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

(11) EP 3 373 255 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
18.05.2022 Bulletin 2022/20

(21) Application number: **18160077.6**

(22) Date of filing: **06.03.2018**

(51) International Patent Classification (IPC):
G07D 7/12 *(2016.01)* ***G07D 7/20*** *(2016.01)*

(52) Cooperative Patent Classification (CPC):
G07D 7/12; G07D 7/2075

(54) **SHEET HANDLING APPARATUS**

BLATTHANDHABUNGSVORRICHTUNG

APPAREIL DE MANIPULATION DE FEUILLES

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

(30) Priority: **08.03.2017 JP 2017043859**

(43) Date of publication of application:
12.09.2018 Bulletin 2018/37

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(56) References cited:
EP-A2- 0 875 866
JP-A- 2013 131 053
US-A- 4 990 790
US-B1- 6 237 739

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EP 3 373 255 B1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a sheet handling apparatus according to the preamble of claim 1 capable of handling a sheet.

2. Description of the Related Art

[0002] A sheet handling apparatus that takes in sheets, such as banknotes, inside the apparatus one by one, and performs recognition and counting of the sheets is known in the art. Many photoelectric sensors are arranged at a transport path, on which the sheets are transported inside the apparatus, for detecting the sheets. The photoelectric sensor comprises a light receiving unit and a light emitting unit, and the light receiving unit detects detection light emitted from the light emitting unit. The photoelectric sensor detects a transported banknote on the transport path by detecting a change of the detecting light. That is, a state of the detection light is changed from a light transmissive state where the detection light is not blocked between the light emitting unit and the light receiving unit by the banknote to a light interruptive state where the detection light is blocked by the banknote. Whether the detection light is in the light transmissive state or is in the light interruptive state can be determined by comparing an output level of the signal output from the light receiving unit with a predetermined threshold value. The position of the banknote on the transport path can be determined based on a position of the sensor that detects the banknote on the transport path. A length of the banknote in a transport direction of the banknote can be determined based on a duration from a time when a leading edge of the banknote in the transport direction of the banknote reaches a detection position of the sensor to a time when a trailing edge of the banknote in the transport direction of the banknote passes the detection position, and a transport speed of the banknote.

[0003] Banknotes made of synthetic resin are called polymer banknotes. Polymer banknotes have a window part that is composed of a transparent or semitransparent partial area formed in a non-transparent area of the banknote. A transmittance of the detection light in the window part is much higher than that in the non-transparent area. The state of the detection light, which should be the light interruptive state while the detection light scans a polymer banknote being transported, changes to the light transmissive state while scanning the transparent or semitransparent window part. The polymer banknote may not be detected correctly by the method of detecting a banknote whose whole surface blocks the detection light. To address this issue, PCT Publication No. WO2009/075015 discloses a banknote handling apparatus that detects a banknote having a window part by using a method that is different from the method of detecting a banknote that does not have a window part. In this apparatus, after the state of the detection light changes to the light interruptive state by detecting a leading edge of the banknote in the transport direction of a windowed banknote and the state of the detection light returns to the light transmissive state again by detecting the presence of the window part, an operation of a detection and determination of the trailing edge of the banknote in the transport direction is not performed for a predetermined duration. The above-mentioned method can prevent a wrong determination in which transmission of the detection light through the window part is determined as transmission resulting from completion of passage of the banknote.

[0004] US 6 237 739 B1 discloses a sheet handling apparatus according to the preamble of claim 1

SUMMARY OF THE INVENTION

[0005] However, the leading and the trailing edges of the banknote in the transport direction of the windowed banknote may not be detected correctly even by using the above explained conventional art. For example, when the state of the detection light changes from the light transmissive state to the light interruptive state and this light interruptive state continues for a predetermined period, it is determined that the light interruptive state is due to detecting the leading edge of the banknote in the transport direction of the banknote. If a distance from the leading edge of the banknote to the window part is short, and therefore a period between the light interruptive state due to detecting the leading edge of the banknote and the light transmissive state due to detecting the window part is short, the blocking of the detection light may not be determined as detecting the leading edge of the banknote. Moreover, in addition to the window part, the detection light passes through a part in which the printing color is faint, and the banknote may not be detected correctly.

[0006] The present invention is made to address the problems in the conventional technology. One object of the present invention is to provide a sheet handling apparatus that can correctly detect a sheet transported on a transport path.

[0007] To solve the above problems and to achieve the above object, the invention is set out in the appended set of claims.

[0008] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

FIG. 1 is a schematic diagram of an internal configuration of a banknote handling apparatus.
FIG. 2 is a block diagram of a functional configuration of the banknote handling apparatus.
FIG. 3 is a schematic diagram indicating a placement example of a light emitting unit and a light receiving unit.
FIGS. 4A to 4C are schematic diagrams indicating examples in which a banknote is detected at two locations.
FIG. 5 is a schematic diagram for explaining an example of a windowed banknote that is a target of detection of a second-type detection unit.
FIGS. 6A and 6B are views for explaining a detection method of an ordinary banknote.
FIGS. 7A to 7C are views for explaining a detection method of the windowed banknote.
FIGS. 8A and 8B are views for explaining a setting that only an output level of a signal output from a sensor unit is changed while a threshold value is set to the same as used for the ordinary banknote.
FIGS. 9A and 9B are views for explaining a setting that only the threshold value is changed while the output level of the signal output from the sensor unit is set to the same as that used for the ordinary banknote.
FIGS. 10A and 10B are views for explaining a setting that both the output level and the threshold value of the sensor unit are changed.
FIGS. 11A and 11B are views for explaining a threshold voltage values and an output voltage values.
FIG. 12 is a flowchart of a processing for changing a setting of the second-type detection unit after receiving a specification of a denomination.
FIG. 13 is a flowchart of a processing for changing a setting of the second-type detection unit based on a recognition result obtained in a recognition unit.
FIG. 14 is a block diagram of a configuration of a second-type detection unit that includes only one determination unit.
FIG. 15 is a schematic diagram indicating a configuration of a transport path when seen from a Y-axis direction.
FIGS. 16A to 16C are views for explaining a method for avoiding an effect of a waveform breakage.

EMBODIMENTS

[0010] Exemplary embodiments of a sheet handling apparatus according to the present invention are explained below with reference to the accompanying drawings. A type of sheets that can be handled by the sheet handling apparatus is not particularly limited. In the follow embodiments, however, a banknote handling apparatus (sheet handling apparatus) that handles banknotes as a handling target is explained as an example.

[0011] The embodiments, examples or aspects of the invention in this description not falling under the scope of the claims should be interpreted as illustrative examples for understanding the invention.

[0012] At first, a configuration of the banknote handling apparatus is explained. FIG. 1 is a schematic diagram of an internal configuration of a banknote handling apparatus 1. FIG. 2 is a block diagram of a functional configuration of the banknote handling apparatus 1. As shown in FIG. 1, the banknote handling apparatus 1 includes a money depositing unit 10, a recognition unit 20, a transport unit 30, a money dispensing unit 40, an outside reject unit 50, an inside reject unit 60, a storing/dispensing units 70, and a collection unit 80. The banknote handling apparatus 1 includes an upper unit 2 and a lower unit 3. The money depositing unit 10, the recognition unit 20, the transport unit 30, the money dispensing unit 40, the outside reject unit 50, and the inside reject unit 60 are arranged in the upper unit 2. The storing/dispensing units 70 and the collection unit 80 are arranged in the lower unit 3. The banknote handling apparatus 1 is capable of performing various banknote handling including a money depositing process and a money dispensing process.

[0013] In the money depositing process, banknotes to be deposited are put on the money depositing unit 10. The money depositing unit 10 feeds those banknotes one by one inside the apparatus. The transport unit 30 transports along a transport path the banknotes fed inside the apparatus by the money depositing unit 10. The recognition unit 20 recognizes a denomination, authenticity, fitness of the banknote transported on the transport path. Based on a recognition result, the transport unit 30 transports a banknote that cannot be accepted for the money depositing process to the outside reject unit 50 and stacks therein as a depositing reject banknote, and transports a banknote accepted for the money depositing process to one of the storing/dispensing units 70 and stores therein. In the storing/dispensing units 70, the banknotes are sorted and stacked based on the recognition result of the denomination by the recognition unit 20. A banknote of a denomination not assigned to any of the storing/dispensing units 70 and a banknote of a denomination assigned to the storing/dispensing unit 70 that is full with stacked banknotes and cannot stack any more banknotes (in full state) are transported to the collection cassette 80 and stored therein by the transport unit 30.

[0014] In the money dispensing process, the storing/dispensing unit 70 feeds banknotes to be dispensed one by one to the transport path. The transport unit 30 transports the fed banknote to the money dispensing unit 40 and discharges therein. The transport unit 30 transports to the inside reject unit 60 a banknote that cannot be dispensed due to a transport error, such as multifeed, as a dispensing reject banknote, and stacks therein.

[0015] The banknote handling apparatus 1 includes two types of detection units which are a first-type detection unit 101 and a second-type detection unit 102. For example, the first-type detection unit 101 is used for detecting the presence or absence of a banknote in a stationary state such as a stacked banknote. The first-type

detection unit 101 is arranged such that it detects a non-transparent area other than a window part of a banknote that is stopping and not moving in the apparatus 1. On the other hand, the second-type detection unit 102 is used for detecting a banknote being transported and moving in the apparatus 1. For example, the second-type detection unit 102 is provided to perform recognition process by the recognition unit 20, switching process of a transport direction by a diverter arranged in the transport path, storing process of the banknotes in the storing/dispensing unit 70 and the collection unit 80. When detecting a banknote being transported, it is necessary to detect a window part of the banknote as a part of the banknote. In this case, the second-type detection unit 102 is used. Moreover, the second-type detection unit 102 is useful when it is required to correctly detect a position of the leading edge of the banknote or calculate a length of the banknote in the transport direction of the banknote by detecting the leading and trailing edges of the banknote in the transport direction of the banknote.

[0016] The first-type detection units 101 are arranged in each of the money depositing unit 10, the money dispensing unit 40, the outside reject unit 50, and the inside reject unit 60 to detect the presence or absence of a banknote stacked therein. The first-type detection unit 101 includes a light emitting unit that emits detection light and a light receiving unit that receives the detection light, like in the conventional art, and detects the banknote with the fixed setting.

[0017] The second-type detection units 102 are arranged at many locations in the transport path on which the transport unit 30 transports the banknote, and detect the banknote on the transport path. Moreover, the second-type detection unit 102 is arranged in each of the storing/dispensing units 70. The second-type detection unit 102 detects the banknote stored into the storing/dispensing unit 70 and the banknote fed from the storing/dispensing unit 70.

