 is read by the unfit-note-rate calculation portion 315. The determination result stored in the determination result storage portion 324 is classified for each of denominations according to the result obtained by determining a fitness for each criterion, is classified according to the loss of shape, the stain and the abnormal thickness and is then stored.

[0077] The target unfit-note-rate receiving portion 310 is a functional portion that receives a target unfit-note rate either set by an operator with the upper terminal 2 (target value transmission portion 214 shown in Fig. 8) or determined by a program, and that records (= writes) it in the target unfit-note-rate storage portion 321.

[0078] In the banknote handling apparatus 1, banknotes whose denominations have been determined by the recognition of the banknotes through the banknote recognition portion 150 are considered to be banknotes accepted. The deterioration detection portion 311 (corresponding to part of a deterioration detection unit) is a functional portion that generates the banknote deterioration information indicating the deteriorated state of the banknote accepted and that records it in the deterioration information storage portion 322. Here, the banknote deterioration information is deterioration information (= loss of shape information, stain information and abnormal thickness information) on unfit-note factors for the loss of shape, the stain and the abnormal thickness. The deterioration detection portion 311 generates, based on signals from the banknote recognition portion 150, the loss of shape information, the stain information and the abnormal thickness information as evaluation values (= a loss of shape evaluation value, a stain evaluation value and an abnormal evaluation thickness value) composed of, for example, 256 levels (= any value of 0 to 255). As the evaluation value increases, it indicates that the degree of damage of a banknote becomes higher.

[0079] The virtual reference value setting portion 312 (corresponding to a virtual reference value setting unit) is a functional portion for setting and storing in its internal storage portion at least one unfit-note determination criterion value, which is deviated from the execution determination criterion value, and selected on each of strict and relaxing sides from a predetermined number of two or more unfit-note determination criterion values (assume that they are input and set from ten levels ranging from "0" to "9") as a virtual determination criterion value. Unfit-note determination criterion (this process is called a "virtual reference value setting step"). The virtual reference value setting portion 312 sets, as the virtual determination criterion value, each unfit-note determination criterion value corresponding to one level on each of the strict and relaxing sides with respect to the execution determination criterion value from a predetermined number of two or more unfit-note determination criterion values. For example, when the level of the execution determination criterion value is "4," the virtual reference value setting portion 312 sets and stores, as the virtual de-

termination criterion values, criterion values of levels "3" and "5."

[0080] The virtual reference value setting portion 312 sets and stores a virtual determination criterion value that is set for each of denominations and that corresponds to each of the loss of shape, the stain and the abnormal thickness. Here, the virtual reference value setting portion 312 sets and stores 42 (= 7 (denominations) × 3 (unfit-note factors) × 2) virtual determination criterion values.

[0081] The first unfit note determination portion 313 (corresponding to a first unfit note determination unit) is a functional portion that determines, based on the banknote deterioration information stored in the deterioration information storage portion 322 and the execution determination criterion value stored in the determination criterion value storage portion 323, whether or not a banknote is an unfit note for each of banknotes previously and successfully passing denomination recognition, that is, of banknotes accepted, and records (add the corresponding value) the determination result in the determination result storage portion 324 (this process is called a "first unfit note determination step"). The first unfit note determination portion 313 determines whether or not a banknote is an unfit note each time when the banknote deterioration information is generated by the deterioration detection portion 311. The first unfit note determination portion 313 determines whether or not a banknote is an unfit note on each of the loss of shape, the stain and the abnormal thickness.

[0082] Specifically, the first unfit note determination portion 313 reads from the determination criterion value storage portion 323 execution determination criterion values on the loss of shape, the stain and the abnormal thickness corresponding to the denominations of the banknotes accepted, that is, reads the execution determination criterion values from the ROM 33 shown in Fig. 5, and determines whether or not a banknote is an unfit note by cheeking whether or not the loss of shape evaluation value, the stain evaluation value and the abnormal thickness evaluation value generated by the deterioration detection portion 311 are greater than the corresponding criterion values, respectively.

[0083] The second unfit note determination portion 314 (corresponding to a second unfit note determination unit) is a functional portion that determines, based on the banknote deterioration information stored in the deterioration information storage portion 322 and the virtual determination criterion value set and stored by the virtual reference value setting portion 312, whether or not a banknote is an unfit note for each of the banknotes accepted, and records (i.e. add the corresponding value) the determination result in the determination result storage portion 324 (this process is called a "second unfit note determination step"). The second unfit note determination portion 314 determines whether or not a banknote is an unfit note each time when the banknote deterioration information is generated by the deterioration detection portion 311. The second unfit note determination portion 314 determines whether or not a banknote is an unfit note on each of the loss of shape, the stain and the abnormal thickness.

[0084] Specifically, The second unfit note determination portion 314 determines whether or not a banknote is an unfit note by cheeking whether or not the loss of shape evaluation value, the stain evaluation value and the abnormal thickness evaluation value generated by the deterioration detection portion 311 are greater than the corresponding criterion values, respectively with respect to the virtual determination criterion values on the loss of shape, the stain and the abnormal thickness, which correspond to the denominations of the banknote accepted and are taken from the virtual determination criterion values set and stored by the virtual reference value setting portion 312,.

[0085] The unfit-note-rate calculation portion 315 (corresponding to an unfit-note-rate calculation unit) is a functional portion that determines a ratio (hereinafter, also referred to a "current unfit-note rate") of the number of banknotes determined as unfit notes by the first unfit note determination portion 313 to the total number of banknotes accepted and a ratio (hereinafter, also referred to a "virtual unfit-note rate") of the number of banknotes determined as unfit notes by the second unfit note determination portion 314 to the total number of banknotes accepted. Hereinafter, the process for calculating the unfit-note rates in this way is also referred to as an "unfit-note-rate calculation step." The unfit-note-rate calculation portion 315 determines the current unfit-note rate and the virtual unfit-note rate (hereinafter, they are also collectively referred to simply as an "unfit-note rate") as to each of the loss of shape, the stain and the abnormal thickness for each of denominations of banknotes.

[0086] The unfit-note-rate calculation portion 315 (corresponding to an unfit-note-rate calculation unit) is a functional portion that determines unfit-note rates, that is, a ratio of the number of banknotes determined as unfit notes by the first unfit note determination portion 313 to the total number of banknotes accepted and a ratio of the number of banknotes determined as unfit notes by the second unfit note determination portion 314 to the total number of banknotes accepted (this process is called an "unfit-not-rate calculation step"). The unfit-note-rate calculation portion 315 determines the unfit-note rate as to each of the loss of shape, the stain and the abnormal thickness for each of denominations of banknotes.

[0087] Specifically, since the virtual reference value setting portion 312 sets and stores, as the virtual determination criterion value, each one of unfit-note determination criterion values adjacent to the execution determination criterion value on each of the strict and relaxing sides, the unfit-note-rate calculation portion 315 determines unfit-note rates R1, R2 and R3 for the execution determination criterion value, the virtual determination criterion value adjacent to the execution determination criterion value on the strict side and the virtual determi-

nation criterion value adjacent to the execution determination criterion value on the relaxing side, respectively. For example, when the level of the execution determination criterion value is "4" and the virtual reference value setting portion 312 sets and stores, as the virtual determination criterion values, the criterion values of the levels "3" and "5," the unfit-note-rate calculation portion 315 determines the unfit-note rates R1, R2 and R3 for the unfit-note determination criterion values of the levels "4", "3" and "5", respectively.

[0088] The update determination portion 316 (corresponding to an update determination unit) is a functional portion that determines, based on the unfit-note rates R1, R2 and R3 calculated by the unfit-note-rate calculation portion 315 and the target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321, whether or not the execution determination criterion value is to be updated with any one of the virtual determination criterion values set and stored by the virtual reference value setting portion 312 (whether or not the virtual determination criterion value needs to be set as an execution determination criterion value for the subsequent rounds) each time when a predetermined time period (for example, one month) that has been previously set elapses or a predetermined number of receiving processed banknotes (for example, 10000 banknotes) are reached. Here, the "number of receiving processed banknotes" refers to the total number of banknotes whose denominations have been determined by the banknote recognition portion 150 among banknotes accepted. The update determination portion 316 determines whether or not the execution determination criterion value is to be updated on each of the loss of shape, the stain and the abnormal thickness, for each of denominations of banknotes.

[0089] Specifically, the update determination portion 316 determines whether or not the update is performed based on whether or not the unfit-note determination criterion value corresponding to an unfit-note rate closest to the target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321 among the unfit-note rates R1, R2 and R3 calculated by the unfit-note-rate calculation portion 315 is the execution determination criterion value. In other words, when the unfit-note rate R1 corresponding to the execution determination criterion value among the unfit-note rates R1, R2 and R3 calculated by the unfit-note-rate calculation portion 315 is closest to the target unfit-note rate R0, the update determination portion 316 determines that the update is not performed; when the unfit-note rate R2 or the unfit-note rate R3 corresponding to the virtual determination criterion value is closest to the target unfit-note rate R0, the update determination portion 316 determines that the update is performed.

[0090] The update execution portion 317 (corresponding to an update execution unit) is a functional portion that updates the execution determination criterion value to the virtual determination criterion value when the update determination portion 316 determines that the virtual determination criterion value is set as the execution determination criterion value. The update execution portion 317 updates the execution determination criterion value on each of the loss of shape, the stain and the abnormal thickness, for each of denominations of banknotes.

[0091] Specifically, the update execution portion 317 updates the execution determination criterion value with the unfit-note determination criterion value that corresponds to the unfit-note rate closest to the target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321 among the unfit-note rates R1, R2 and R3 calculated by the unfit-note-rate calculation portion 315.

[0092] Fig. 7 is a table showing an example of the update of the execution determination criterion value by the update execution portion 317. For ease of the following description, the "unfit-note determination criterion value", the "execution determination criterion value" and the "virtual determination criterion value" are also formally referred to as an "unfit-note determination level", an "execution determination level" and a "virtual determination level", respectively. A description will be given of a case where the execution determination level is set at "4" for all of the loss of shape, the stain and the abnormal thickness, and the target unfit-note rate is set at "10%" for all of the loss of shape, the stain and the abnormal thickness. Table (a) is a table showing an example of information on the number of unfit notes determined by the first unfit note determination portion 313 and the second unfit note determination portion 314 and stored in the determination result storage portion 324. Table (b) is a table showing an example of the unfit-note-rate information calculated by the unfit-note-rate calculation portion 315. Table (c) is a table showing an example of the absolute value of a difference between the unfit-note rate calculated by the unfit-note-rate calculation portion 315 and the target unfit-note rate stored in the target unfit-note-rate storage portion 321.

[0093] As shown in Table (a), the number of unfit notes corresponding to each of the execution determination level (= unfit-note determination level "4") and the virtual determination levels (= unfit-note determination levels "3" and "5") for each of the unfit-note factors, namely, the loss of shape, the stain and the abnormal thickness is stored in the determination result storage portion 324. Here, "level 1" indicates a virtual determination level (unfit-note determination level "3" in this case) adjacent to the execution determination level on the relaxing side; "level ± 0" indicates the execution determination level (unfit-note determination level "4" in this case); and "level + 1" indicates a virtual determination level (unfit-note determination level "5" in this case) adjacent to the execution determination level on the strict side. For example, with respect to the abnormal thickness, the number of unfit notes corresponding to unfit-note determination level "3" (that is, when the unfit-note determination level is set at the execution determination level or the virtual determination level) is 399, the number of unfit notes corresponding to unfit-note determination level "4" is 405

and the number of unfit notes corresponding to unfit-note determination level "5" is 525. The total number of unfit notes is 10068.

[0094] As shown in Table (b), for example, with respect to the abnormal thickness, the unfit-note rate R2 corresponding to unfit-note determination level "3" is 3.96%; the unfit-note rate R1 corresponding to unfit-note determination level "4" is 4.02%; and the unfit-note rate R3 corresponding to unfit-note determination level "5" is 5.21 %. Moreover, as shown in Table (c), for example, with respect to the abnormal thickness, the absolute value of a difference between the unfit-note rate R2 corresponding to unfit-note determination level "3" and the target unfit-note rate R0 (here, 10%) is 6.04%; the absolute value of a difference between the unfit-note rate R1 corresponding to unfit-note determination level "4" and the target unfit-note rate R0 is 5.98%; and the absolute value of a difference between the unfit-note rate R3 corresponding to unfit-note determination level "5" and the target unfit-note rate R0 is 4.79%. Since the absolute value of the difference between the unfit-note rate R3 corresponding to unfit-note determination level "5" and the target unfit-note rate R0 is smallest, the update execution portion 317 updates the execution determination level with the unfit-note determination level "5." Likewise, as indicated by a heavy-line frame, with respect to the loss of shape and the stain, the update execution portion 317 updates the execution determination levels with unfit-note determination level "5" and unfit-note determination level "3", respectively. As described above, when a plurality of virtual unfit-note rates closer to the target unfit-note rate than the current unfit-note rate are present, the update execution portion 317 selects the virtual unfit-note rate closest to the target unfit-note rate from the plurality of virtual unfit-note rates. The execution determination level is updated such that the virtual determination level corresponding to the selected virtual unfit-note rate is set as the execution determination level for the subsequent rounds.