[0018] In addition, as shown in FIG. 2, the banknote handling apparatus 1 includes a control unit 90, an operation/display unit 91, and a memory 92. The control unit 90 controls various structural components shown in FIG. 2. The memory 92 is, for example, a nonvolatile storage device constituted by a semiconductor memory. Computer programs and data necessary to realize the functions and operations of the various structural components shown in FIG. 2 are stored in the memory 92. The operation/display unit 91, for example, is constituted by a touch-screen liquid crystal display device. The operation/display unit 91 functions as an operation unit used to input various pieces of information when an operator of the banknote handling apparatus 1 performs an instruction operation and a setting operation. Moreover, the operation/display unit 91 functions as a display unit for the control unit 90 to output and display various information for the operator.

[0019] Next, a configuration of the second-type detection unit 102 is explained. As shown in FIG. 2, the second-type detection unit 102 includes a sensor unit 103, a first determination unit 111, a second determination unit 112, an output selection unit 120, a threshold value setting unit 130, and a sensor setting unit 140.

[0020] The sensor unit 103 includes a light emitting unit 103a that emits detection light, and a light receiving unit 103b that receives the detection light emitted by the light emitting unit 103a. The light emitting unit 103a and the light receiving unit 103b are arranged such that the detection light is blocked by the banknote transported by the transport unit 30. The light receiving unit 103b outputs an analog signal indicative of a received light intensity of the detection light. The analog signal output by the light receiving unit 103b is input into both the first determination unit 111 and the second determination unit 112. The analog signal output from the light receiving unit 103b is named a detecting signal, and the sensor unit 103 is also outputs the detecting signal of the light receiving unit 103b.

[0021] A threshold value (i.e. a first threshold value) for the first determination unit 111 is fixed. On the other hand, a threshold value (i.e. a second threshold value) for the second determination unit 112 can be changed. The threshold value setting unit 130 changes the threshold value of the second determination unit 112.

[0022] The sensor setting unit 140 sets an output level of the detecting signal output from the sensor unit 103 that is an output level of the detecting signal output form the light receiving unit 103b. When the setting of the light receiving unit 103b is fixed and an emission intensity of the detection light emitted by the light emitting unit 103a is adjusted, an output level of the detecting signal output from the light receiving unit 103b can be changed. When the setting of the light emitting unit 103a is fixed and a sensor sensitivity of the sensor unit 103 is adjusted, an output level output of the detecting signal from the light receiving unit 103b can be changed. The adjustment of the sensor sensitivity of the sensor unit 103 refers to adjustment of the output level of the detecting signal output from the light receiving unit 103b that receives the detection light of the same emission intensity. The sensor setting unit 140 sets an output level of the detecting signal output from the sensor unit 103 by adjusting one or both the emission intensity of the detection light emitted by the light emitting unit 103a and the sensor sensitivity of the sensor unit 103.

[0023] The first determination unit 111 and the second determination unit 112 compare the analog signal input thereinto by the light receiving unit 103b with the first threshold value and the second threshold value respectively, and determine whether the sensor unit 103 is in a state when the detection light is in a light transmissive state or in a state when the detection light is in a light interruptive state. That is, it is determined whether the banknote is detected at a detection position of the sensor unit 103. Each of the first determination unit 111 and the second determination unit 112 output a digital signal named a determination signal to indicate the determina-

tion result of each of the first determination unit 111 and the second determination unit 112. That is, the first determination unit 111 and the second determination unit 112 output a first digital signal named a first determination signal and a second determination signal respectively. Furthermore, the digital signal means a binarized signal which is generated by binarizing the analog signal by the first or second determination unit 111, 112 in this description.

[0024] There are various types of banknote such as a paper banknote or a polymer banknote not having a window part, a banknote such as a windowed banknote having a window part, and so forth. A banknote such as a paper banknote and a polymer banknote that can be detected in the same manner as the paper banknote, are detected by using the first determination unit 111. On the other hand, a banknote that cannot be correctly detected in the determination by the first determination unit 111, such as a polymer banknote having a window part, is detected by using the second determination unit 112. Details of a detection method of the banknote are described later.

[0025] The first determination signal indicating the determination result obtained by the first determination unit 111 is input into the output selection unit 120. The second determination signal indicating the determination result obtained by the second determination unit 112 is also input into the output selection unit 120. The output selection unit 120 selects one between the first determination signal indicating the determination result obtained by the first determination unit 111 and the second determination signal indicating the determination result obtained by the second determination unit 112, and inputs the selected signal into the control unit 90.

[0026] The setting of the threshold value by the threshold value setting unit 130, the setting of the output level by the sensor setting unit 140, and the selection of the determination signal by the output selection unit 120 are performed under the control of the control unit 90. Details of such control will be explained later.

[0027] The control unit 90 determines whether the state of the sensor unit 103 is in the state where the detection light is in the light transmissive state or in the state where the detection light is in the light interruptive state. The control unit 90 determines that based on the first determination signal of the first determination unit 111 or the second determination signal of the second determination unit 112 input by the output selection unit 120. The control unit 90 performs, by controlling the various structural components based on the determination result, the recognition process of the banknotes by the recognition unit 20, the switching process of the transport path by the diverter arranged in the transport path, the storing process of the banknotes in the storing/dispensing units 70, the feeding process of the banknotes from the storing/dispensing units 70, the storing process of the banknotes in the collection unit 80, the calculation process of the length of the banknote in the transport direction of the banknote.

[0028] Next, the sensor unit 103 that includes the light emitting unit 103a and the light receiving unit 103b is explained. FIG. 3 is a schematic diagram indicating an example of arrangement of the light emitting unit 103a and the light receiving unit 103b. In the below explanation it is assumed that a short edge of a banknote 200 transported by the transport unit 30 is the leading edge in the transport direction of the banknote 200, and the banknote 200 is transported in a positive X-axis direction along a transport surface 31 parallel to an XY plane.

[0029] As shown in FIG. 3, the light emitting unit 103a and the light receiving unit 103b are arranged in such a way to sandwich the transport surface 31 on which the banknote 200 is transported. The detection light is emitted by the light emitting unit 103a arranged on one side of the transport surface 31 and the detection light is received by the light receiving unit 103b arranged on the other side of the transport surface 31. When the banknote 200 transported along the transport surface 31 blocks the detection light, an intensity of the detection light received by the light receiving unit 103b changes. The control unit determines the state of the banknote transported on the transport surface 31 based on the determination of the first determination unit 111 and the second determination unit 112 by the sensor unit 103 detecting the change.

[0030] A movement of the banknote 200 on the transport surface 31 in a Y-axis direction is restricted in a predetermined range by a transport guide. FIG. 3 shows an example in which the banknote 200 is detected at one location on the transport surface 31. The banknote handling apparatus 1 can also detect the banknote 200 at the other locations along the Y-axis direction, which is orthogonal to the transport direction, so that the banknote 200 can be surely detected irrespective of a transport position within the predetermined range restricted by the transport guide.

[0031] FIGS. 4A to 4C are schematic diagrams indicating examples in which a banknote is detected at two places. FIGS. 4A to 4C are views when seen from the transport direction, and dotted line arrows show the path of the detection light. FIG. 4A shows an example in which two sets of the light emitting unit 103a and the light receiving unit 103b are arranged to detect the banknote at two locations. The detection light is emitted in a positive Z-axis direction from an emission surface of the light emitting unit 103a, and the light is received by a photodetecting surface of the light receiving unit 103b. The photodetecting surface is separated from the emission surface by a distance Db in the Z-axis direction. The two light emitting units 103a are arranged such that their emission surfaces are in the same plane as the transport surface 31. When the banknote passes through the space of the distance Db between the emission surfaces of the light emitting units 103a and the photodetecting surfaces of the light receiving units 103b, the detection light is blocked. The two sets of the light emitting unit 103a and

the light receiving unit 103b are arranged at two locations that are spaced apart by the distance Da in the Y-axis direction that is orthogonal to the transport direction. The banknote can be detected at each of the detection positions at the two locations.

[0032] FIG. 4B is a view of an example in which the banknote is detected at two locations by using the light emitting unit 103a, the light receiving unit 103b, and a prism 104. The emission surface of the light emitting unit 103a and the photodetecting surface of the light receiving unit 103b are in the same plane as the transport surface 31. An incidence surface and an exit surface of the prism 104 are arranged in the same plane that is parallel to the transport surface 31. The detection light emitted in the positive Z-axis direction from the emission surface of the light emitting unit 103a enters the prism 104 from the incidence surface thereof. The detection light is reflected inside the prism 104 and changes its path, travels in a negative Z-axis direction, which is 180 degrees reversed than at the time of incidence, and exits from the exit surface. The exit surface is apart from the incidence surface by the distance Da in a negative Y-axis direction. The detection light exiting from the prism 104 is received by the photodetecting surface of the light receiving unit 103b. When the banknote passes through the space of the distance Db between the emission surface of the light emitting unit 103a and the incidence surface of the prism 104 and/or the space of the distance Db between the exit surface of the prism 104 and the photodetecting surface of the light receiving unit 103b, the detection light is blocked. When the banknote blocks the detection light at one of the detection positions at the two locations that are spaced apart by the distance Da in the Y-axis direction that is orthogonal to the transport direction, this banknote can be detected.

[0033] A configuration shown in FIG. 4C is different from that shown in FIG. 4B in that a light guide 105 is attached to each of the emission surface of the light emitting unit 103a and the photodetecting surface of the light receiving unit 103b. A lower surface of one light guide 105 contacts with an emission surface of the light emitting unit 103a and a lower surface of the other light guide 105 contacts with the photodetecting surface of the light receiving unit 103b. Upper surfaces of the two light guides 105 are in the same plane as the transport surface 31. The detection light emitted in the positive Z-axis direction from the emission surface of the light emitting unit 103a enters from a lower incidence surface of the light guide 105 and exits from an upper exit surface thereof. Then, like in FIG. 4B, the detection light enters from the incidence surface of the prism 104 and exits from the exit surface thereof. The detection light enters from the upper incidence surface and exits from the lower exit surface of the light guide 105 attached to the light receiving unit 103b, and is received by the photodetecting surface of the light receiving unit 103b. When the banknote passes through the space of the distance Db between the upper surfaces of one light guide 105 and the incidence surface of the prism 104 and/or the space of the distance Db between the exit surface of the prism 104 and the upper surface of the other light guide 105, the detection light is blocked. When the banknote blocks the detection light at one of the detection positions at the two locations that are spaced apart by the distance Da in the Y-axis direction that is orthogonal to the transport direction, this banknote can be detected.

[0034] In FIG. 4A, an optical path length of the detection light from the emission surface of the light emitting unit 103a to the photodetecting surface of the light receiving unit 103b is equal to the distance Db between the light emitting unit 103a and the light receiving unit 103b. On the other hand, the optical path length in case of FIG. 4B is a distance (Da+2(Db+Dc)), and the optical path length in case of FIG. 4C is a distance (Da+2(Db+Dc+Dd)). The distances Da, Db, Dc, and Dd vary according to the configuration of the banknote handling apparatus 1, the configuration of the transport path, and the like. The longer the optical path length is, the more the detection light is attenuated between the light emitting unit 103a and the light receiving unit 103b. Even if the lights of the same emission intensity are emitted by the light emitting unit 103a, the output level of the detecting signal output from the detecting signal output from the light receiving unit 103b of the sensor unit 103 reduces as the optical path length of the sensor unit 103 increases, and the output level of the detecting signal output from the light receiving unit 103b of the sensor unit 103 increases as the optical path length reduces. Accordingly, it is desirable to adjust the output level and the threshold value of the sensor unit 103 depending on the optical path length of the sensor unit 103. Moreover, an attenuation rate of the light also varies depending on a wavelength of the light emitted by the light emitting unit 103a. Therefore, it is desirable to adjust the output level and the threshold value of the sensor unit 103 depending on the wavelength of the light emitted by the light emitting unit 103a and the like that are different according to a type of the sensor unit 103. Moreover, a difference appears in the detection light received by the light receiving unit 103b depending on an environmental state where the sensor unit 103 is arranged and a deterioration state of the sensor unit 103. Therefore, the output level and the threshold value of the sensor unit 103 can be adjusted depending on these factors. In this manner, in the banknote handling apparatus 1, one or both the output level of the detecting signal output from the sensor unit 103 in the second-type detection unit 102 and the threshold value, which is used to compare with an output signal of the detecting signal output from the sensor unit 103 in the second-type detection unit 102 when determining whether the banknote is detected, can be changed based on one or more factors among a difference in the sensor including the optical path length difference and the wavelength difference, the difference in the environment in which the sensor is arranged, a deterioration degree of the sensor, a difference in material of the banknote, a

difference in the window part of the banknote, and the like. Therefore, the banknote transported on the transport path inside the apparatus can be correctly detected irrespective of the type of the banknote. When changing at least one of the output level and the threshold value of the sensor units 103 of the second-type detection units 102, the output level and the threshold value can be changed to different values in each of the sensor units 103. However, if the effect of the difference in the sensor including the optical path length difference and the wavelength difference, the difference in the environment in which the sensor is arranged, the deterioration degree of the sensor, the difference in the material of the banknote, the difference in the window part of the banknote, and the like, is small, the output level and the threshold value can be changed uniformly in the target sensor units 103.

[0035] Next, a detection method for detecting the banknote by using the second-type detection unit 102 is explained. FIG. 5 is a schematic diagram for explaining an example of a windowed banknote 200 that is a detection target of the second-type detection unit 102. The windowed banknote 200 shown in FIG. 5 is made of polymer and has a window part 202. The window part 202 induces a transparent part 202a and a semi-transparent part 202b. The transparent part 202a is made of transparent polymer resin. Almost nothing is printed at the transparent part 202a. A transmittance of the detection light is high at the transparent part 202a. The semi-transparent part 202b is a part in which a border or a pattern is printed in a faint printing color, such as white, on the transparent resin. A transmittance of the semi-transparent part 202b is lower than that of the transparent part 202a but is higher than that of a printed area 201 other than the window part 202. The printed area 201 other than the window part 202 is a non-transparent area. The detection light does almost not transmit through the printed area 201.

[0036] When using the sensor unit 103 that includes the prism 104 as shown in FIGS. 4B and 4C, the windowed banknote 200 is transported between the prism 104 and both the light emitting unit 103a and the light receiving unit 103b as shown with an arrow in FIG. 5. As shown with a dotted line in FIG. 5, the window part 202 constituted by the transparent part 202a and the semi-transparent part 202b pass the detection positions of the light emitting unit 103a and the light receiving unit 103b. Both the detection light emitted from the light emitting unit 103a and the detection light exiting from the exit surface of the prism 104 after being reflected inside the prism 104 pass through the window part 202, and therefore the banknote 200 may not be detected correctly. In the second-type detection unit 102, at least one of the output level and the threshold value of the sensor unit 103 is changed so that the windowed banknote 200 can be detected correctly. In the below explanation, a banknote through which the detection light does not pass, such as the paper banknote or the polymer banknote that does not have a window part is referred to as an "ordinary banknote" to differentiate from the windowed banknote 200 through which the detection light pass.

[0037] FIGS. 6A and 6B are views for explaining a detection method of the ordinary banknote. FIG. 6A shows a detecting signal (analog signal) output by the light receiving unit 103b when the ordinary banknote passes the detection position of the sensor unit 103. FIG. 6B shows a first determination signal (a digital signal, that is, a binarized signal) output by the first determination unit 111 based on the detecting signal (analog signal) of FIG. 6A output by the light receiving unit 103b. In a signal waveform of the analog signals and the digital signals (binarized signals) shown in FIGS. 6A to FIG. 10B, a voltage value is shown along the vertical axis and time is shown along the horizontal axis.

[0038] In the detection process of the ordinary banknote, the output level of the detecting signal output from the sensor unit 103, that is, the voltage value output by the light receiving unit 103b, is fixed as shown in FIG. 6A. Specifically, the voltage value output by the light receiving unit 103b in the light interruptive state, in which the detection light is blocked by the banknote, is set to 0 (zero), and the voltage value output by the light receiving unit 103b in the light transmissive state, in which the detection light is not blocked by the banknote, is set to Vs.

[0039] When the leading edge of the ordinary banknote in the transport direction of the banknote arrives at the detection position of the banknote of the sensor unit 103 and blocks the detection light, as shown in FIG. 6A, the voltage value output by the light receiving unit 103b changes from Vs to 0 (zero) . The light interruptive state continues while the ordinary banknote passes the detection position of the sensor unit 103, and the voltage value output by the light receiving unit 103b remains 0. When the trailing edge the ordinary banknote in the transport direction of the banknote passes the detection position, the state of the detection light changes to the light transmissive state, and the voltage value output by the light receiving unit 103b returns to Vs from 0. The analog signal output by the light receiving unit 103b of the sensor unit 103 is input into both the first determination unit 111 and the second determination unit 112. The ordinary banknote is detected by using the first determination unit 111.

[0040] The threshold value of the first determination unit 111 is fixed to a voltage value Vt set for the ordinary banknote. The first determination unit 111 determines that the detection light has been blocked when the voltage value drops to the threshold value Vt from Vs (t = tf) as shown in FIG. 6A. The first determination unit 111 determines that the state of the detection light has returned to the light transmissive state from the light interruptive state when the voltage value increases and reaches the threshold value Vt (t = te) as shown in FIG. 6A. The first determination unit 111, based on the determination result, outputs a digital signal in which the voltage value for the light transmissive state is 0 (zero) and the voltage value for the light interruptive state is Vd. That is, the first determination unit 111 converts the analog

signal shown in FIG. 6A to the digital signal shown in FIG. 6B in which the voltage value during the period between tf and te is Vd, and outputs this digital signal.

[0041] The output selection unit 120 outputs to the control unit 90 the digital signal input by the first determination unit 111. The control unit 90, based on the digital signal shown in FIG. 6B, recognizes the time tf when the leading edge of the ordinary banknote in the transport direction of the banknote arrived at the detection position of the sensor unit 103 and the time te when the trailing edge of the ordinary banknote in the transport direction of the banknote passed the detection position of the sensor unit 103. Then, the control unit 90 control the various structural components based on the recognition result to perform various processing.

[0042] FIGS. 7A to 7C are views for explaining a detection method of the windowed banknote 200. FIG. 7A shows the windowed banknote 200 which has a window part 202 as a detection target. FIG. 7B shows an analog signal output by the light receiving unit 103b when the windowed banknote 200 shown in FIG. 7A passes the detection position of the sensor unit 103. FIG. 7C shows a first determination signal (a digital signal, that is, a binarized signal) output by the first determination unit 111 based on the detecting signal (analog signal) of FIG. 7B output by the light receiving unit 103b.

[0043] In the detection process of the windowed banknote 200, while areas a1 and a2 shown in FIG. 7A pass the detection position of the sensor unit 103, a part of the detection light passes through the transparent part 202a and the semi-transparent part 202b of the window part 202. The output voltage value of the light receiving unit 103b becomes 0 (zero) while the ordinary banknote passes the detection position of the sensor unit 103. In contrast, the output voltage value of the light receiving unit 103b increases at the positions corresponding to the areas a1 and a2 as shown in FIG. 7B. The first determination unit 111 determines that the sensor unit 103 is in the state where the detection light is in the light transmissive state during a period between t2 and t3 in which the voltage value is higher than the threshold value Vt.

[0044] As a result, as shown in FIG. 7C, the digital signal output by the first determination unit 111 will have a waveform showing that the leading edge of the windowed banknote 200 in the transport direction of the banknote arrives at the banknote detection position of the sensor unit 103 and blocks the detection light (t = t1), and the state quickly changed to the light transmissive state (t = t2 to t3). Because the duration of the light interruptive state witch is during the period between t1 and t2 is short, it is possible that the control unit 90 mistakenly determines the light is blocked by dust and the like. Also, the control unit 90 mistakenly determines the blocking of the light that continues from a time t3 is a blocking by the leading edge of the windowed banknote 200 in the transport direction of the windowed banknote 200.

[0045] To address this issue, in the banknote handling apparatus 1, when detecting the windowed banknote 200, the digital signal of the first determination unit 111 is not output, but the digital of the second determination unit 112 is output. Specifically, the control unit 90 controls the output selection unit 120, the threshold value setting unit 130, and the sensor setting unit 140. The control unit 90 sets the output level of the detecting signal output from the sensor unit 103 , the threshold value of the second determination unit 112, and the digital signal to be output from the output selection unit 120 so that the windowed banknote 200 can be detected. The setting of the output level of the detecting signal output from the sensor setting unit 140 and the setting of the threshold value of the threshold value setting unit 130 is performed based on a characteristic of the window part 202 of the windowed banknote 200.