[0095] The functional configuration of the CPU 31 will be described with reference back to Fig. 6. The display control portion 318 (corresponding to a display control unit) is a functional portion that displays the unfit-note rates R1, R2 and R3 determined by the unfit-note-rate calculation portion 315 through the display portion 125 such that the teller can view them (see Fig. 14).

[0096] The unfit-note-rate transmission portion 319 (corresponding to an unfit-note-rate transmission unit) is a functional portion that transmits the unfit-note information determined by the unfit-note-rate calculation portion 315 through the interface portion 35 shown in Fig. 5 to the upper terminal 2 such that the unfit-note information corresponds to denomination information, unfit-note factor information and the unfit-note determination criterion value.

[0097] Fig. 8 is a block diagram showing an example of the configuration of main portions of the upper terminal 2. The CPU 21 of the upper terminal 2 functionally includes an unft-note-rate receiving portion 211, a transition display portion 212, a target value setting portion 213 and a target value transmission portion 214. The RAM 22 functionally includes an unft-note-rate storage portion 221.

[0098] Here, the CPU 21 reads and performs the control program previously stored in the ROM 23 and the like shown in Fig. 5. Thefre, the CPU 21 functions as functional portions such as the unfit-note-rate receiving portion 211, the transition display portion 212, the target value setting portion 213 and the target value transmission portion 214, and the RAM 22 functions as functional portions such as the unfit-note-rate storage portion 221.

[0099] The unfit-note-rate storage portion 221 (corresponding to an unfit-note-rate storage unit) is a functional portion that stores the unfit-note-rate information received by the unfit-note-rate receiving portion 211 with the unfit-note-rate information corresponding to the denomination information, the unfit-note factor information and the unfit-note determination criterion value. The unfit-note-rate information stored in the unfit-note-rate storage portion 221 is read by the transition display portion 212.

[0100] The unfit-note-rate receiving portion 211 is a functional portion that receives the unfit-note-rate information corresponding to the denomination information, the unfit-note factor information and the unfit-note determination criterion value from the banknote handling apparatus 1 (the unfit-note-rate transmission portion 319 shown in Fig. 6) through the interface portion 25 shown in Fig. 5, and that records (= writes) the received unfit-note-rate information in the unfit-note-rate storage portion 221 such that the unfit-note-rate information corresponds to the denomination information, the unfit-note factor information and the unfit-note determination criterion value.

[0101] The transition display portion 212 (corresponding to part of a transition display unit) is a functional portion that produces a graph showing the transition of the unfit-note rate stored in the unfit-note-rate storage portion 221 and that display the graph through the display portion 28 such that the teller can view it. The transition display portion 212 displays a graph showing the transition of the unfit-note rate for each of the denominations and the unfit-note factors.

[0102] Fig. 9 is a diagram showing an example of a graph displayed by the transition display portion 212 on the display portion 28. For ease of description, the "execution determination criterion value" is also formally referred to as an "execution determination level." Graph (a) is a graph showing the transition of the execution determination level; graph (b) is a graph showing the transition of the unfit-note rates R1, R2 and R3. In graph (a), the horizontal axis of the figure represents the number of updates; the vertical axis represents the execution determination level. In graph (b), the horizontal axis of the figure represents the number of updates; the vertical axis represents the unfit-note rate (%). The solid line of graph (b) represents the unfit-note rate R1 corresponding to

the execution determination level; the broken line represents the unfit-note rate R2 corresponding to the virtual determination level adjacent to the execution determination level on the strict side; and the alternate long and short dashed line represents the unfit-note rate R3 corresponding to the virtual determination level adjacent to the execution determination level on the relaxing side.

[0103] As shown in graph (a), the execution determination level shifts from "4" to "7" on the strict side. Accordingly, as shown in graph (b), as the execution determination level shifts on the strict side, the unfit-note rates R1, R2 and R3 are increased, and the unfit-note rate R1 converges to about 10% which is the target unfit-note rate. In other words, it is found that, as a result of the execution determination level being properly updated by the update execution portion 317 in the banknote handling apparatus 1 (CPU 32), the unfit-note determination level for achieving the target unfit-note rate (10%) have been set.

[0104] The functional configuration of the CPU 21 will be described with reference back to Fig. 8. The target value setting portion 213 is a functional portion that receives operational inputs from the teller through the operation portion 27 and sets the target unfit-note rate based on the received operational inputs. The target value setting portion 213 sets the target unfit-note rate for each of the denominations and the unfit-note factors.

[0105] Fig. 10 is a screen diagram showing an example of a target unfit-note-rate setting screen displayed by the target value setting portion 213 on the display portion 28. Here, a description will be given of a case where the denomination is previously set. In the target unfit-note-rate setting screen 500, an abnormal thickness target unfit-note-rate display portion 501, a loss of shape target unft-note-rate display portion 502 and a stain target unfit-note-rate display portion 503 are displayed in this order from the upper side of the screen; a setting button 504 and a cancel button 505 are displayed in the lower part of the screen.

[0106] The abnormal thickness target unfit-note-rate display portion 501, the loss of shape target unfit-note-rate display portion 502 and the stain target unfit-note-rate display portion 503 are displayed such that the target unfit-note rates on the abnormal thickness, the loss of shape and the stain can be set respectively, for a predetermined denomination that has been previously set. The teller selects any one of the abnormal thickness target unfit-note-rate display portion 501, the loss of shape target unfit-note-rate display portion 502 and the stain target unfit-note-rate display portion 503 such as by clicking it with, for example, a mouse, and can input a desired target unfit-note-rate with a numeric keypad or the like provided in a keyboard.

[0107] The setting button 504 is a button that is pressed (here, for example, clicked with a mouse) when target unfit-note rates inputted into the abnormal thickness target unfit-note-rate display portion 501, the loss of shape target unfit-note-rate display portion 502 and the stain target unfit-note-rate display portion 503 are set. The cancel button 505 is a button that is pressed (here, for example, clicked with a mouse) when the setting is cancelled.

[0108] The functional configuration of the CPU 21 will be described with reference back to Fig. 8. The target value transmission portion 214 is a functional portion that transmits the target unfit-note rate set by the target value setting portion 213 through the interface portion 25 shown in Fig. 5 to the banknote handling apparatus 1 (the target unfit-note-rate receiving portion 310 shown in Fig. 6).

[0109] Fig. 11 is a flowchart showing an example of unfit note determination process performed by the banknote handling apparatus 1 (mainly by the CPU 31). Whether or not banknotes are inserted into the banknote depositing inlet 123 by the receipt of an instruction to perform depositing process from the upper terminal 2 is first checked (S 1 01). If it is determined that the instruction to perform depositing process is not received or the banknotes are not inserted (no in S101), the process remains on standby. If the banknotes are determined to have been inserted (yes in S101), the banknotes are fed out one by one and its denomination is discriminated by the banknote recognition portion 150 (S103). If the denomination is not determined, the banknote is rejected (S114). If the denomination is determined, the number of banknotes accepted is counted (S104), and then the deterioration detection portion 311 generates banknote deterioration information (= loss of shape information, stain information and abnormal thickness information) indicating the deteriorated state of the banknote accepted (S 105).

[0110] Then, the first unfit note determination portion 313 and the second unfit note determination portion 314 perform loss of shape determination process, that is, process for determining whether or not the banknote is an unfit note involving the loss of shape, on the banknote accepted in step S101 (S107). Then, the first unfit note determination portion 313 and the second unfit note determination portion 314 perform stain determination process, that is, the process for determining whether or not the banknote is an unfit note related to the stain, on the banknote accepted in step S101 (S109).

[0111] Furthermore, the first unfit note determination portion 313 and the second unfit note determination portion 314 perform abnormal thickness determination process, that is, the process for determining whether or not the banknote is an unfit note related to the abnormal thickness, on the banknote accepted in step S101 (S111). Then, if the first unfit note determination portion 313 determines, based on the execution determination criterion value, that the banknote is unfit notes, the banknote is sorted and transported to unfit-note destinations that have been set, whereas if the first unfit note determination portion 313 determines that the banknote is fit notes, the banknote is sorted and transported to fit-note destinations (S 112). Then, the deterioration detection portion

311 determines whether or not all the deposited banknotes have been fed out through the banknote depositing inlet and banknotes to be recognized are not present (S113). If the deposited banknotes are determined to be present (no in S113), the process returns to step S 103, and the process in step S 103 and the subsequent steps is repeatedly performed. If the deposited banknotes are determined not to be present (yes in S113), the process is completed.

[0112] Fig. 12 is a detailed flowchart showing an example of the loss of shape determination process performed in step S107 in the flowchart shown in Fig. 11. Here, the loss of shape determination process performed in step S107 in the flowchart shown in Fig. 11 will be described; since the similar process is performed with respect to the stain determination process and the abnormal thickness determination process performed in step S109 and step S111, respectively, in the flowchart shown in Fig. 11, the stain determination process and the abnormal thickness determination process will not be described. Here, for convenience, a description will be given of a case where the virtual reference value setting portion 312 previously sets and stores, as the virtual determination criterion value, one unfit-note determination criterion value corresponding to each level adjacent to the execution determination criterion value on each of the strict and relaxing sides. In the following description, for convenience, an unfit-note determination criterion value corresponding to a level adjacent to the execution determination criterion value on the strict side is referred to as a "reference value of the execution determination level + 1", and an unfit-note determination criterion value corresponding to a level adjacent to the execution determination criterion value on the relaxing side is referred to as a "reference value of the execution determination level - 1."

[0113] First, A loss of shape evaluation value corresponding to the loss of shape information generated in step S 105 in the flowchart shown in Fig. 11 is obtained by the deterioration detection portion 311. (S201) Then, the first unfit note determination portion 313 reads from the determination criterion value storage portion 323 the execution determination criterion value on the loss of shape for the denomination discriminated in step S103 in the flowchart shown in Fig. 11 (S202). Then, the first unfit note determination portion 313 determines whether or not the loss of shape evaluation value determined in step S201 is more than the reference value read in step S202 (S203). If the loss of shape evaluation value is determined to be the reference value or less (no in S203), the process is advanced to step S205. If the loss of shape evaluation value is determined to be more than the reference value (yes in S203), the number of unfit notes corresponding to the execution determination criterion value is increased only by one by the first unfit note determination portion 313 (S204).

[0114] If no is selected in step S203 or the process in step S204 is completed, the second unfit note determination portion 314 reads the reference value of the "execution determination level + 1" (S205). Then, the second unfit note determination portion 314 determines whether or not the loss of shape evaluation value determined in step S201 is more than the reference value read in step S205 (S206). If the loss of shape evaluation value is determined to be the reference value or less (no in step S206), the process is advanced to step S208. If the loss of shape evaluation value is determined to be more than the reference value (yes in step S206), the second unfit note determination portion 314 increases the number of unfit notes corresponding to the "execution determination level + 1" only by one (S207). Then, if no is selected in step S206 or the process in step S207 is completed, the second unfit note determination portion 314 reads the reference value of the "execution determination level - 1" (step S208). Then, the second unfit note determination portion 314 determines whether or not the loss of shape evaluation value determined in step S201 is more than the threshold value read in step S208 (S209). If the loss of shape evaluation value is determined to be the reference value or less (no in S209), the subsequent process is skipped. If the loss of shape evaluation value is determined to be more than the reference value (yes in step S209), the second unfit note determination portion 314 increases the number of unfit notes corresponding to the "execution determination level - 1" only by one (S210), and thereafter the process is returned.

[0115] Fig. 13 is a flowchart showing an example of process for automatically updating the execution determination criterion value performed by the banknote handling apparatus 1 (mainly by the CPU 31). The denomination of a banknote is first specified (S301). Then, the unfit-note-rate calculation portion 315 specifies one determination element from the loss of shape, the stain and the abnormal thickness (S303). Then, the unfit-note-rate calculation portion 315 reads from the target unfit-note-rate storage portion 321 the target unfit-note rate R0 on the determination element specified in step S303 for the denomination specified in step S301 (S305). Then, the unfit-note-rate calculation portion 315 calculates the unfit-note rate R1 corresponding to the execution determination criterion value based on the determination result stored in the determination result storage portion 324 (S307).

[0116] Then, the unfit-note-rate calculation portion 315 calculates the unfit-note rate R2 with using the reference value corresponding to the "execution determination level + 1" based on the determination result stored in the determination result storage portion 324 (S309). Then, the unfit-note-rate calculation portion 315 calculates the unfit-note rate R3 with using the reference value corresponding to the "execution determination level - 1" based on the determination result stored in the determination result storage portion 324 (S311). Then, the update determination portion 316 calculates absolute values Q1, Q2 and Q3 of differences between the unfit-note rates R1, R2 and R3 calculated in steps S307, S309 and S311,

respectively, and the target unfit-note rate R0 read in step S305 (S313).