[0046] The setting of the second-type detection unit 102 to detect the windowed banknote 200 and the digital signal input into the control unit 90 by the second-type detection unit 102 are explained while referring to FIGS. 8A to 10B. FIGS. 8A and 8B are views for explaining a setting that only the output level of the detecting signal output from sensor unit 103 is changed while the threshold value is set to the same as that used for the ordinary banknote. FIG. 8A shows a detecting signal (analog signal) output by the light receiving unit 103b when the windowed banknote 200 shown in FIG. 7A passes the detection position of the sensor unit 103. FIG. 8B shows a second determination signal (a digital signal, that is, a binarized signal) output by the second determination unit 112 based on the detecting signal (analog signal) of FIG. 8A output by the light receiving unit 103b.

[0047] To detect the windowed banknote 200, the sensor setting unit 140 sets the sensor sensitivity such that the voltage value output by the light receiving unit 103b in the light interruptive state is set to 0 (zero), and the voltage value output by the light receiving unit 103b in the light transmissive state is set to Vsa as shown in FIG. 8A. The voltage value Vsa is lower than the voltage value Vs used to detect the ordinary banknote. On the other hand, the threshold value setting unit 130 does not change the threshold value Vt of the second determination unit 112 but maintains it to the one used to detect the ordinary banknote.

[0048] As shown in FIG. 8A, the signal waveform of the analog signal output by the light receiving unit 103b will have a waveform that is compressed along the vertical axis direction in comparison to the signal waveform shown in FIG. 7B, and the voltage value that increases while the window part 202 passes becomes lower than the threshold value Vt. As shown in FIG. 8B, the digital signal output by the second determination unit 112 will have a waveform showing the light interruptive state in a period from a time t1 when the leading edge of the windowed banknote 200 in the transport direction of the banknote arrives at the detection position by the sensor unit 103 to a time t4 when the trailing edge in the transport direction passes the detection position. That is, the signal waveform becomes the waveform that correctly detects

the leading edge and the trailing edge the windowed banknote 200 in the transport direction of the banknote without being affected by the window part 202.

[0049] The output selection unit 120 inputs the determination result (digital signal, that is, binarized signal) obtained by the second determination unit 112 into the control unit 90, and the control unit 90 correctly detects the windowed banknote 200 based on the input digital signal.

[0050] Various methods can be used to change the voltage value (output level) of the sensor unit 103. For example, only the sensor sensitivity can be changed, only the emission intensity of the light emitting unit 103a can be changed, or both the sensor sensitivity and the emission intensity can be changed. Specifically, the sensor setting unit 140 can set the sensor sensitivity such that the voltage value output by the light receiving unit 103b in the light interruptive state becomes 0 (zero), and the voltage value output by the light receiving unit 103b in the light transmissive state becomes Vsa. Alternatively, the sensor setting unit 140 can set the emission intensity of the light emitting unit 103a so that the voltage value output by the light receiving unit 103b in the light interruptive state becomes 0 (zero), and the voltage value output by the light receiving unit 103b in the light transmissive state becomes Vsa. Alternatively, the sensor setting unit 140 can set both the sensor sensitivity and the emission intensity of the light emitting unit 103a so that the voltage value output by the light receiving unit 103b in the light interruptive state becomes 0 (zero), and the voltage value output by the light receiving unit 103b in the light transmissive state becomes Vsa. By setting at least one between the emission intensity of the light emitting unit 103a and the sensor sensitivity of the sensor unit 103, the output level of the detecting signal output from the sensor unit 103 can be changed to obtain the waveforms shown in FIGS. 8A and 8B.

[0051] FIGS. 9A and 9B are views for explaining a setting that only the threshold value is changed while the output level of the detecting signal output from the sensor unit 103 is set to the same as that used for the ordinary banknote. FIG. 9A shows a detecting signal (analog signal) output by the light receiving unit 103b when the windowed banknote 200 shown in FIG. 7A passes the detection position of the sensor unit 103. FIG. 9B shows a second determination signal (a digital signal, that is, a binarized signal) output by the second determination unit 112 based on the detecting signal (analog signal) of FIG. 9A output by the light receiving unit 103b.

[0052] To detect the windowed banknote 200, the threshold value setting unit 130 changes the threshold value of the second determination unit 112 from the threshold value Vt for the ordinary banknote to Vta. The threshold value Vta is higher than the threshold value Vt used to detect the ordinary banknote. On the other hand, the sensor setting unit 140 does not change the output level of the detecting signal output from the sensor unit 103 but maintains it to that used to detect the ordinary banknote. That is, the emission intensity and the sensor sensitivity are set such that the voltage value output by the light receiving unit 103b in the light interruptive state becomes 0 (zero), and the voltage value output by the light receiving unit 103b in the light transmissive state becomes Vs.

[0053] As shown in FIG. 9A, the signal waveform output by the light receiving unit 103b is the same as the signal waveform shown in FIG. 7B; however, because the threshold value has been set high, the voltage value that increases while the window part 202 passes becomes lower than the threshold value Vta. As shown in FIG. 9B, the digital signal output by the second determination unit 112 will have a waveform showing the light interruptive state in a period from a time t1 when the leading edge of the windowed banknote 200 in the transport direction of the windowed banknote 200 arrives at the detection position by the sensor unit 103 to a time t4 when the trailing edge in the transport direction passes the detection position. That is, the signal waveform becomes the waveform that correctly detects the leading edge and the trailing edge of the windowed banknote 200 in the transport direction of the windowed banknote 200 without being affected by the window part 202.

[0054] The output selection unit 120 inputs the determination result (digital signal, that is, binarized signal) obtained by the second determination unit 112 into the control unit 90, and the control unit 90 correctly detects the windowed banknote 200 based on the input digital signal.

[0055] FIGS. 10A and 10B are views for explaining a setting that both the output level and the threshold value of the sensor unit 103 are changed. FIG. 10A shows a detecting signal (analog signal) output by the light receiving unit 103b when the windowed banknote 200 shown in FIG. 7A passes the detection position of the sensor unit 103. FIG. 10B shows a second determination signal (a digital signal, that is, a binarized signal) output by the second determination unit 112 based on the detecting signal (analog signal) of FIG. 10A output by the light receiving unit 103b.

[0056] To detect the windowed banknote 200, the sensor setting unit 140 sets at least one between the emission intensity and the sensor sensitivity of the light emitting unit 103a so that the voltage value output by the light receiving unit 103b in the light interruptive state is set to 0 (zero), and the voltage value output by the light receiving unit 103b in the light transmissive state is set to Vsb. The voltage value Vsb is lower than the voltage value Vs used to detect the ordinary banknote. As shown in FIG. 10A, the signal waveform of the analog signal output by the light receiving unit 103b will have a waveform that is compressed along the vertical axis direction in comparison to the signal waveform shown in FIG. 7B. As a result, the voltage value that increases while the window part 202 passes becomes lower than the threshold value Vt for the ordinary banknote.

[0057] Moreover, the threshold value setting unit 130

changes the threshold value of the second determination unit 112 from the threshold value Vt for the ordinary banknote to Vtb. The threshold value Vtb is lower than the threshold value Vt used to detect the ordinary banknote but higher than the voltage value that increases due to the window part 202. As shown in FIG. 10A, the voltage value that increases while the window part 202 passes becomes lower than the threshold value Vtb.

[0058] As shown in FIG. 10B, the digital signal output by the second determination unit 112 will have a waveform showing that the light interruptive state in a period from a time t1 when the leading edge of the windowed banknote 200 in the transport direction of the banknote arrives at the detection position by the sensor unit 103 to a time t4 when the trailing edge of the windowed banknote 200 in the transport direction of the banknote passes the detection position. That is, the signal waveform becomes the waveform that correctly detects the leading edge and the trailing edge of the windowed banknote 200 in the transport direction of the banknote without being affected by the window part 202.

[0059] The output selection unit 120 inputs the determination result (digital signal) obtained by the second determination unit 112 into the control unit 90, and the control unit 90 correctly detects the windowed banknote 200 based on the input digital signal.

[0060] As shown in FIG. 8A, when only the output level of the signal output from the sensor is changed without changing the threshold value Vt, a difference between the voltage value Vsa indicating the light transmissive state and the threshold value Vt becomes small. As shown in FIG. 9A, when only the threshold value is changed to Vta without changing the output level of the signal output from the sensor, the difference between the voltage value Vs indicating the light transmissive state and the threshold value Vta becomes small. Therefore, if the detection light is blocked by dust and the like on the transport path, the voltage value output by the light receiving unit 103b may drop below the threshold value, and such blocking due to the dust and the like may be mistakenly determined as the blocking by the banknote. As shown in FIGS. 10A and 10B, by changing the output level of the signal output from the sensor to lower the voltage value indicating the light transmissive state and by lowering the threshold value, the effect of transmission of the detection light due to the window part 202 can be avoided, and the possibility that the dust and the like is mistakenly detected as a banknote can be reduced.

[0061] The threshold voltage values Vt, Vta, and Vtb, and the output setting voltage levels Vs, Vsa, and Vsb that are the output level of the signal output from the sensor are set depending on the characteristics of the banknote that is the detection target. Specifically, the voltage values Vt and Vs are set to values by which the leading edge and the trailing edge of the ordinary banknote in the banknote transport direction can be detected correctly, and the voltage values Vta, Vtb, Vsa, and Vsb are set to values by which the leading edge and the trailing edge of the windowed banknote 200 in the transport direction of the windowed banknote 200 can be detected correctly. For example, these voltage values are determined experimentally by actually processing a banknote that is the detection target in the banknote handling apparatus 1. When there are several types of the windowed banknote 200, different threshold voltage values and different output voltage values can be set depending on at least one among material of the banknote, a size of a window part, a shape of the window part, a transmittance of a transparent part of the window part and a transmittance of a semi-transparent part of the window part, and the like.

[0062] FIGS. 11A and 11B are views for explaining the threshold voltage values and the output voltage values. The control unit 90 manages information about processing target denominations shown in FIG. 11A, and information about storing target denominations and depositing target denominations stored in the memory 92 and managed.

[0063] FIG. 11A is shows the processing target denominations. A banknote of a denomination which is included in the processing target denominations can be recognized and counted by the banknote handling apparatus 1. For each of the processing target denominations, information about a currency, a denomination, material, a window part, a banknote detection setting are stored previously. Information under an item of the window part indicates whether the banknote has a window part.

[0064] The banknote detection setting includes information about a determination unit, an output voltage value, a threshold voltage value, and a priority. Information under an item of the determination unit indicates which between the first determination unit 111 and the second determination unit 112 is to be used to detect the banknote. When several types of banknotes are to be detected, information under an item of the priority is used to select a default setting from among banknote detection settings for the several types of banknotes. Lower the value of the priority is, higher the priority is.

[0065] For example, when a banknote of a denomination E is processed by the banknote handling apparatus 1, the control unit 90 refers to the information of the processing target denomination. Then, the control unit 90 controls the threshold value setting unit 130 to set the threshold voltage value of the second determination unit 112 to Vtb, and controls the sensor setting unit 140 to set the output voltage value of the sensor unit 103 to Vsb. Moreover, the control unit 90 controls the output selection unit 120 so that the digital signal output by the second determination unit 112 is input into the control unit 90. By setting the output level of the detecting signal output from the sensor unit 103 and the threshold value of the second determination unit 112 as is explained with reference to FIGS. 10A and 10B, the banknote of the denomination E that is the polymer banknote having the window part can be detected correctly.

[0066] FIG. 11B shows the storing target denomina-

tions and the depositing target denominations. A denomination included in the storing target denominations is assigned to the storing/dispensing unit 70 of the banknote handling apparatus 1 to stack the banknotes of assigned denomination. The storing target denominations are included in the depositing target denominations. A banknote of a denomination which is included in the depositing target denomination can be received in the money depositing unit 10 and stored in the storing/dispensing unit 70 or the collection unit 80 by the banknote handling apparatus 1.

[0067] An operator of the banknote handling apparatus 1 selects a denomination from among the processing target denominations shown in FIG. 11A, and assigns the selected denomination to one of the storing/dispensing units 70. The denominations assigned to the storing/dispensing units 70 are the storing target denominations. Each of the storing/dispensing units 70 stores therein the banknotes of the denomination assigned thereto.

[0068] The operator of the banknote handling apparatus 1 selects, from among the processing target denominations shown in FIG. 11A, a denomination of the banknote that can be deposited but cannot be dispensed, and assigns the selected denomination to the collection unit 80. The denominations assigned to the collection unit 80 and the storing target denominations constitute the depositing target denominations.

[0069] In the money dispensing process, the operator can select a denomination from among the denominations set as the storing target denominations, and the banknote of the selected denomination is dispensed by the banknote handling apparatus 1. In the money depositing process, the operator can deposit the banknote of the denominations set as the depositing target denominations. In the counting process performed by using only the upper unit 2, the operator can select a target denomination from among the denominations included in the processing. In the counting process, the banknotes put in the money depositing unit 10 are recognized and counted by the recognition unit 20, and all the banknotes are discharged to the money dispensing unit 40 or the outside reject unit 50.

[0070] When the storing target denominations are set as shown in FIG. 11B, the control unit 90 of the banknote handling apparatus 1 changes the setting of the second-type detection unit 102 arranged in each of the storing/dispensing units 70 based on the banknote detection setting shown in FIG. 11A. For example, the control unit 90 refers to the banknote detection setting of FIG. 11A for the second-type detection units 102 of a first storing/dispensing unit 70 and a second storing/dispensing unit 70 to which a denomination B has been assigned. The control unit 90 controls the output selection unit 120 based on the banknote detection setting of the denomination B so that the digital signal output by the first determination unit 111 is input into the control unit 90. For example, the control unit 90 refers to the banknote detection setting of FIG. 11A for the second-type detection unit 102 of a third storing/dispensing unit 70 to which the banknote of a denomination C has been assigned. The control unit 90 controls the output selection unit 120, the threshold value setting unit 130 and the sensor setting unit 140 based on the banknote detection setting of the denomination C so that the threshold voltage value is set to Vsa and the output voltage value is set to Vt, and the digital signal output by the second determination unit 112 is input into the control unit 90.

[0071] The control unit 90 sets the second-type detection unit 102 that is arranged in the transport path provided outside the storing/dispensing units 70 based on the depositing target denominations and the priority of the banknote detection setting. Specifically, when the denominations A to E are set as the depositing target denominations as shown in FIG. 11B, the control unit 90 refers to the priority shown in FIG. 11A and changes the setting of all the second-type detection units 102 arranged outside the storing/dispensing units 70 based on the setting of the denomination E having the highest priority.

[0072] That is, the control unit 90 changes the setting of the second-type detection unit 102 arranged in each of the storing/dispensing units 70 so as to match with the setting of the denomination to be stored therein, and the control unit 90 changes the setting of the other second-type detection units 102 so as to match with the setting of the denomination having the highest priority among the depositing target denominations. Moreover, while the a setting selected based on the depositing target denominations and the priority is set as the default setting, the setting of the second-type detection units 102 arranged in the transport path outside the storing/dispensing units 70 can be changed based on the denomination specified as the processing target and the denomination recognized by the recognition unit 20. A method of changing the setting is explained by referring FIGS. 12 and 13.

[0073] FIG. 12 is a flowchart of a process for changing a setting of the second-type detection unit 102 after a denomination is specified. The operator of the banknote handling apparatus 1 operates the operation/display unit 91 to specify a denomination and start the money depositing process . The control unit 90 receives a specification of a denomination (Step S1). The control unit 90 refers to the information of the processing target denominations shown in FIG. 11A, and retrieves the banknote detection setting of the specified denomination specified by the operator (Step S2). The control unit 90 compares the default setting of the second-type detection unit 102 that was set based on the depositing target denominations and the priority with the banknote detection setting of the specified denomination. Based on such comparison, the control unit 90 determines whether it is necessary to change the setting of the second-type detection unit 102 (Step S3). When it is not necessary to change the setting (Step S3: No), the control unit 90 performs the banknote processing by using the default setting (Step S4) and finishes the banknote processing.

[0074] On the other hand, when it is necessary to change the setting (step S3: Yes), the control unit 90 changes the setting of all the second-type detection units 102 arranged in the transport path outside the storing/dispensing units 70 to the banknote detection setting of the specified denomination (Step S5). The control unit 90 performs the banknote processing with the changed setting (Step S6), and finishes the banknote processing.

[0075] For example, assume that the banknote detection setting of the denomination E is used as the default setting. When the denomination B is specified as the specified denomination, the control unit 90 controls the output selection unit 120 to change the setting of the second-type detection units 102 arranged in the transport path outside the storing/dispensing units 70, and therefore the digital signal of the first determination unit 111 is input into the control unit 90. As a result, in the second detecting units 102 arranged in the transport path, each banknote is detected by using the first determination unit 111 while processing banknotes of the denomination B.

[0076] After having finished the banknote processing, the control unit 90 can return the setting of the second-type detection units 102 arranged in the transport path outside the storing/dispensing units 70 to the default setting of the denomination E or can maintain to the setting of the denomination B as is. In either case, after the banknote processing is started next, if it is necessary to change the setting of the second-type detection unit 102 depending on the type of the banknote, the setting will be changed automatically. If the denomination of the banknote has not been specified, the denomination cannot be identified, and the like, the default setting is used as the setting of the second-type detection unit 102.

[0077] In the money dispensing process as well, based on a denomination of a banknote specified to be dispensed, the setting of the second-type detection units 102 arranged in the transport path outside the storing/dispensing units 70 is changed as necessary. While feeding the banknotes one by one from the storing/dispensing units 70 and transporting the fed banknotes to the money dispensing unit 40, the setting of the second-type detection unit 102 is changed for each of banknotes being transported. As a result, each of the banknotes can be detected correctly. Even when dispensing banknotes of a plurality of denominations, each of the banknotes can be detected correctly by changing the setting of the second-type detection unit 102 based on the denomination of each banknote.

[0078] FIG. 13 is a flowchart of a process for changing a setting of the second-type detection unit 102 based on a recognition result obtained by the recognition unit 20. When the money depositing process is started in the banknote handling apparatus 1, the recognition unit 20 recognizes a denomination of a banknote (Step S11). The control unit 90 refers to the information about the processing target denominations of FIG. 11A based on the recognition result, and retrieves the banknote detection setting of this banknote (Step S12). The control unit 90 compares the default setting of the second-type detection unit 102 that was set based on the depositing target denominations with the banknote detection setting of the recognized denomination. Based on such comparison, the control unit 90 determines whether it is necessary to change the setting (Step S13). When it is not necessary to change the setting (Step S13: No), the control unit 90 continues the banknote processing, without changing the default setting, of transporting the banknote and storing the banknote in a predetermined destination.

[0079] On the other hand, when it is necessary to change the setting (step S13: Yes), the control unit 90 changes the setting of the second-type detection units 102 arranged in the transport path outside the storing/dispensing units 70 to the banknote detection setting corresponding to the denomination of this banknote at the time of the arrival of the recognized banknote (Step S14). The control unit 90 executes Step S14 sequentially for all the second-type detection units 102.

[0080] When processing of all the banknotes tc be deposited is not finished (Step S15: No), the process procedure returns to Step S11 and the control unit 90 continues the banknote processing. When processing of all the banknotes to be deposited is finished (Step S15: Yes), the control unit 90 finishes the banknote deposit process. Even in this case, like in the case of FIG. 12, after having finished the banknote handling, the setting of the second-type detection units 102 arranged in the transport path outside the storing/dispensing units 70 can maintained as is or can be returned to the default setting. In either case, after the next banknote handling is started, if it is necessary, the setting of the second-type detection unit 102 will be changed automatically.

[0081] In this manner, by changing the setting of the second-type detection units 102 that are arranged in the transport path provided outside the storing/dispensing units 70 based on the recognition result of the banknote obtained by the recognition unit 20, each of the banknotes can be detected correctly based on a setting depending on each banknote.

[0082] When changing the setting cf the second-type detection unit 102 depending on the processing target denomination, it is not limited that the setting of only the second-type detection units 102 arranged in the transport path outside the storing/dispensing units 70 is changed. That is, when performing the process shown in FIG. 12, depending on the specified denomination, it is allowable to change the setting of all the second-type detection units 102 arranged in the banknote handling apparatus 1. Similarly, when performing the process shown in FIG. 13, depending on the recognition result obtained by the recognition unit 20, it is allowable to change the setting of all the second-type detection units 102 arranged in the banknote handling apparatus 1.

[0083] In the present embodiment, as shown in FIG. 2, the second-type detection unit 102 includes the two determination units of the first determination unit 111 and the second determination unit 112; however, the config-

uration of the second-type detection unit 102 is not limited to this. It is allowable that the second-type detection unit 102 does not include the first determination unit 111 but includes only one determination unit having the same configuration as the second determination unit 112. FIG. 14 is a block diagram of a configuration of the second-type detection unit 102 that includes only one determination unit 110. Even when the second-type detection unit 102 has the configuration shown in FIG. 14, by setting a threshold voltage value of the determination unit 110 by the threshold value setting unit 130 and setting the output level of the detecting signal output from the sensor unit 103 by the sensor setting unit 140 based on the type of the detection target banknote, the banknotes including the ordinary banknote and the windowed banknote can be detected correctly in the same manner as explained above.