[0117] Then, the update determination portion 316 determines whether or not the absolute value Q1 is the smallest of the absolute values Q1, Q2 and Q3 of the differences with the target unfit-note rate R0 calculated in step S313 (S315). If the absolute value Q1 is determined to be the smallest (yes in S315), the process is advanced to step S319. If the absolute value Q1 is determined not to be the smallest (no in S315), the update execution portion 317 updates the execution determination criterion value with the unfit-note determination criterion value (here, the reference value of the "execution determination level + 1" or the reference value of the "execution determination level - 1") corresponding to the smallest absolute value among the absolute values Q1, Q2 and Q3 (S317).

[0118] If no is selected in step S315 or the process in step S317 is completed, the unfit-note-rate calculation portion 315 determines whether or not the update process on all the determination elements is completed for the denomination set in step S301 (S319). If the determination element on which the update process has not been completed is determined to be present (no in step S319), the process returns to step S303, and the process in step 303 and the subsequent steps is repeatedly performed. If the update process is determined to be completed on all the determination elements (yes in S319), the unfit-note-rate calculation portion 315 determines whether or not the update process is completed for all the denominations (S321). If the denomination for which the update process has not been completed is determined to be present (not in step S321), the process returns to step S301, and the process in step 301 and the subsequent steps is repeatedly performed. If the update process is determined to be completed for all the denominations (yes in S321), the process is completed.

[0119] In this way, the banknote deterioration information indicating the deteriorated state of the banknote is previously stored in the deterioration information storage portion 322 for each of the banknotes accepted; a given number of , such as at least two, unfit-note determination criterion values other than the execution determination criterion value are set from a predetermined number of two or more unfit-note determination criterion values (here, ten levels) as the virtual determination criterion value which is a virtually set unfit-note determination criterion value.

[0120] For each of the banknotes whose denominations have been discriminated by the banknote recognition portion 150 and which have been accepted, the first unfit note determination portion 313 determines whether or not the banknote is an unfit note based on the banknote deterioration information stored in the deterioration information storage portion 322 and the execution determination criterion value. For each of the banknotes accepted, the second unfit note determination portion 314 determines whether or not the banknote is an unfit note based on the banknote deterioration information stored in the deterioration information storage portion 322 and the execution determination criterion value that has been set.

[0121] The unfit-note rate (current unfit-note rate), which is a ratio of the number of banknotes determined by the first unfit note determination portion 313 to be unfit notes to the total number of banknotes accepted is determined. The unfit-note rate (virtual unfit-note rate), which is a ratio of the number of banknotes determined by the second unfit note determination portion 314 to be unfit notes to the total number of banknotes accepted is determined. Thus, it is possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0122] In other words, if the virtual unfit-note rate determined based on the virtual determination criterion value is compared with the current unfit-note rate determined based on the execution determination criterion value, and is determined to be close to the target unfit-note rate, the execution determination criterion is updated with the virtual determination criterion, and thus it is possible to set the execution determination criterion for achieving an unfit-note rate closer to the target unfit-note rate. It is therefore possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0123] The target unfit-note rate R0, which is the target of an unfit-note rate, is previously stored in the target unfit-note-rate storage portion 321. Whether or not the virtual determination criterion value that has been set is updated to the execution determination criterion value is determined based on the calculated unfit-note rate and the target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321, for each predetermined time period that has been previously set or each time a predetermined number of banknotes that has been previously set. If it is determined that the virtual determination criterion value is set with the execution determination criterion value, the virtual determination criterion value is set and updated to the execution determination criterion value. Thus, it is possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0124] In other words, each time a predetermined time period (for example, one month) that has been previously set elapses or a predetermined number of banknotes (for example, 10000 banknotes) that have been previously set are accepted, whether or not the virtual determination criterion value needs to be set and updated to the execution determination criterion value is determined based on the current unfit-note rate, the virtual unfit-note rate and the target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321. If it is determined that the virtual determination criterion value needs to be set and updated to the execution determination criterion value, the execution determination criterion value is updated.

[0125] Hence, the execution determination criterion

value is updated such that an unfit-note rate close to the target unfit-note rate R0 is achieved, without the execution determination criterion value being updated by a user such as the teller (that is, automatically). Consequently, the unfit-note determination criterion value for achieving a desired unfit-note rate is set with a simple configuration. The execution determination criterion value may be updated and set by the operator.

[0126] Whether or not the update is performed is determined based on whether or not the unfit-note determination criterion value for generating an unfit-note rate closest to the target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321 among the calculated unfit-note rates is the execution determination criterion value. The unfit-note determination criterion value for generating the unfit-note rate closest to the target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321 among the calculated unfit-note rates is set and updated to the execution determination criterion value. Thus, it is possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0127] In other words, since the unfit-note determination criterion value corresponding to the unfit-note rate closest to the target unfit-note rate R0 stored in the target unfit-note-rate storage portion 321 among the calculated unfit-note rates is set and updated to the execution determination criterion value, when the distribution of the deterioration of the banknotes that have been accepted for a predetermined time period (or of only a predetermined number of banknotes accepted) is substantially constant, it is possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0128] In other words, the predetermined time period is set at a proper time period (for example, one month) (or the predetermined number of banknotes is set at a proper number of banknotes (for example, 10,000 banknotes)), and thus the distribution of the deterioration of the banknotes accepted becomes substantially constant. It is therefore possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0129] Moreover, each one of unfit-note determination criterion values adjacent to the execution determination level on each of the strict and relaxing sides is set as the virtual determination criterion value from a given number of two or more unfit-note determination criterion values (here, ten levels). Thus, it is possible to reliably set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0130] In other words, since one unfit-note determination criterion value for each level adjacent to the execution determination criterion level on each of the strict and relaxing sides is set as the virtual determination criterion value, the unfit-note rates R2, R1 and R3 that respectively correspond to the unfit-note determination criterion value adjacent to the execution determination criterion value on the strict side, the execution determination criterion value and the unfit-note determination criterion value adjacent to the execution determination criterion value on the relaxing side are determined. When either the unfit-note rate R2 for the unfit-note determination criterion value corresponding to a level adjacent to the execution determination criterion value on the strict side or the unfit-note rate R3 for the unfit-note determination criterion value corresponding to a level adjacent to the execution determination criterion value on the relaxing side is closer to the target unfit-note rate R0 than the unfit-note rate R1 corresponding to the execution determination criterion value, it is possible to update the execution determination criterion value with a more proper unfit-note determination criterion value. Thus, it is possible to reliably set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simple configuration.

[0131] Each time a banknote is accepted from outside, banknote deterioration information indicating the deteriorated state of the banknote accepted is generated and recorded in the deterioration information storage portion 322 and the first unfit note determination portion 313 and the second unfit note determination portion 314 generate the banknote deterioration information, whether or not the banknote is an unfit note is determined. Thus, it is possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a simpler configuration.

[0132] In other words, since the first unfit note determination portion 313 and the second unfit note determination portion 314 determine whether or not the banknote is an unfit note each time the banknote deterioration information is generated, whether or not the banknote is an unfit note is determined without a large load being placed on the CPU 31 and the like. Thus, it is possible to set the unfit-note determination criterion value for achieving a desired unfit-note rate with a much simpler configuration.

[0133] Moreover, the execution determination level corresponds to each of the loss of shape, the stain and the abnormal thickness; the banknote deterioration information corresponding to each of the loss of shape, the stain and the abnormal thickness is previously stored in the deterioration information storage portion 322; the virtual determination level is set according to each of the loss of shape, the stain and the abnormal thickness; the first unfit note determination portion 313 and the second unfit note determination portion 314 determine whether or not the banknote is an unfit note on each of the loss of shape, the stain and the abnormal thickness; and the unfit-note rate is determined on each of the loss of shape, the stain and the abnormal thickness. Thus, with a simple configuration, it is possible to set the execution determination criterion value for achieving a desired unfit-note rate on each of the loss of shape, the stain and the abnormal thickness.

[0134] Furthermore, the execution determination level corresponds to each of denominations of banknotes; the

virtual determination level is set according to each of denominations of banknotes; the banknote deterioration information is stored in the deterioration information storage portion 322 so as to correspond to the denomination information of banknotes; and the first unfit note determination portion 313 and the second unfit note determination portion 314 determine whether or not each of banknotes whose denominations have been discriminated is an unfit note. Since the unfit-note rate is determined for each of denominations of banknotes, with a simple configuration, it is possible to set the unfit-note determination level for achieving a desired unfit-note rate for each of denominations of banknotes.

[0135] Since the connection to the upper terminal 2 is available, the determined unfit-note-rate information is transmitted to the upper terminal 2 and, in the upper terminal 2, the received unfit-note-rate information is stored in the unfit-note-rate storage portion 221, the upper terminal 2 performs various types of processes (for example, displaying a graph showing the transition of the unfit-note rate) based on the unfit-note-rate information stored in the unfit-note-rate storage portion 221. Thus, it is possible to, for example, evaluate whether or not the unfit-note determination criterion value for achieving a desired unfit-note rate has been set as the execution determination criterion value.

[0136] Furthermore, the upper terminal 2 produces a graph showing the transition of the unfit-note rate stored in the unfit-note-rate storage portion 221, and displays it through the display portion 28 such that the teller can view the graph. Thus, it is possible to, for example, evaluate whether or not or the unfit-note determination criterion value for achieving a desired unfit-note rate has been set as the execution determination criterion value.

[0137] The present invention is also applicable to the following embodiments.

(A) Although the present embodiment deals with the case where the banknote handling apparatus 1 is connected to two upper terminals 2 such that they can communicate with each other, the banknote handling apparatus 1 may be connected to one upper terminal 2 such that they can communicate with each other or may be connected to three or more upper terminals 2 such that they can communicate with each other. Alternatively, the banknote handling apparatus 1 may be such that it is not connected to the upper terminal 2.

[0138] (B) Although the present embodiment deals with the case where the CPU 31 of the banknote handling apparatus 1 includes function portions such as the target unfit-note-rate receiving portion 310, the deterioration detection portion 311, the virtual reference value setting portion 312, the first unfit note determination portion 313, the second unfit note determination portion 314, unfit-note-rate calculation portion 315, the update determination portion 316, the update execution portion 317, the display control portion 318 and the unfit-note-rate transmission portion 319, at least one function portion of the target unfit-note-rate receiving portion 310, the deterioration detection portion 311, the virtual reference value setting portion 312, the first unfit-note determination portion 313, the second unfit-note determination portion 314, the unfit-note-rate calculation portion 315, the update determination portion 316, the update execution portion 317, the display control portion 318 and the unfit-note-rate transmission portion 319 may be formed with hardware such as a circuit.

[0139] (C) In the present embodiment, the virtual reference value setting portion 312 sets, as the virtual determination criterion value, the unfit-note determination criterion value corresponding to each level adjacent to the execution determination criterion value on each of the strict and relaxing sides. Specifically, the virtual reference value setting portion 312 virtually sets, as the virtual determination criterion values, an unfit-note determination criterion value at least one level away from the execution determination criterion value on the strict side and an unfit-note determination criterion value at least one level away from the execution determination criterion value on the relaxing side.

[0140] In this respect, the virtual reference value setting portion 312 may set, as the virtual determination criterion values, unfit-note determination criterion values corresponding to each two or more levels (two or more levels that are set closest to the execution determination criterion value) adjacent to the execution determination criterion value on each of the strict and relaxing sides. Specifically, the virtual reference value setting portion 312 may virtually set, as the virtual determination criterion values, two or more unfit-note determination criterion values respectively at least one level away from the execution determination criterion value on the strict side and two or more unfit-note determination criterion values at least one level away from the execution determination criterion value on the relaxing side. In this case, it is possible to rapidly and properly update the execution determination criterion value.

[0141] (D) The present embodiment deals with the case where the first unfit note determination portion 313 and the second unfit note determination portion 314 determine whether or not a banknote is an unfit note based on the unfit-note determination criterion value. An evaluation value is indicated by 256 scales (where the evaluation value is any value among 0 to 255) may be grouped into a plural levels. 256 scales to indicate each evaluation value may be grouped into a plural levels, and the first unfit note determination portion 313 and the second unfit note determination portion 314 may determine whether or not a banknote is an unfit note based on one of the levels. In this case, the operator specifies only the execution determination level and the virtual determination level instead of setting the execution determination criterion value and the virtual determination criterion value in the present embodiment; it enables to automatically set the threshold by referencing a reference value table prepared according to the levels. In this case, the display and setting as to whether or not a banknote is an unfit

note are easily understood. Moreover, the operator does not need to directly set the unfit-note determination criterion value.