[0084] It is also allowable that the second-type detection unit 102 shown in FIG. 2 can include the first determination unit 111, and two or more determination units that have the same function and realize the same operation as the second determination unit 112. It is also allowable that the second-type detection unit 102 shown in FIG. 14 can include a plurality of determination units that have the same function and realize the same operation as the determination unit 110.

[0085] It is desirable to use a smart sensor as the sensor unit 103 of the second-type detection unit 102 for detecting the window part of the banknote with a high degree of accuracy. Specifically, during the light transmissive state of the detection light in which the window part passes between the light emitting unit 103a and the light receiving unit 103b, it is required that a stable output signal is obtained by the sensor unit 103.

[0086] While the window part passes between the light emitting unit 103a and the light receiving unit 103b, the banknote is present therebetween even though the detection light is in the light transmissive state. Conventionally, for example, a less expensive tracking sensor constituted by a light emitting unit and a light receiving unit is used for detecting the passing of the banknote on the transport path. When the window part is detected by using such a tracking sensor, the output signal becomes unstable by being affected by material, a crease, and the like of the window part leading to occurrence of a waveform breakage. The waveform breakage is a phenomenon in which the level of the output signal drops in the middle of being in the light transmissive state. Accordingly, it is desirable to use as the sensor unit 103 a smart sensor by which the waveform breakage can be prevented from occurring; however, in the banknote handling apparatus 1, a less expensive tracking sensor can be used while avoiding the output signal being affected by the waveform breakage.

[0087] The details will be explained below by referring to FIGS . 15 to 16C. FIG. 15 is a schematic diagram indicating a configuration of the transport path when seen from the Y-axis direction. FIGS. 16A to 16C are views for explaining a method for avoiding an effect of the waveform breakage. A banknote 300 shown in FIGS. 15 and 16A is a polymer banknote having a window part 302. The window part 302 is made of transparent resin that constitutes the polymer forming the banknote 300 and transmits the light. On the other hand, a printed area 301 blocks the light.

[0088] As shown in FIG. 15, a smart sensor 303 and a tracking sensor 304 are arranged side by side in the transport direction (X-axis direction) at positions where the banknote 300 transported along the transport surface 31 passes immediately after being fed from the money depositing unit 10. The smart sensor 303 is separated from the tracking sensor 304 by a distance Wa so that the detection result by the smart sensor 303 is not affected by detection light of the tracking sensor 304 while the smart sensor 303 detects the window part 302 of the banknote 300, and the detection result by the tracking sensor 304 is not affected by detection light of the smart sensor 303 while the tracking sensor 304 detects the window part 302. Specifically, the distance Wa is set to be longer than a width Wb (Wa > Wb) of the window part 202 in the transport direction shown in FIG. 16a. As shown in FIG. 15, the smart sensor 303 and the tracking sensor 304 are arranged at positions where the banknote 300 passes immediately after being fed from the money depositing unit 10, a sensor 305 that is a sensor same as the tracking sensor 304 is arranged at other position, and this sensor 305 is used as the sensor unit 103 of the second-type detection unit 102.

[0089] As shown in FIG. 16A, the smart sensor 303 and the tracking sensor 304 are arranged so that the positions thereof match a passing position of the window part 302 of the banknote 300 immediately after being fed. FIG. 16B is a diagram indicating the output signal when the smart sensor 303 detects the window part 302. FIG. 16C is a diagram indicating the output signal when the tracking sensor 304 detects the window part 302. The output signal shown in FIG. 16B is obtained when the banknote 300 is transported on the transport surface 31 as shown in FIG. 16A and the window part 302 passes a detection position of the smart sensor 303. Thereafter, the output signal shown in FIG. 16C is obtained when the window part 302 passes a detection position of the tracking sensor 304. FIGS. 16A to 16C are shown in a single line so as to allow to see the correspondence between the output signals and the window part 302.

[0090] As shown in FIG. 16B, by setting the output voltage value to 0 (zero) in the light interruptive state where the printed area 301 other than the window part 302 passes the detection position, the smart sensor 303 outputs a stable voltage value V1 during a period from a time t11 to a time t12 that is a period for which the window part 302 is passing. On the other hand, as shown in FIG. 16C, by setting the output voltage value to 0 (zero) in the light interruptive state where the printed area 301 passes the detection position, the tracking sensor 304 outputs a voltage value V2 during the period between t11 and t12 that

is the period for which the window part 302 is passing, however; the voltage value V2 is unstable. For example, as shown in FIG. 16C, the waveform breakage in which the voltage value decreases during a period from a time t22 to a time t23 occurs. During this period between t22 and t23, it is generally determined as the light interruptive state.

[0091] The control unit 90 of the banknote handling apparatus 1 compares the output signal shown in FIG. 16B with the output signal shown in FIG. 16C. Based on the output signal of the smart sensor 303 obtained during the period between t11 and t12, the control unit 90 determines that the output signal of the tracking sensor 304 obtained during a period from the time t21 to a time t24 indicates the detection result of the window part 302. The control unit 90 determines that the drop in the voltage value during the period between t22 and t23 does not indicate the light interruptive state and the waveform breakage occurred. The control unit 90 stores information about the waveform breakage in the memory 92.

[0092] Specifically, for example, the control unit 90 stores in the memory 92 a waveform of the output signal obtained by the tracking sensor 304 during the passing of the window part 302, that is, information for specifying a waveform during the period between t21 and t24 shown in FIG. 16C. When the output signal having the waveform shown in FIG. 16C is obtained from the sensor 305 positioned downstream of the tracking sensor 304 in the transport direction, the control unit 90 determines that the obtained output signal is the signal obtained by detecting the window part 302 of the banknote 300.

[0093] Alternatively, for example, the control unit 90 stores in the memory 92 a period (period between t21 and t22) from a time when a front end of the window part 302 reaches the detection position of the tracking sensor 304 and the state changes to the light transmissive state to a time when the voltage drop starts, and a duration (period between t22 and t23) for which the voltage drop continues. After the output signal of the sensor 305 indicates the light transmissive state, if a position at which the voltage drop starts and a duration of the voltage drop obtained from the output signal of the sensor 305 match the information stored in the memory 92, the control unit 90 determines that the output signal is the signal obtained by detecting the window part 302 of the banknote 300.

[0094] Alternatively, for example, it is possible to detect the window part 302 of the banknote 300 by performing a tracking process of the banknote 300. The control unit 90 can track by using a plurality of the sensors 305 arranged in several positions on the transport path a position of each of the banknotes 300 fed inside the apparatus from the money depositing unit 10 and transported on the transport path. After the banknote is fed from the money depositing unit 10, he control unit 90 determines whether a banknote has a window part by using the smart sensor 303. The control unit 90 tracks the banknote having the window part being transported on the transport path, and therefore the control unit 90 can determine whether the banknote detected by a certain sensor 305 has the window part based on the tracking result. Additionally, even when the output signal obtained by that sensor 305 has a waveform breakage, the control unit 90 can determine that the banknote is normal if the waveform breakage of the output signal matches the information about the waveform breakage of this banknote stored in the memory 92.

[0095] The control unit 90 detects a window part of the banknote by using the smart sensor 303 and the tracking sensor 304 every time when the banknotes are fed one by one inside the apparatus from the money depositing unit 10. When it is determined that a waveform breakage appears in the output signal of the tracking sensor 304 based on the comparison of the output signal of the smart sensor 303 with the output signal of the tracking sensor 304, the control unit 90 stores information about the waveform breakage in the memory 92. The control unit 90 determines based on the information stored in the memory 92 whether the waveform indicating the voltage drop occurring in the output signal of the sensor 305 matches a feature that indicates the waveform breakage. Upon matching, the control unit 90 determines that the voltage drop does not indicate that the light interruptive state and that the waveform includes the waveform breakage. Accordingly, even when the waveform breakage occurs in the detected waveform of the window part 302 due to the performance of the sensor, it is possible to detect the window part 302 while avoiding the effect of the waveform breakage. By using the smart sensor 303 only at the position where the banknote passes immediately after being fed from the money depositing unit 10, and by using the less expensive sensor as other sensors, it is possible to suppress the costs incurred in the banknote handling apparatus 1.

[0096] In the present embodiment, for making the explanation simple, the operation performed by the control unit 90 is explained, however; when the sensor 305 shown in FIG. 15 is used as the sensor unit 103 of the second-type detection unit 102 shown in FIG. 2, a signal determination process for the sensor 305 is performed by the first determination unit 111 and the second determination unit 112. Similarly, when the sensor 305 is used as the sensor unit 103 of the second-type detection unit 102 shown in FIG. 14, the signal determination process for the sensor 305 is performed by a determination unit 110. By inputting from the control unit 90 the information about the feature of the waveform breakage to the first determination unit 111, the second determination unit 112, and the determination unit 110, the functions and the operations explained with referring to FIGS. 1 to 14 can be realized even when the less expensive sensor 305 is used as the sensor unit 103 of the second-type detection unit 102.

[0097] A reflection-type photoelectric sensor can be used as the smart sensor 303. The smart sensor 303 and the tracking sensor 304 are configured as one sensor. Specifically, a first light receiving unit is arranged on one

side and a second light receiving unit is arranged on the other side of the transport path. The first light receiving unit receives light emitted by a light emitting unit and reflected by the banknote, and the second light receiving unit receives light emitted by the light emitting unit and passed through the banknote . The smart sensor 303 is constituted by a light emitting unit and the first light receiving unit, and the tracking sensor 304 is constituted by a light emitting unit and the second light receiving unit. Accordingly, the smart sensor 303 and the tracking 304 can simultaneously detect the same part of the banknote.

[0098] In the present embodiment, as shown in FIG. 11A, an example in which the denomination, the banknote detection setting, and the like is set for the processing target denomination; however, the setting method is not limited to this. For example, a denomination table in which the denomination of the banknote and the characteristics of the banknote are stored in an associated manner, and a detection setting table in which the characteristics of the banknote and the setting of the second-type detection unit 102 to detect the banknote are stored in an associated manner can be arranged separately. For example, in the denomination table, as the characteristics of the banknote to be associated with the denomination of the banknote, at least one among information indicating the material of the banknote, information indicating whether to change the setting of the second-type detection unit 102, information indicating the presence or absence of the window part of the banknote, information indicating the position and the size of the window part is used. In the detection setting table, setting contents of the second-type detection unit 102 are set in association with each of the characteristics set in the denomination table. The control unit 90 recognizes the characteristics of the banknote by referring to the denomination table based on the denomination of the banknote. The setting of the second-type detection unit 102 can be identified by referring to the detection setting table based on the characteristics of this banknote, and the setting of the second-type detection unit 102 can be changed based cn the identified setting. By doing so, the banknotes including the ordinary banknote and the windowed banknote can be detected correctly. By using the denomination table and the detection setting table, for example, it can be set whether to change the setting of the second-type detection unit 102 depending on whether the banknote is a paper banknote or a polymer banknote. It can be set whether to change the setting of the second-type detection unit 102 depending on the presence or absence of the window part. It can be set whether to change the setting of the second-type detection unit 102 based on a relation between a position of the light emitting unit 103a and the light receiving unit 103b of the sensor unit 103 constituting the second-type detection unit 102, and the position and the size of the window part of the banknote.

[0099] As has been explained above, with the banknote handling apparatus 1 according to the present embodiment, depending on the type of the detection target banknote, the setting of the second-type detection unit 102 can be changed so that allows the detection target banknote can be detected. Accordingly, each banknote can be detected correctly irrespective of the type of the banknote. By correctly detecting the banknote, the recognition process and counting process of the banknote, the switching process of the transport path by the diverter arranged in the transport path, the storing process of the banknote, the feeding process of the banknote, the calculation process of the length of the banknote in the transport direction of the banknote, and the like can be performed correctly.

[0100] A sheet handling apparatus according to one aspect of the present invention includes a transport unit that transports a sheet along a transport path; a detection unit that detects the sheet transported by the transport unit; and a control unit that changes a setting of the detection unit based on a type of the sheet transported by the transport unit.

[0101] In the above sheet handling apparatus, the detection unit includes a sensor unit having a light emitting unit that emits detection light and a light receiving unit that receives the detection light emitted by the light emitting unit; and a determination unit that determines whether a sheet is detected by comparing an output level of the signal output from the light receiving unit with a threshold value. The control unit changes the setting of the detection unit by changing one of the output level and the threshold value.

[0102] In the above sheet handling apparatus, the detection unit includes a sensor unit having a light emitting unit that emits detection light and a light receiving unit that receives the detection light emitted by the light emitting unit; and a determination unit that determines whether a sheet is detected by comparing an output level of the signal output from the light receiving unit with a threshold value. The control unit changes the setting of the detection unit by changing both the output level and the threshold value.

[0103] In the above sheet handling apparatus, the control unit changes the output level by changing an emission intensity of the detection light emitted by the light emitting unit.

[0104] In the above sheet handling apparatus, the control unit changes the output level by changing a sensor sensitivity of the sensor unit to change the output level when the detection light having the same intensity is received.

[0105] In the above sheet handling apparatus, the control unit changes the setting of the detection unit based on material of the sheet to be detected.

[0106] In the above sheet handling apparatus, the control unit changes the setting of the detection unit based on whether the sheet has a window part that is a transparent part or a semitransparent part of the sheet.

[0107] In the above sheet handling apparatus, the control unit changes the setting of the detection unit based

on at least one of a position and a size of a window part that is a transparent part or a semitransparent part of the sheet.

[0108] The above sheet handling apparatus further includes a storing unit that stores the sheet of a predetermined type; and a memory for storing a plurality of settings of the detection unit by type of the sheet. The control unit reads from the memory the setting corresponding to the type of the sheet to be stored in the storing unit and changes the setting of the detection unit based on the read setting.

[0109] The above sheet handling apparatus further includes an operation unit for specifying a type of the sheet; and a memory for storing therein a plurality of settings by type of the sheet. The control unit reads from the memory a setting corresponding to the type of the sheet specified by the operation unit and changes the setting of the detection unit based on the read setting.

[0110] The above sheet handling apparatus further includes a recognition unit that recognizes a type of the sheet; and a memory for storing a plurality of settings by type of the sheet. The control unit reads from the memory a setting corresponding to the type of the sheet recognized by the recognition unit and changes the setting of the detection unit based on the read setting.

[0111] According to another aspect, of the present invention, a sheet handling apparatus that transports a sheet along a transport path and handles the sheet, includes a sensor unit having a light emitting unit arranged in the transport path for emitting detection light and a light receiving unit arranged in the transport path for receiving the detection light emitted by the light emitting unit; a determination unit that determines whether a sheet is detected by comparing an output level of the signal output from the light receiving unit with a threshold value; a sensor setting unit that sets the output level; a threshold value setting unit that sets the threshold value setting unit to change at least one of the output level and the threshold value based on a type of the sheet transported on the transport path.

[0112] In the above sheet handling apparatus, the determination unit includes a first determination unit that determines whether the sheet is detected by comparing the output level with a first threshold value; and a second determination unit that determines whether the sheet is detected by comparing the output level with a second threshold value different from the first threshold value. The control unit selects one of a determination result obtained by the first determination unit and a determination result obtained by the second determination unit based on the type of the sheet transported on the transport path and detects the sheet by using a selected determination result.

[0113] According to the present invention, a sheet transported on a transport path can be detected correctly by changing a setting of a detection unit that detects the sheet transported on the transport path.

[0114] As explained above, a sheet handling apparatus according to the present invention is useful in correctly detecting a sheet based on a characteristic of the sheet transported on a transport path.

Claims

1. A sheet handling apparatus (1) comprising:

a transport unit (30) configured to transport a sheet along a transport path;
a recognition unit (20) configured to recognize a type of the sheet transported by the transport unit (30);
a memory (92); and
a control unit (90),
characterized in that
the sheet handling apparatus (1) further comprises a detection unit (102) configured to detect the sheet transported by the transport unit (30), based on a setting; wherein
the memory (92) is configured to previously store a plurality of settings of the detection unit (102) by type of the sheet; and
the control unit (90) is configured to change the setting of the detection unit (102) based on the type of the sheet transported by the transport unit (30), wherein the control unit (90) is configured to read from the memory (92) the previously stored setting corresponding to the type of the sheet recognized by the recognition unit (20) and change the setting of the detection unit (102) based on the read setting.

2. The sheet handling apparatus (1) as claimed in claim 1, wherein

the detection unit (102) includes

a sensor unit (103) having a light emitting unit (103a) configured to emit detection light and a light receiving unit (103b) configured to receive the detection light emitted by the light emitting unit (103a); and
a determination unit (112) configured to determine whether a sheet is detected by comparing an output level of a signal output from the light receiving unit (103b) with a threshold value,

wherein the control unit (90) is configured to change the setting of the detection unit (102) by changing one of the output level and the threshold value, or by changing both the output level and the threshold value.

3. The sheet handling apparatus (1) as claimed in claim 2, wherein the control unit (90) is configured to

change the output level by changing an emission intensity of the detection light emitted by the light emitting unit (103a).

4. The sheet handling apparatus (1) as claimed in claim 2, wherein the control unit (90) is configured to change the output level by changing a sensor sensitivity of the sensor unit (103) to change the output level when the detection light having the same intensity is received.

5. The sheet handling apparatus (1) as claimed in claim 1, wherein the control unit (90) is configured to change the setting of the detection unit (102) based on material of the sheet to be detected.

6. The sheet handling apparatus (1) as claimed in claim 1, wherein the control unit (90) is configured to change the setting of the detection unit (102) based on whether the sheet has a window part that is a transparent part or a semitransparent part of the sheet.

7. The sheet handling apparatus (1) as claimed in claim 1, wherein the control unit (90) is configured to change the setting of the detection unit (102) based on at least one of a position and a size of a window part that is a transparent part or a semitransparent part of the sheet.

8. The sheet handling apparatus (1) as claimed in claim 1, further comprising

a storing unit (70) configured to store the sheet of a predetermined type,
wherein the control unit (90) is configured to read from the memory the setting corresponding to the type of the sheet to be stored in the storing unit (70) and changes the setting of the detection unit (102) based on the read setting.

9. The sheet handling apparatus (1) as claimed in claim 1, further comprising

an operation unit (91) for specifying a type of the sheet, wherein
the control unit (90) is configured to read from the memory a setting corresponding to the type of the sheet specified by the operation unit (91) and changes the setting of the detection unit (102) based on the read setting.

10. The sheet handling apparatus (1) as claimed in claim 2, wherein

the detection unit (102) further comprising
a sensor setting unit (140) configured to set the output level, and
a threshold value setting unit (130) configured to set the threshold value,
wherein the control unit (90) is configured to control the sensor setting unit (140) and the threshold value setting unit (130) to change at least one of the output level and the threshold value based on the type of the sheet transported on the transport path.

11. The sheet handling apparatus (1) as claimed in claim 2, wherein

the determination unit (111, 112) includes

a first determination unit (111) configured to determine whether the sheet is detected by comparing the output level with a first threshold value; and
a second determination unit (112) configured to determine whether the sheet is detected by comparing the output level with a second threshold value different from the first threshold value,

wherein the control unit (90) selects one of a determination result obtained by the first determination unit (111) and a determination result obtained by the second determination unit (112) based on the type of the sheet transported on the transport path and detects the sheet by using a selected determination result.

Patentansprüche

1. Blatthandhabungsvorrichtung (1) mit:

einer Transporteinheit (30), die konfiguriert ist, um ein Blatt entlang eines Transportwegs zu transportieren;
einer Erkennungseinheit (20), die konfiguriert ist, um einen Typ des von der Transporteinheit (30) transportierten Blatts zu erkennen;
einem Speicher (92); und
einer Steuereinheit (90),
dadurch gekennzeichnet
die Blatthandhabungsvorrichtung (1) ferner eine Erfassungseinheit (102) umfasst, die konfiguriert ist, um das von der Transporteinheit (30) transportierte Blatt, basierend auf einer Einstellung zu erfassen; wobei
der Speicher (92) konfiguriert ist, um vorab mehrere Einstellungen der Erfassungseinheit (102) nach Blatttyp zu speichern; und
die Steuereinheit (90) konfiguriert ist, um die Einstellung der Erfassungseinheit (102) basierend auf der Art des von der Transporteinheit (30) transportierten Blatts zu ändern, wobei die

Steuereinheit (90) konfiguriert ist, um aus dem Speicher (92) die zuvor gespeicherte Einstellung zu lesen, die der Art des von der Erkennungseinheit (30) erkannten Blatts entspricht (20) und die Einstellung der Erfassungseinheit (102) basierend auf der gelesenen Einstellung ändern.