[0142] (E) Although the present embodiment deals with the case where the update determination portion 316 determines whether or not the execution determination criterion value is updated based on whether or not the unfit-note rate R1 corresponding to the execution determination criterion value is closest to the target unfit-note rate R0 among the calculated unfit-note rates R1, R2 and R3, the update determination portion 316 may receive operation inputs from the teller through the operation portion 125a, and may determine whether or not the execution determination criterion value is updated based on the received operation input. In this case, the teller or the like references the unfit-note rate displayed on the display portion 125 and can give an instruction as to whether or not the execution determination criterion value is updated. Thus, it is possible to set the execution determination criterion value for achieving a desired unfit-note rate with a simpler configuration.

[0143] Fig. 14 is a screen diagram showing an example of a determination level update screen on the abnormal thickness displayed by the display control portion 318 on the display portion 125. In the example, it is necessary to use this screen to set the execution determination criterion value and the virtual determination criterion value; here, for ease of understanding, the "reference value" is also formally referred to as a "level." In the determination level update screen 400, a target unfit-note rate display portion 401 is displayed in an upper portion of the screen, and a strict side unfit-note rate display portion 402, an execution unfit-note rate display portion 403 and a relaxing side unfit-note rate display portion 404 are displayed in this order below the target unfit-note rate display portion 401 such that they are selectable. In a lower portion of the screen, a determination level update button 405 and a cancel button 406 are displayed.

[0144] The target unfit-note rate display portion 401 displays the target unfit-note rate stored in the target unfit-note-rate storage portion 321. The strict side unfit-note rate display portion 402, the execution unfit-note rate display portion 403 and the relaxing side unfit-note rate display portion 404 respectively display the unfit-note determination criterion value and the unfit-note rate corresponding to the unfit-note determination level adjacent to the execution determination level on the strict side, the unfit-note determination level and the unfit-note rate corresponding to the execution determination level, and the unfit-note determination criterion value and the unfit-note rate corresponding to the unfit-note determination level adjacent to the execution determination level on the relaxing side such that they can be set. The teller can select any of the strict side unfit-note rate display portion 402, the execution unfit-note rate display portion 403 and the relaxing side unfit-note rate display portion 404 such as by clicking it with, for example, a mouse.

[0145] The determination level update button 405 is a button that is pressed (here, for example, clicked with a mouse) when the display of the unfit-note determination level indicating an actual unfit-note rate corresponding to the selected display portion is used to set the execution determination criterion value corresponding to the execution determination level. The cancel button 406 is a button that is pressed (here, for example, clicked with a mouse) when the setting is cancelled. With a simple configuration, the update determination portion 316 can update the execution determination criterion value through the determination level update screen 400.

Industrial Applicability

[0146] According to the present invention, both in a banknote handling apparatus including a banknote recognition portion recognizing whether or not a banknote accepted is an unfit note based on an execution determination criterion value which is one unfit-note determination criterion value that has been previously set from unfit-note determination criterion values corresponding to a predetermined number of three or more levels and in a banknote handling method, the use of statistical processing allows the unfit-note determination criterion value for achieving a desired unfit-note rate to be set as the execution determination criterion value.

Claims

1. A banknote handling apparatus recognizing whether or not each of banknotes transported and accepted one by one is an unfit note based on an execution determination criterion value for determination of an unfit note that has been previously selected and set from a predetermined number of three or more unfit-note determination criterion values, the banknote handling apparatus comprising:

   a virtual determination criterion value setting unit that virtually sets, as virtual determination criterion values, one of the unfit-note determination criterion values at least one level away from the execution determination criterion value on a strict side and one of the unft-note determination criterion values at least one level away from the execution determination criterion value on a relaxing side;

   a deterioration information storage unit that stores banknote deterioration information indicating a deteriorated state of a banknote detected for each of the banknotes accepted;

   a first unfit note determination unit that determines, for each of the banknotes accepted, whether or not the banknote is an unfit note based on the banknote deterioration information and the execution determination criterion value;

   a second unfit note determination unit that de-

termines whether or not the banknote is an unfit note based on the banknote deterioration information for each of the banknotes accepted and the virtual determination criterion values that have been set; and
an unfit-note-rate calculation unit that determines a current unfit-note rate which is a ratio of a number of banknotes determined by the first unfit note determination unit to be unfit notes to a total number of the banknotes accepted and a virtual unfit-note rate which is a ratio of a number of banknotes determined by the second unfit note determination unit to be unfit notes for each of the virtual determination criterion values to the total number of the banknotes accepted.

2. The banknote handling apparatus of claim 1 further comprising:

a target unfit-note-rate storage unit that previously stores a target unfit-note rate to be achieved;
an update determination unit that determines whether or not the virtual determination criterion value needs to be set as an execution determination criterion value for subsequent rounds based on the current unfit-note rate, the virtual unfit-note rate and the target unfit-note rate each time a predetermined time period that has been previously set elapses or a predetermined number of banknotes that have been previously set are accepted; and
an update execution unit that updates the execution determination criterion value when the update determination unit determines that the virtual determination criterion value needs to be set.

3. The banknote handling apparatus of claim 2,
wherein, when either of the virtual unfit-note rates is closer to the target unfit-note rate than the current unfit-note rate, the update determination unit determines that the virtual determination criterion value corresponding to the virtual unfit-note rate needs to be set as an execution determination criterion value for subsequent rounds.

4. The banknote handling apparatus of claim 3,
wherein, when a plurality of the virtual unfit-note rates that are closer to the target unfit-note rate than the current unfit-note rate are present, the update execution unit selects the virtual unfit-note rate closest to the target unfit-note rate from the plurality of the virtual unfit-notes, and updates the execution determination criterion value such that a virtual determination criterion value corresponding to the selected virtual unfit-note rate is set as an execution determination criterion value for subsequent rounds.

5. The banknote handling apparatus of claim 1 further comprising:

a display unit that displays character information such that the character information can be viewed from outside;
a display control unit that displays the current unfit-note rate and the virtual unfit-note rate through the display unit such that the current unfit-note rate and the virtual unfit-note rate can be viewed from outside;
an update determination unit that receives an operation input from outside and determines whether or not the virtual determination criterion value needs to be set as an execution determination criterion value for subsequent rounds based on the operation input received; and
an update execution unit that updates the execution determination criterion value when the update determination unit determines that the virtual determination criterion value needs to be set.

6. The banknote handling apparatus of claim 1,
wherein the virtual reference value setting unit sets, as the virtual determination criterion values, two or more of the unfit-note determination criterion values at least one level away from the execution determination criterion value on the strict side and two or more of the unfit-note determination criterion values at least one level away from the execution determination criterion value on the relaxing side.

7. The banknote handling apparatus of claim 1 further comprising:

a deterioration detection unit that receives the banknote from outside, generates the banknote deterioration information indicating the deteriorated state of the banknote accepted and records the banknote deterioration information in the deterioration information storage unit,
wherein the first unfit note determination unit and the second unfit note determination unit determine whether or not the banknote accepted is an unfit note each time the deterioration detection unit generates the banknote deterioration information.

8. The banknote handling apparatus of claim 1,
wherein the execution determination criterion value corresponds to each of loss of shape, stain and abnormal thickness,
the deterioration information storage unit stores the banknote deterioration information detected according to each of the loss of shape, the stain and the abnormal thickness of the banknote,
the virtual reference value setting unit sets the virtual

determination criterion values respectively corresponding to each of the loss of shape, the stain and the abnormal thickness,
the first unfit note determination unit and the second unfit note determination unit determine whether or not the banknote is an unfit note on each of the loss of shape, the stain and the abnormal thickness; and
the unfit-note-rate calculation unit determines the current unfit-note rate and the virtual unfit-note rate on each of the loss of shape, the stain and the abnormal thickness.

9. The banknote handling apparatus of claim 1,
wherein the execution determination criterion value corresponds to each of denominations of the banknotes,
the deterioration information storage unit stores the banknote deterioration information according to denomination information on the banknote,
the virtual reference value setting unit sets the virtual determination criterion values respectively corresponding to each of denominations of the banknotes,
the first unfit note determination unit and the second unfit note determination unit determine whether or not the banknote is an unfit note for each of denominations of the banknotes and
the unfit-note-rate calculation unit determines the current unfit-note rate and the virtual unfit-note rate for each of denominations of the banknotes.

10. The banknote handling apparatus of claim 1 further comprising:

an unfit-note-rate transmission unit which is connected to an upper terminal such that the unfit-note-rate transmission unit can communicate with the upper terminal and which transmits to the upper terminal unfit-note-rate information, that is, information on the current unfit-note rate and the virtual unfit-note rate,
wherein the upper terminal includes an unfit-note-rate storage unit storing the unfit-note-rate information received form the unfit-note-rate transmission unit.

11. The banknote handling apparatus of claim 10,
wherein the upper terminal includes a transition display unit which produces a graph showing transition of the current unfit-note rate and the virtual unfit-note rate based on the unfit-note-rate information stored in the unfit-note-rate storage unit and which displays the graph such that the graph can be viewed from outside.

12. A banknote handling method of recognizing whether or not each of banknotes transported and accepted one by one is an unfit note based on an execution determination criterion value that is an unft-note determination criterion value which has been previously selected and set from a predetermined number of three or more unfit-note determination criterion values, the banknote handling method comprising
a virtual determination criterion value setting step of virtually setting, as virtual determination criterion values, one of the unfit-note determination criterion values at least one level away from the execution determination criterion value on a strict side and one of the unfit-note determination criterion values at least one level away from the execution determination criterion value on a relaxing side;
a storage step of storing banknote deterioration information indicating a deteriorated state of a banknote detected for each of the banknotes accepted;
a first unfit note determination step of determining, for each of the banknotes accepted, whether or not the banknote is an unfit note based on the banknote deterioration information for each of the banknotes accepted and the execution determination criterion value;
a second unfit note determination step of determining, for each of the banknotes accepted, whether or not the banknote is an unfit note based on the banknote deterioration information for each of the banknotes accepted and the virtual determination criterion values that have been set; and
an unfit-note-rate calculation step of determining a current unfit-note rate which is a ratio of a number of banknotes determined by the first unfit note determination unit to be unfit notes to a total number of the banknotes accepted and a virtual unfit-note rate which is a ratio of a number of banknotes determined by the second unfit note determination unit to be unfit notes for each of the virtual determination criterion values to the total number of the banknotes accepted.

FIG.1

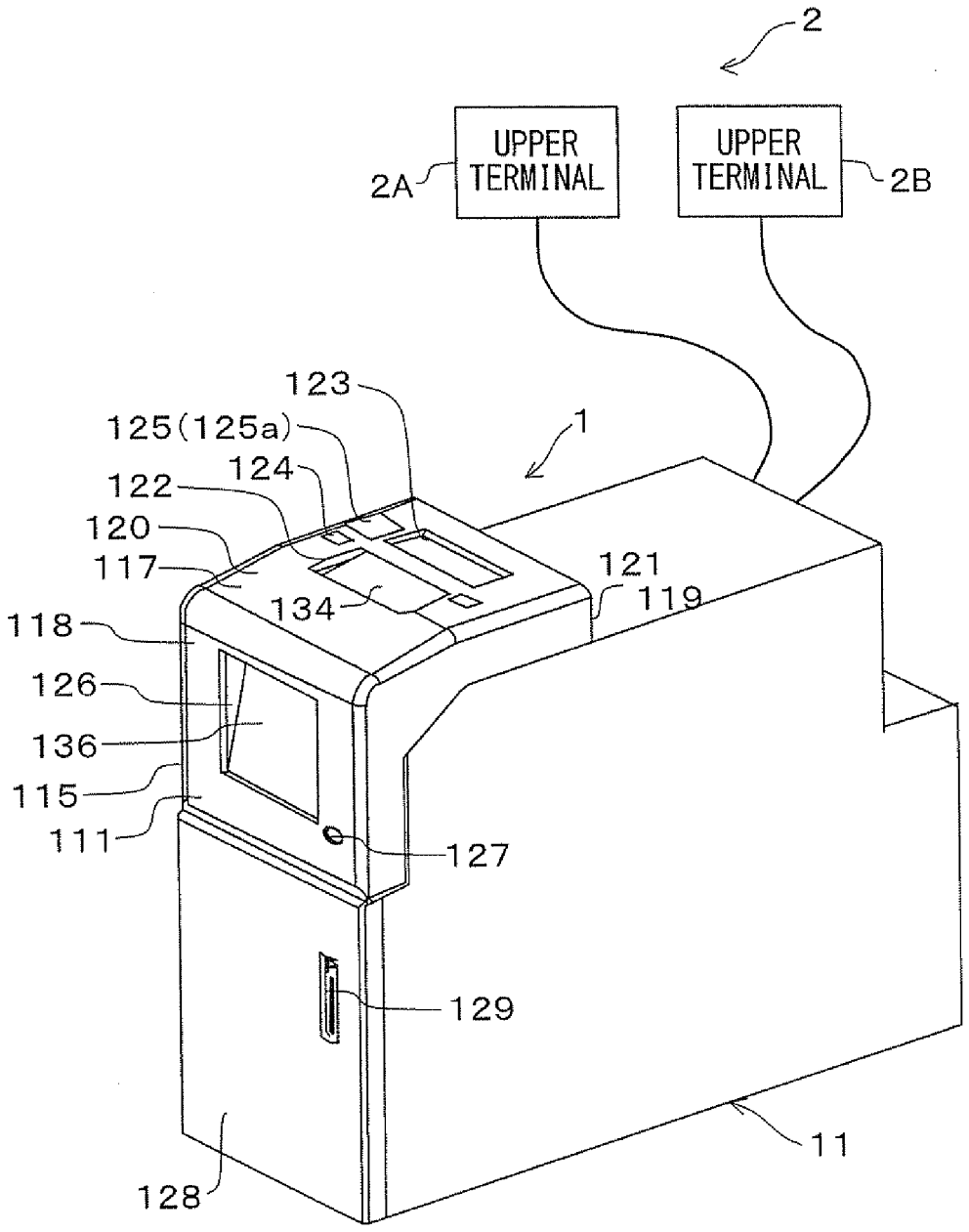

2
UPPER TERMINAL
2A
UPPER TERMINAL
2B
123
125(125a)
124
122
120
117
1
121
119
134
118
126
136
115
111
127
129
128
11

FIG.2

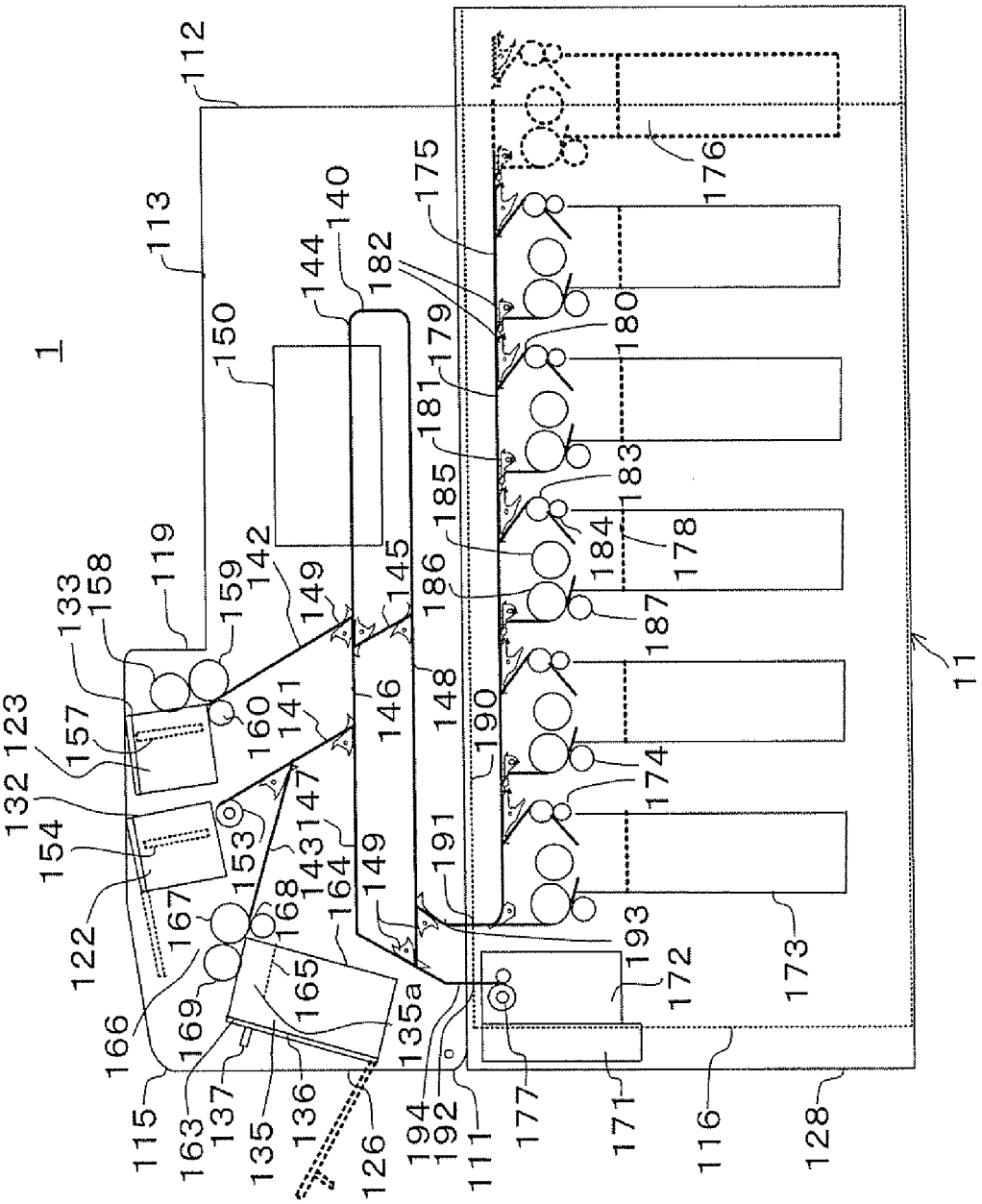

1
11
112
113
116
119
122
123
126
128
132
133
135
135a
136
137
140
141
142
143
144
145
146
147
148
149
150
153
154
157
158
159
160
163
164
165
166
167
168
169
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
190
191
192
193
194
111
115

FIG.3

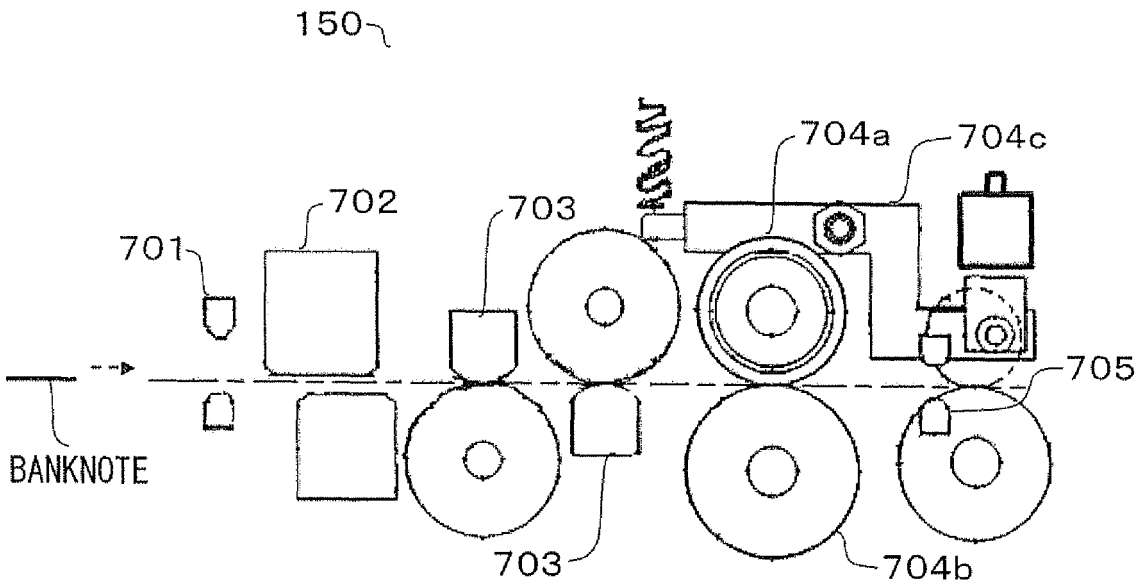

150
704a
704c
702
703
701
705
BANKNOTE
703
704b

FIG.4

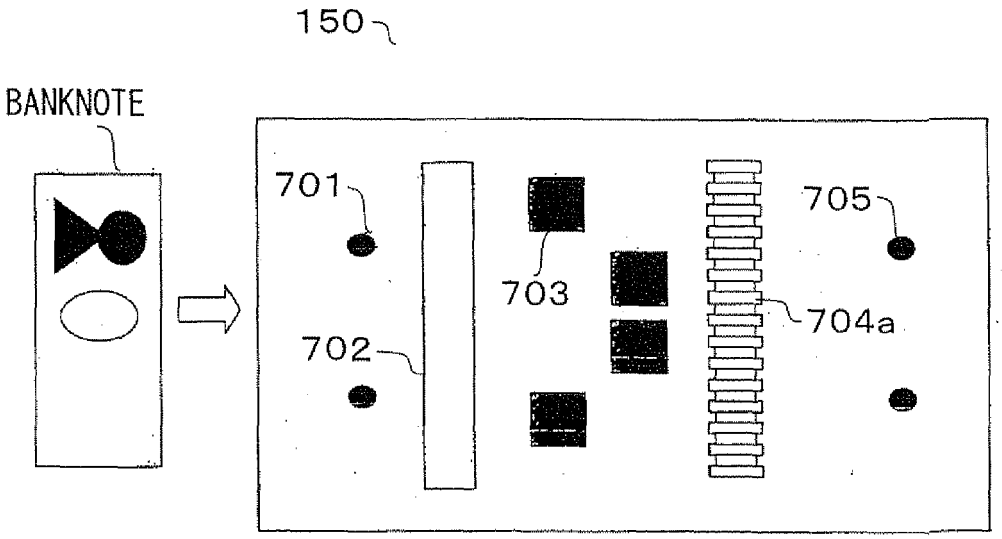

150
BANKNOTE
701
705
703
704a
702

FIG.5

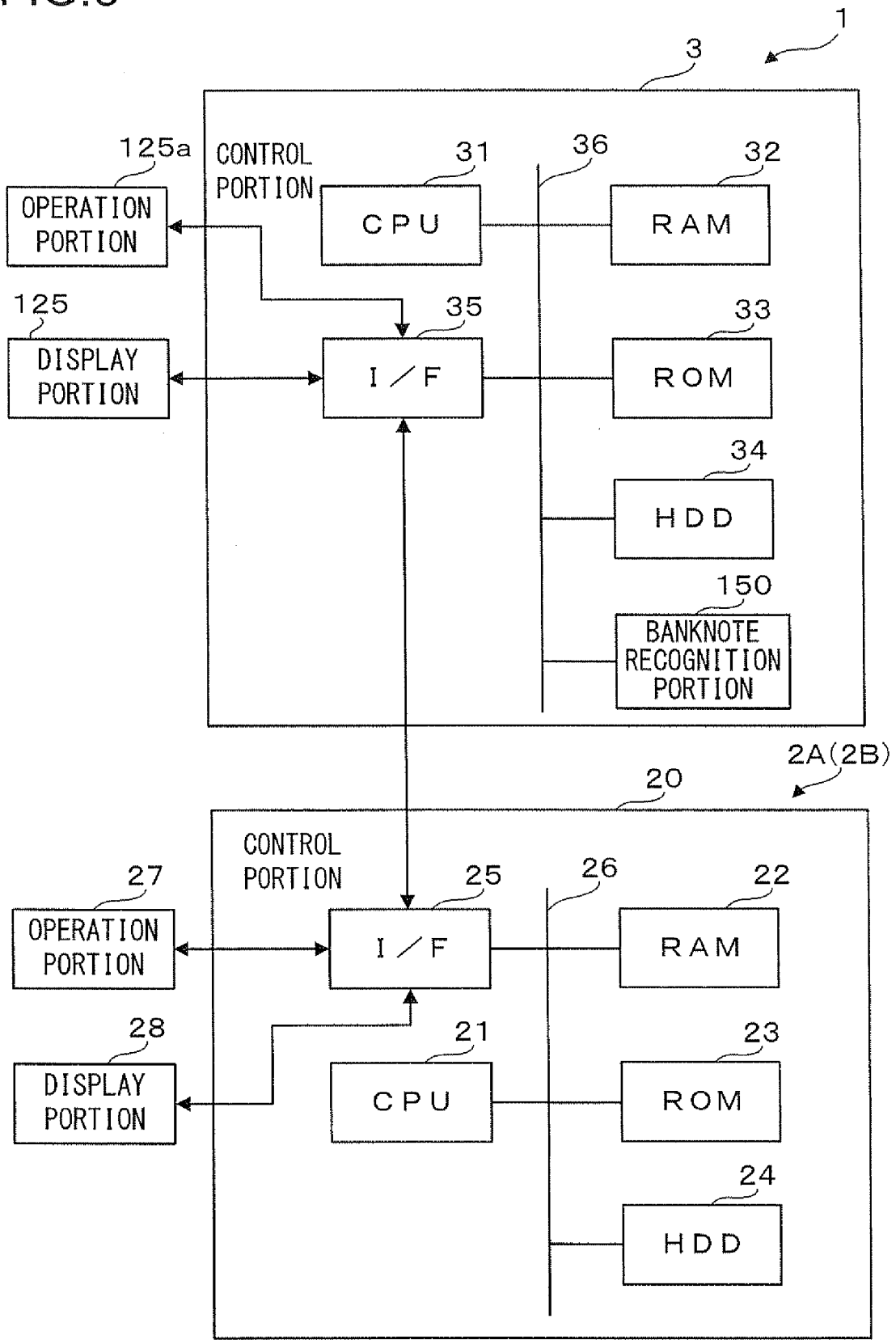

1
3
125a
OPERATION PORTION
CONTROL PORTION
31
CPU
36
32
RAM
125
DISPLAY PORTION
35
I／F
33
ROM
34
HDD
150
BANKNOTE RECOGNITION PORTION
2A(2B)
20
CONTROL PORTION
27
OPERATION PORTION
25
I／F
26
22
RAM
28
DISPLAY PORTION
21
CPU
23
ROM
24
HDD

FIG.6

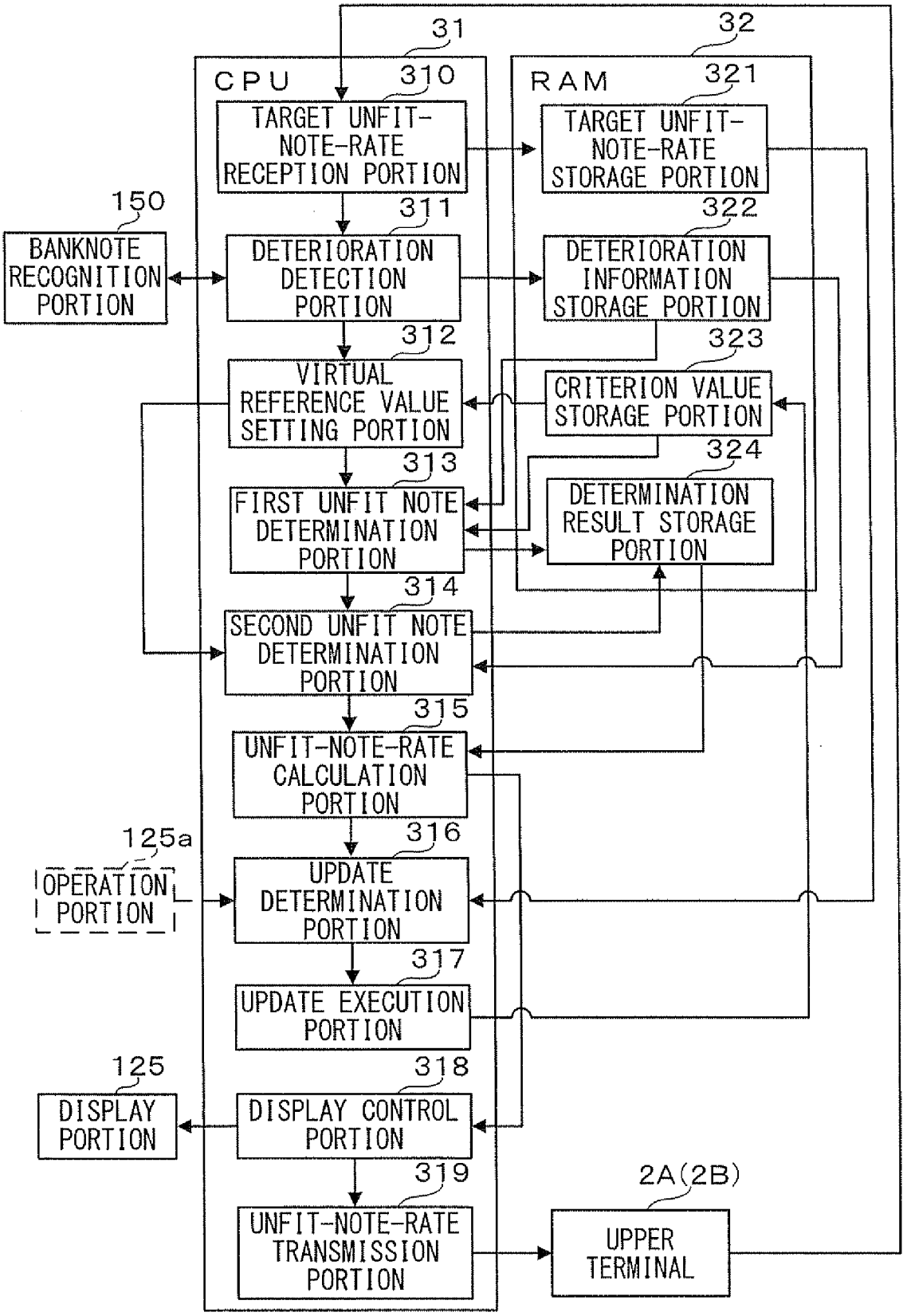

31
CPU
310
TARGET UNFIT-NOTE-RATE RECEPTION PORTION
311
DETERIORATION DETECTION PORTION
312
VIRTUAL REFERENCE VALUE SETTING PORTION
313
FIRST UNFIT NOTE DETERMINATION PORTION
314
SECOND UNFIT NOTE DETERMINATION PORTION
315
UNFIT-NOTE-RATE CALCULATION PORTION
316
UPDATE DETERMINATION PORTION
317
UPDATE EXECUTION PORTION
318
DISPLAY CONTROL PORTION
319
UNFIT-NOTE-RATE TRANSMISSION PORTION
32
RAM
321
TARGET UNFIT-NOTE-RATE STORAGE PORTION
322
DETERIORATION INFORMATION STORAGE PORTION
323
CRITERION VALUE STORAGE PORTION
324
DETERMINATION RESULT STORAGE PORTION
150
BANKNOTE RECOGNITION PORTION
125a
OPERATION PORTION
125
DISPLAY PORTION
2A(2B)
UPPER TERMINAL

FIG.7

(a)

UNFIT-NOTE FACTOR	EXECUTION DETERMINATION LEVEL	NUMBER OF UNFIT NOTES			TOTAL NUMBER OF UNFIT NOTES
		LEVEL−1	LEVEL±0	LEVEL+1	
ABNORMAL THICKNESS	4	399	405	525	10068
LOSS OF SHAPE	4	339	516	1035	10068
STAIN	4	1041	1234	1289	10068

(b)

UNFIT-NOTE FACTOR	UNFIT-NOTE RATE		
	LEVEL−1	LEVEL±0	LEVEL+1
ABNORMAL THICKNESS	3.96%	4.02%	5.21%
LOSS OF SHAPE	3.37%	5.13%	10.28%
STAIN	10.34%	12.26%	12.80%

(c)

UNFIT-NOTE FACTOR	ABSOLUTE VALUE OF DIFFERENCE WITH UNFIT-NOTE RATE		
	LEVEL−1	LEVEL±0	LEVEL+1
ABNORMAL THICKNESS	6.04%	5.98%	4.79%
LOSS OF SHAPE	6.63%	4.87%	0.28%
STAIN	0.34%	2.26%	2.80%

FIG.8

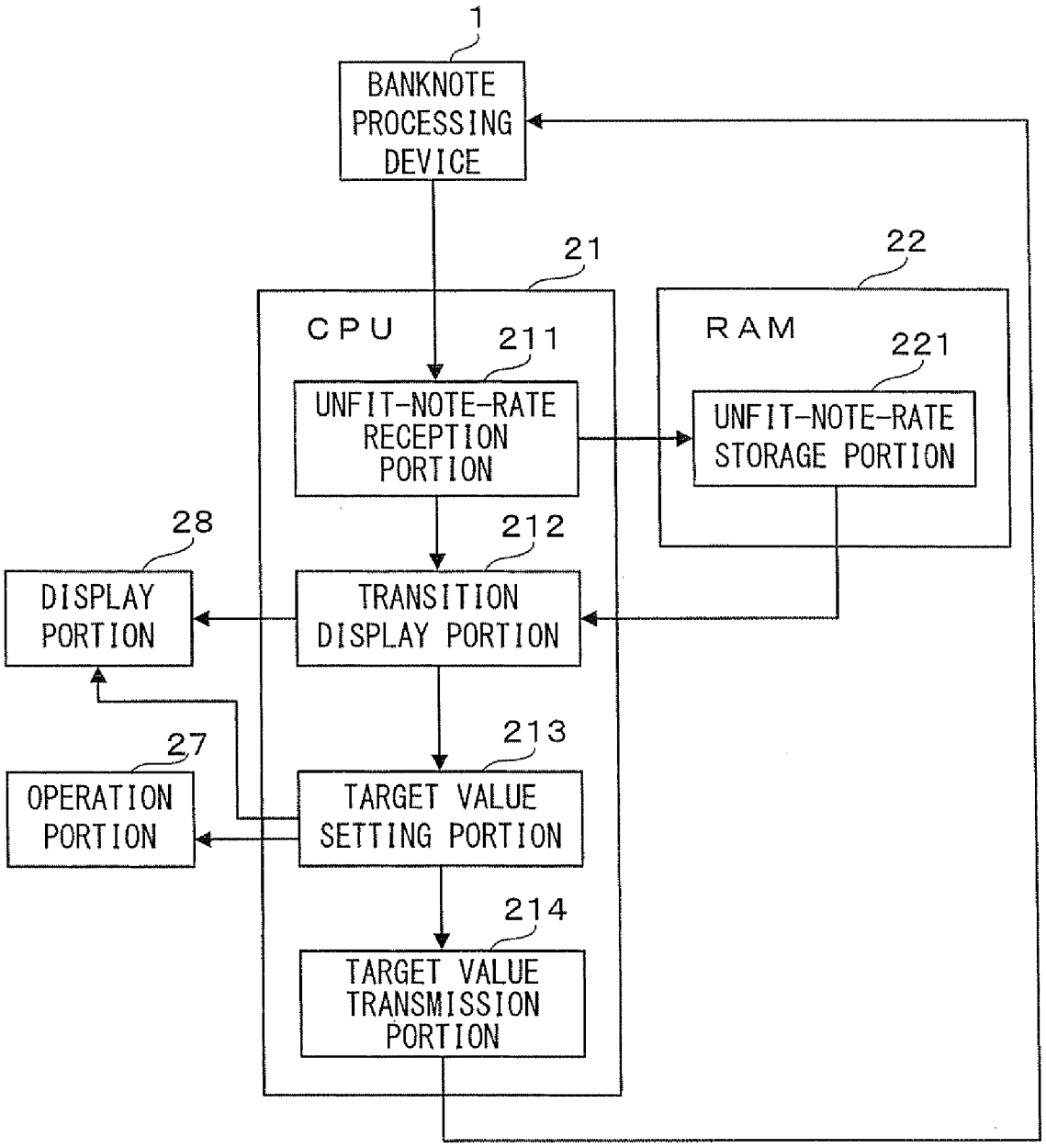
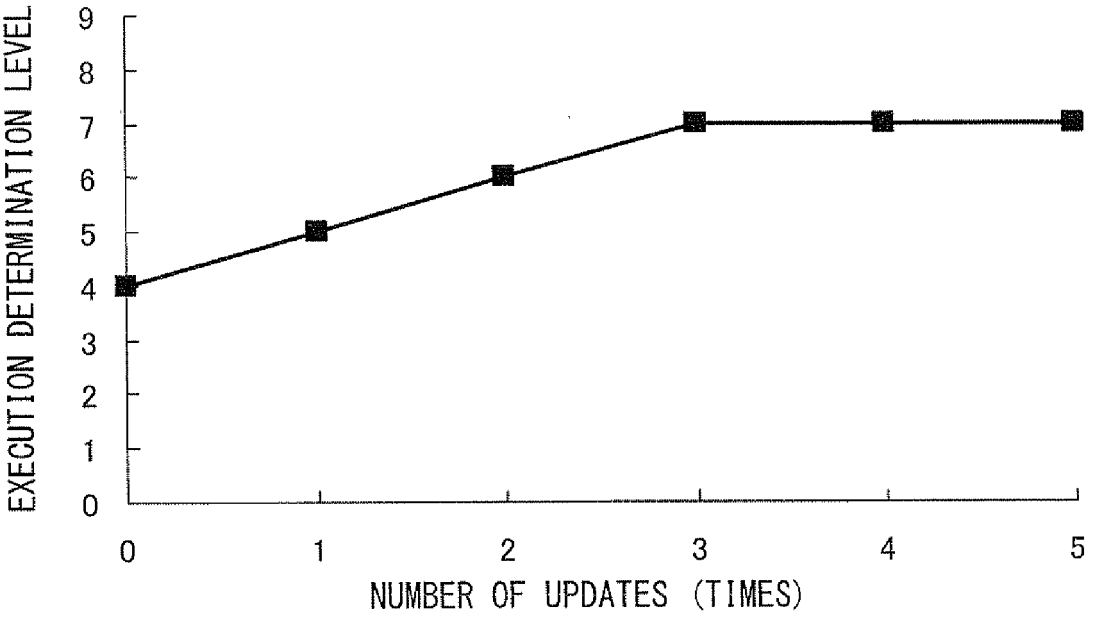

1
BANKNOTE PROCESSING DEVICE
21
CPU
211
UNFIT-NOTE-RATE RECEPTION PORTION
22
RAM
221
UNFIT-NOTE-RATE STORAGE PORTION
28
DISPLAY PORTION
212
TRANSITION DISPLAY PORTION
27
OPERATION PORTION
213
TARGET VALUE SETTING PORTION
214
TARGET VALUE TRANSMISSION PORTION

FIG.9

(a)


EXECUTION DETERMINATION LEVEL
9
8
7
6
5
4
3
2
1
0
0
1
2
3
4
5
NUMBER OF UPDATES (TIMES)

(b)

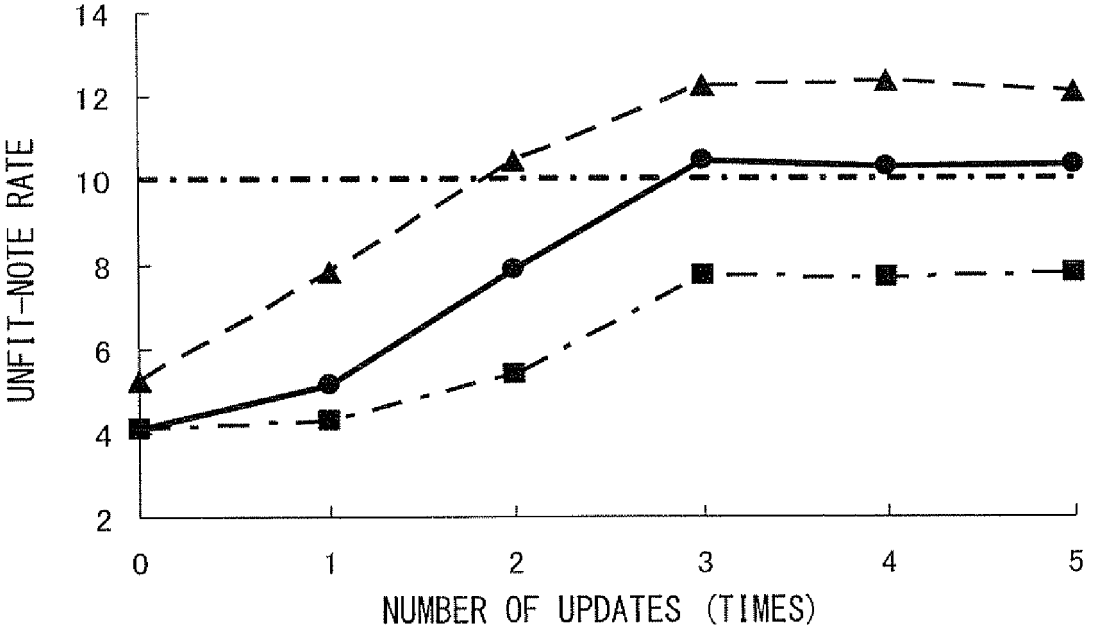

UNFIT-NOTE RATE
14
12
10
8
6
4
2
0
1
2
3
4
5
NUMBER OF UPDATES (TIMES)

FIG.10

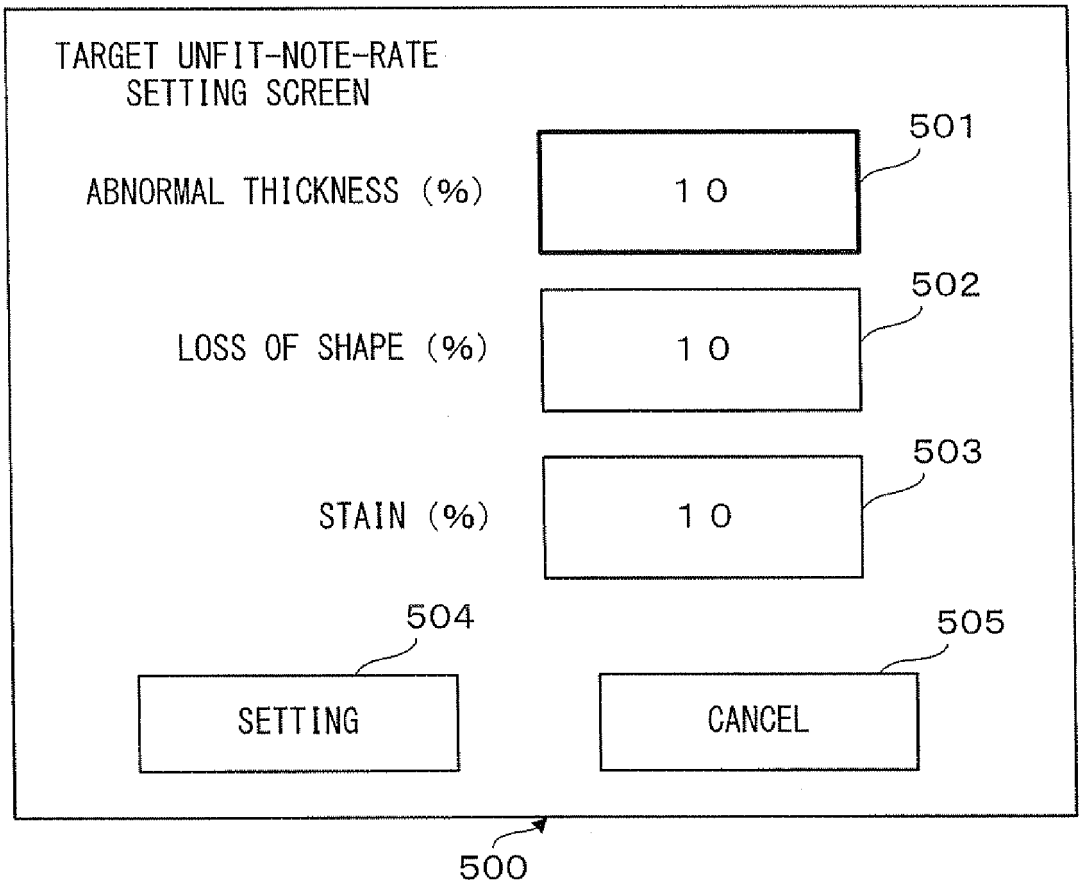

TARGET UNFIT-NOTE-RATE SETTING SCREEN
ABNORMAL THICKNESS (%)
10
501
LOSS OF SHAPE (%)
10
502
STAIN (%)
10
503
504
SETTING
505
CANCEL
500

FIG.11

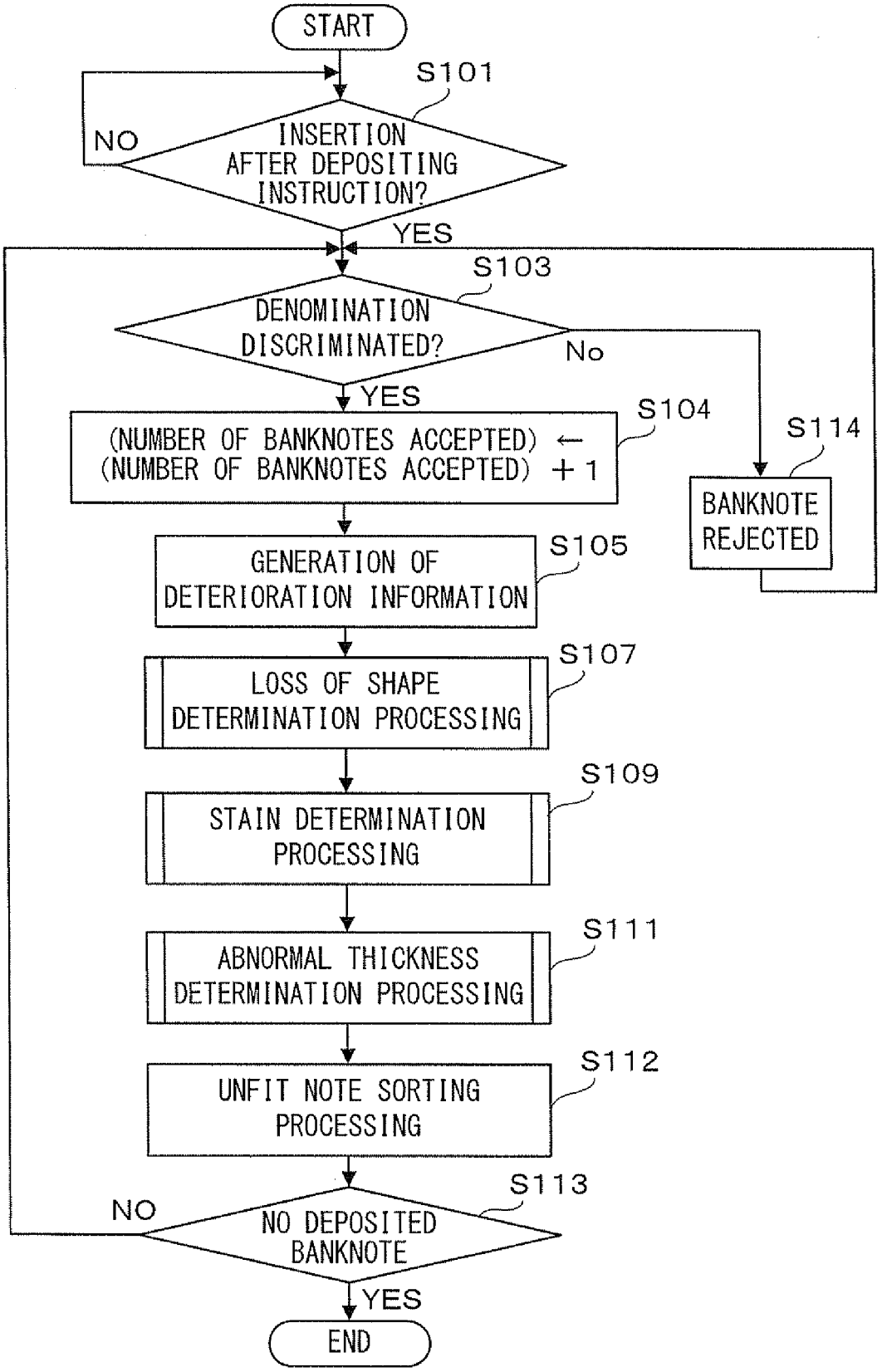

START
S101
INSERTION AFTER DEPOSITING INSTRUCTION?
NO
YES
S103
DENOMINATION DISCRIMINATED?
No
YES
S104
(NUMBER OF BANKNOTES ACCEPTED) ← (NUMBER OF BANKNOTES ACCEPTED) + 1
S114
BANKNOTE REJECTED
S105
GENERATION OF DETERIORATION INFORMATION
S107
LOSS OF SHAPE DETERMINATION PROCESSING
S109
STAIN DETERMINATION PROCESSING
S111
ABNORMAL THICKNESS DETERMINATION PROCESSING
S112
UNFIT NOTE SORTING PROCESSING
S113
NO DEPOSITED BANKNOTE
NO
YES
END

FIG.12

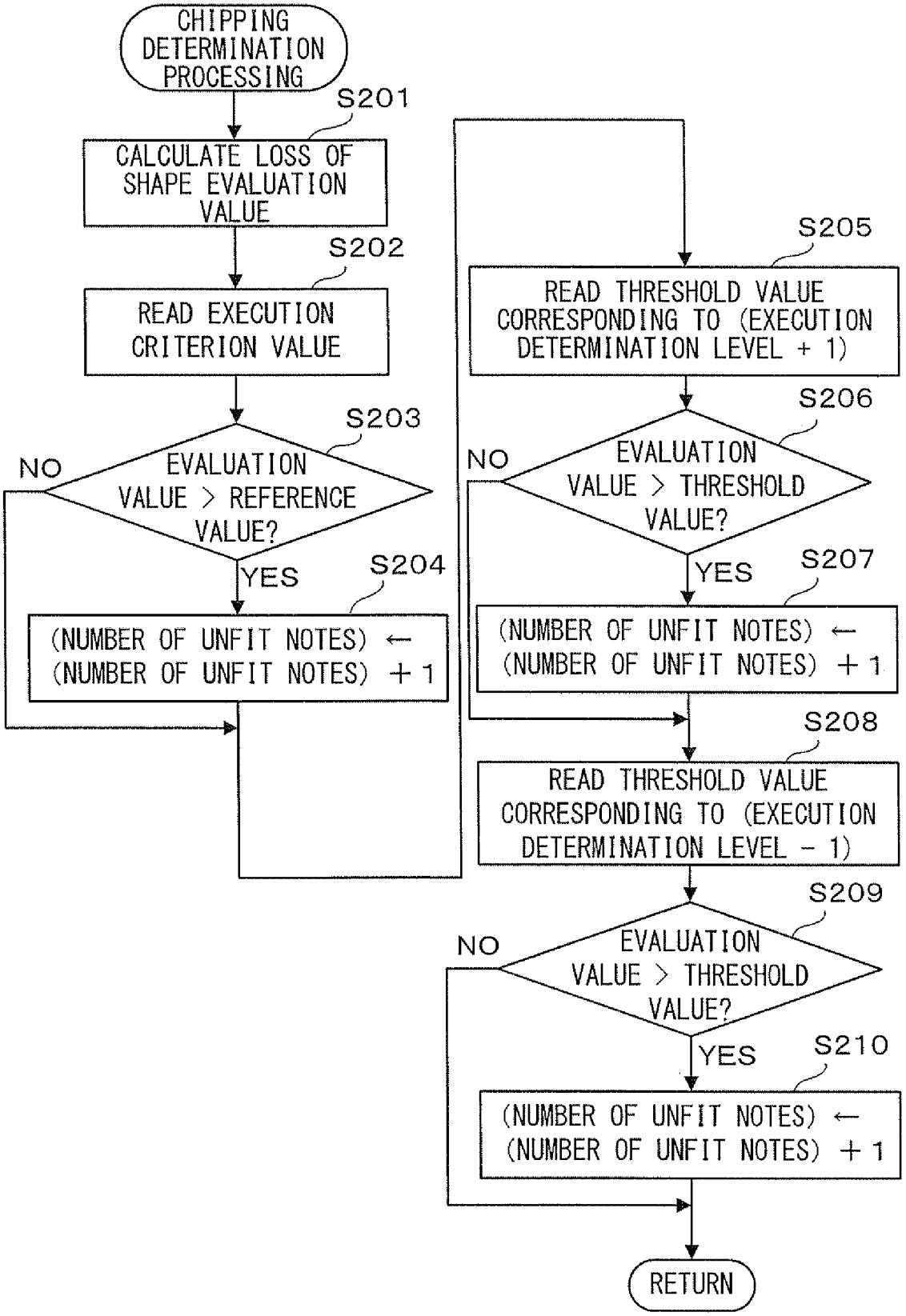

CHIPPING DETERMINATION PROCESSING
S201
CALCULATE LOSS OF SHAPE EVALUATION VALUE
S202
READ EXECUTION CRITERION VALUE
S203
EVALUATION VALUE > REFERENCE VALUE?
NO
YES
S204
(NUMBER OF UNFIT NOTES) ← (NUMBER OF UNFIT NOTES) + 1
S205
READ THRESHOLD VALUE CORRESPONDING TO (EXECUTION DETERMINATION LEVEL + 1)
S206
EVALUATION VALUE > THRESHOLD VALUE?
NO
YES
S207
(NUMBER OF UNFIT NOTES) ← (NUMBER OF UNFIT NOTES) + 1
S208
READ THRESHOLD VALUE CORRESPONDING TO (EXECUTION DETERMINATION LEVEL - 1)
S209
EVALUATION VALUE > THRESHOLD VALUE?
NO
YES
S210
(NUMBER OF UNFIT NOTES) ← (NUMBER OF UNFIT NOTES) + 1
RETURN

FIG.13

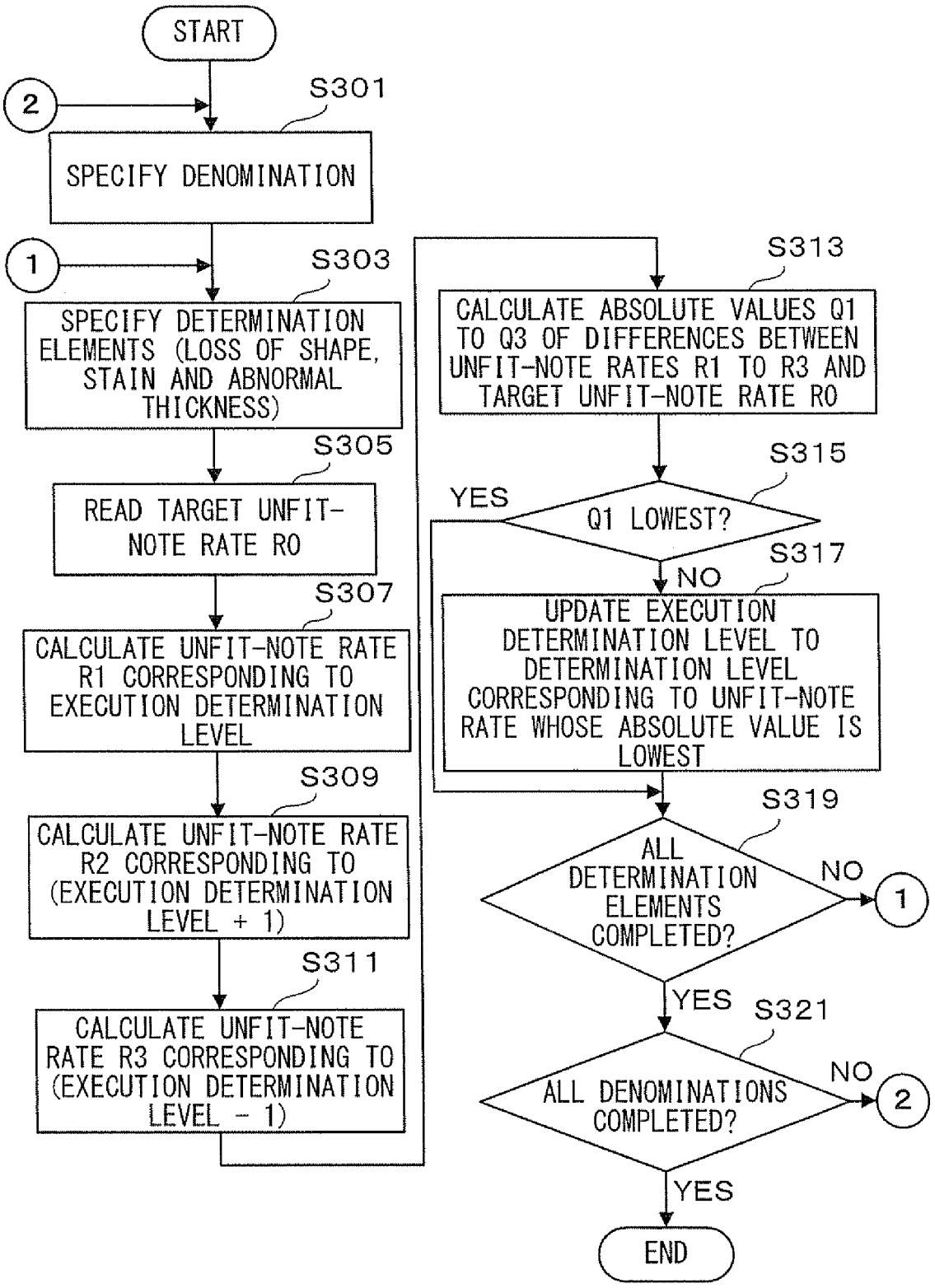
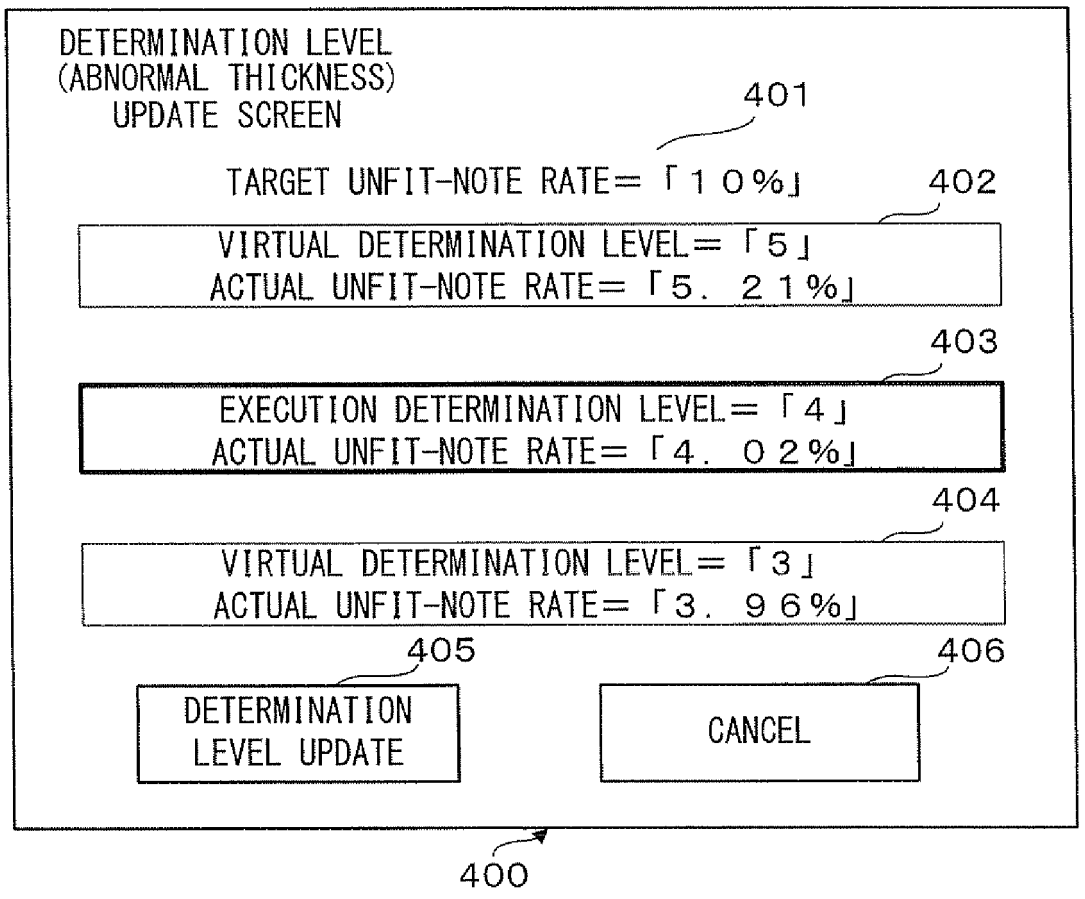

START
2
S301
SPECIFY DENOMINATION
1
S303
SPECIFY DETERMINATION ELEMENTS (LOSS OF SHAPE, STAIN AND ABNORMAL THICKNESS)
S305
READ TARGET UNFIT-NOTE RATE R0
S307
CALCULATE UNFIT-NOTE RATE R1 CORRESPONDING TO EXECUTION DETERMINATION LEVEL
S309
CALCULATE UNFIT-NOTE RATE R2 CORRESPONDING TO (EXECUTION DETERMINATION LEVEL + 1)
S311
CALCULATE UNFIT-NOTE RATE R3 CORRESPONDING TO (EXECUTION DETERMINATION LEVEL - 1)
S313
CALCULATE ABSOLUTE VALUES Q1 TO Q3 OF DIFFERENCES BETWEEN UNFIT-NOTE RATES R1 TO R3 AND TARGET UNFIT-NOTE RATE R0
S315
YES
Q1 LOWEST?
NO
S317
UPDATE EXECUTION DETERMINATION LEVEL TO DETERMINATION LEVEL CORRESPONDING TO UNFIT-NOTE RATE WHOSE ABSOLUTE VALUE IS LOWEST
S319
ALL DETERMINATION ELEMENTS COMPLETED?
NO
1
YES
S321
ALL DENOMINATIONS COMPLETED?
NO
2
YES
END

FIG.14


DETERMINATION LEVEL
(ABNORMAL THICKNESS)
UPDATE SCREEN
401
TARGET UNFIT-NOTE RATE= 「10%」
402
VIRTUAL DETERMINATION LEVEL= 「5」
ACTUAL UNFIT-NOTE RATE= 「5. 21%」
403
EXECUTION DETERMINATION LEVEL= 「4」
ACTUAL UNFIT-NOTE RATE= 「4. 02%」
404
VIRTUAL DETERMINATION LEVEL= 「3」
ACTUAL UNFIT-NOTE RATE= 「3. 96%」
405
DETERMINATION LEVEL UPDATE
406
CANCEL
400

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/057409

A. CLASSIFICATION OF SUBJECT MATTER
G07D7/00(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)
G07D7/00

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 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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.
Y	JP 2008-15813 A (Hitachi-Omron Terminal Solutions, Corp.), 24 January, 2008 (24.01.08), Par. Nos. [0015] to [0050] (Family: none)	1-12
Y	JP 5-282516 A (Laurel Bank Machines Co., Ltd.), 29 October, 1993 (29.10.93), Par. Nos. [0011] to [0020]; Fig. 2 (Family: none)	1-12

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 July, 2008 (03.07.08)	15 July, 2008 (15.07.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2007087219 A **[0003]**