2. Blatthandhabungsvorrichtung (1) nach Anspruch 1, wobei die Erfassungseinheit (102) umfasst:

eine Sensoreinheit (103) mit einer lichtemittierenden Einheit (103a), konfiguriert zum Emittieren von Erfassungslicht und einer Lichtempfangseinheit (103b), konfiguriert zum Empfangen des von der lichtemittierenden Einheit (103a) emittierten Erfassungslichts; und
eine Bestimmungseinheit (112), konfiguriert zum Bestimmen, ob ein Blatt detektiert wird, indem ein Ausgabepegel eines Signals, das von der Lichtempfangseinheit (103b) ausgegeben wird, mit einem Schwellenwert verglichen wird,

wobei die Steuereinheit (90) konfiguriert ist, um die Einstellung der Erfassungseinheit (102) zu ändern, indem entweder der Ausgangspegel oder der Schwellenwert geändert wird, oder indem sowohl der Ausgangspegel als auch der Schwellenwert geändert werden.

3. Blatthandhabungsvorrichtung (1) nach Anspruch 2, wobei die Steuereinheit (90) so konfiguriert ist, dass sie den Ausgangspegel ändert, indem sie eine Emissionsintensität des von der Lichtemissionseinheit (103a) emittierten Erfassungslichts ändert.

4. Blatthandhabungsvorrichtung (1) nach Anspruch 2, wobei die Steuereinheit (90) konfiguriert ist, um den Ausgangspegel durch Ändern einer Sensorempfindlichkeit der Sensoreinheit (103) zu ändern, um den Ausgangspegel zu ändern, wenn das Erfassungslicht mit der gleichen Intensität empfangen wird.

5. Blatthandhabungsvorrichtung (1) nach Anspruch 1, wobei die Steuereinheit (90) konfiguriert ist, um die Einstellung der Erfassungseinheit (102) basierend auf dem Material des zu detektierenden Bogens zu ändern.

6. Blatthandhabungsvorrichtung (1) nach Anspruch 1, wobei die Steuereinheit (90) konfiguriert ist, um die Einstellung der Erfassungseinheit (102) basierend darauf zu ändern, ob das Blatt einen Fensterteil hat, der ein transparenter Teil oder ein halbtransparenter Teil des Blatts ist.

7. Blatthandhabungsvorrichtung (1) nach Anspruch 1, wobei die Steuereinheit (90) konfiguriert ist, um die Einstellung der Erfassungseinheit (102) basierend auf einer Position und/oder einer Größe eines Fensterteils zu ändern, das ein transparenter Teil oder ein halbtransparenter Teil der Folie ist.

8. Blatthandhabungsvorrichtung (1) nach Anspruch 1, die ferner umfasst:

eine Speichereinheit (70), konfiguriert zum Speichern das Blatt eines vorbestimmten Typs, wobei die Steuereinheit (90)konfiguriert ist, um aus dem Speicher die Einstellung zu lesen, die der Art des in der Speichereinheit (70) zu speichernden Blatts entspricht, und die Einstellung der Erfassungseinheit (102) basierend auf der gelesenen Einstellung zu ändern.

9. Blatthandhabungsvorrichtung (1) nach Anspruch 1, die ferner umfasst:

eine Betriebseinheit (91) zum Spezifizieren eines Blatttyps, wobei
die Steuereinheit (90) konfiguriert ist, um aus dem Speicher eine Einstellung zu lesen, die der Art des Blattes entspricht, das durch die Betriebseinheit (91) spezifiziert ist, und die Einstellung der Erfassungseinheit (102) basierend auf der gelesenen Einstellung zu ändern.

10. Blatthandhabungsvorrichtung (1) nach Anspruch 2, wobei die Erfassungseinheit (102) ferner umfasst:

eine Sensoreinstelleinheit (140), konfiguriert zum Einstellen des Ausgangspegels, und
eine Schwellwert-Einstelleinheit (130), konfiguriert zum Einstellen des Schwellenwerts,
wobei die Steuereinheit (90) konfiguriert ist, um die Sensoreinstelleinheit (140) und die Schwellenwerteinstelleinheit (130) zu steuern, um den Ausgangspegel und/oder den Schwellenwert basierend auf der Art des auf dem Transportweg transportierten Blatts zu ändern.

11. Blatthandhabungsvorrichtung (1) nach Anspruch 2, wobei

die Bestimmungseinheit (111, 112) umfasst:

eine erste Bestimmungseinheit (111), konfiguriert zum Bestimmen, ob das Blatt erkannt wird, indem der Ausgangspegel mit einem ersten Schwellenwert verglichen wird; und
eine zweite Bestimmungseinheit (112), konfiguriert zum Bestimmen, ob das Blatt erkannt wird, indem der Ausgabepegel mit einem zweiten Schwellenwert verglichen wird, der sich von dem ersten Schwellen-

wert unterscheidet,

wobei die Steuereinheit (90) basierend auf der Art des auf dem Transportweg transportierten Blattes das von der ersten Bestimmungseinheit (111) erhaltene Bestimmungsergebnis oder das von der zweiten Bestimmungseinheit (112) erhaltene Bestimmungsergebnis auswählt, und das Blatt unter Verwendung eines ausgewählten Bestimmungsergebnisses erfasst.

Revendications

1. Appareil de manipulation de feuilles (1) comprenant :

une unité de transport (30) configurée pour transporter une feuille le long d'un chemin de transport ;
une unité de reconnaissance (20) configurée pour reconnaître un type de feuille transportée par l'unité de transport (30) ;
une mémoire (92) ; et
une unité de commande (90),
caractérisé en ce que
l'appareil de manipulation de feuilles (1) comprend en outre une unité de détection (102) configurée pour détecter la feuille transportée par l'unité de transport (30), sur la base d'un réglage ; dans lequel
la mémoire (92) est configurée pour stocker au préalable une pluralité de réglages de l'unité de détection (102) par type de feuille ; et
l'unité de commande (90) est configurée pour modifier le réglage de l'unité de détection (102) sur la base du type de feuille transportée par l'unité de transport (30), dans lequel l'unité de commande (90) est configurée pour lire à partir de la mémoire (92) le réglage stocké au préalable correspondant au type de feuille reconnu par l'unité de reconnaissance (20) et modifier le réglage de l'unité de détection (102) sur la base du réglage lu.

2. Appareil de manipulation de feuilles (1) selon la revendication 1, dans lequel l'unité de détection (102) comprend

une unité de capteur (103) ayant une unité d'émission de lumière (103a) configurée pour émettre une lumière de détection et une unité de réception de lumière (103b) configurée pour recevoir la lumière de détection émise par l'unité d'émission de lumière (103a) ; et
une unité de détermination (112) configurée pour déterminer si une feuille est détectée en comparant un niveau de sortie d'un signal de sortie depuis l'unité de réception de lumière (103b) avec une valeur de seuil,

dans lequel l'unité de commande (90) est configurée pour modifier le réglage de l'unité de détection (102) en changeant l'un parmi le niveau de sortie et la valeur de seuil, ou en changeant à la fois le niveau de sortie et la valeur de seuil.

3. Appareil de manipulation de feuilles (1) selon la revendication 2, dans lequel l'unité de commande (90) est configurée pour modifier le niveau de sortie en modifiant une intensité d'émission de la lumière de détection émise par l'unité d'émission de lumière (103a).

4. Appareil de manipulation de feuilles (1) selon la revendication 2, dans lequel l'unité de commande (90) est configurée pour changer le niveau de sortie en changeant une sensibilité de capteur de l'unité de capteur (103) pour changer le niveau de sortie lorsque la lumière de détection ayant la même intensité est reçue.

5. Appareil de manipulation de feuilles (1) selon la revendication 1, dans lequel l'unité de commande (90) est configurée pour modifier le réglage de l'unité de détection (102) sur la base du matériau de la feuille à détecter.

6. Appareil de manipulation de feuilles (1) selon la revendication 1, dans lequel l'unité de commande (90) est configurée pour modifier le réglage de l'unité de détection (102) selon que la feuille a une partie de fenêtre qui est une partie transparente ou une partie semi-transparente de la feuille.

7. Appareil de manipulation de feuilles (1) selon la revendication 1, dans lequel l'unité de commande (90) est configurée pour modifier le réglage de l'unité de détection (102) sur la base d'au moins une position et une taille d'une partie de fenêtre qui est une partie transparente ou une partie semi-transparente de la feuille.

8. Appareil de manipulation de feuilles (1) selon la revendication 1, comprenant en outre

une unité de stockage (70) configurée pour stocker la feuille d'un type prédéterminé,
dans lequel l'unité de commande (90) est configurée pour lire dans la mémoire le réglage correspondant au type de feuille à stocker dans l'unité de stockage (70) et modifie le réglage de l'unité de détection (102) sur la base du réglage lu.

9. Appareil de manipulation de feuilles (1) selon la re-

vendication 1, comprenant en outre

une unité d'opération (91) pour spécifier un type de feuille, dans lequel
l'unité de commande (90) est configurée pour lire à partir de la mémoire un réglage correspondant au type de feuille spécifié par l'unité d'opération (91) et modifie le réglage de l'unité de détection (102) sur la base du réglage lu.

10. Appareil de manipulation de feuilles (1) selon la revendication 2, dans lequel

l'unité de détection (102) comprend en outre
une unité de réglage de capteur (140) configurée pour régler le niveau de sortie, et
une unité de réglage de valeur de seuil (130) configurée pour régler la valeur de seuil,
dans lequel l'unité de commande (90) est configurée pour commander l'unité de réglage de capteur (140) et l'unité de réglage de valeur de seuil (130) pour modifier au moins l'un parmi le niveau de sortie et la valeur de seuil sur la base du type de feuille transportée sur le chemin de transport.

11. Appareil de manipulation de feuilles (1) selon la revendication 2, dans lequel

l'unité de détermination (111, 112) comprend

une première unité de détermination (111) configurée pour déterminer si la feuille est détectée en comparant le niveau de sortie avec une première valeur de seuil. ; et
une deuxième unité de détermination (112) configurée pour déterminer si la feuille est détectée en comparant le niveau de sortie à une deuxième valeur de seuil différente de la première valeur de seuil,

dans lequel l'unité de commande (90) sélectionne l'un parmi un résultat de détermination obtenu par la première unité de détermination (111) et un résultat de détermination obtenu par la deuxième unité de détermination (112) sur la base du type de feuille transportée sur le chemin de transport et détecte la feuille en utilisant un résultat de détermination sélectionné.

FIG.1

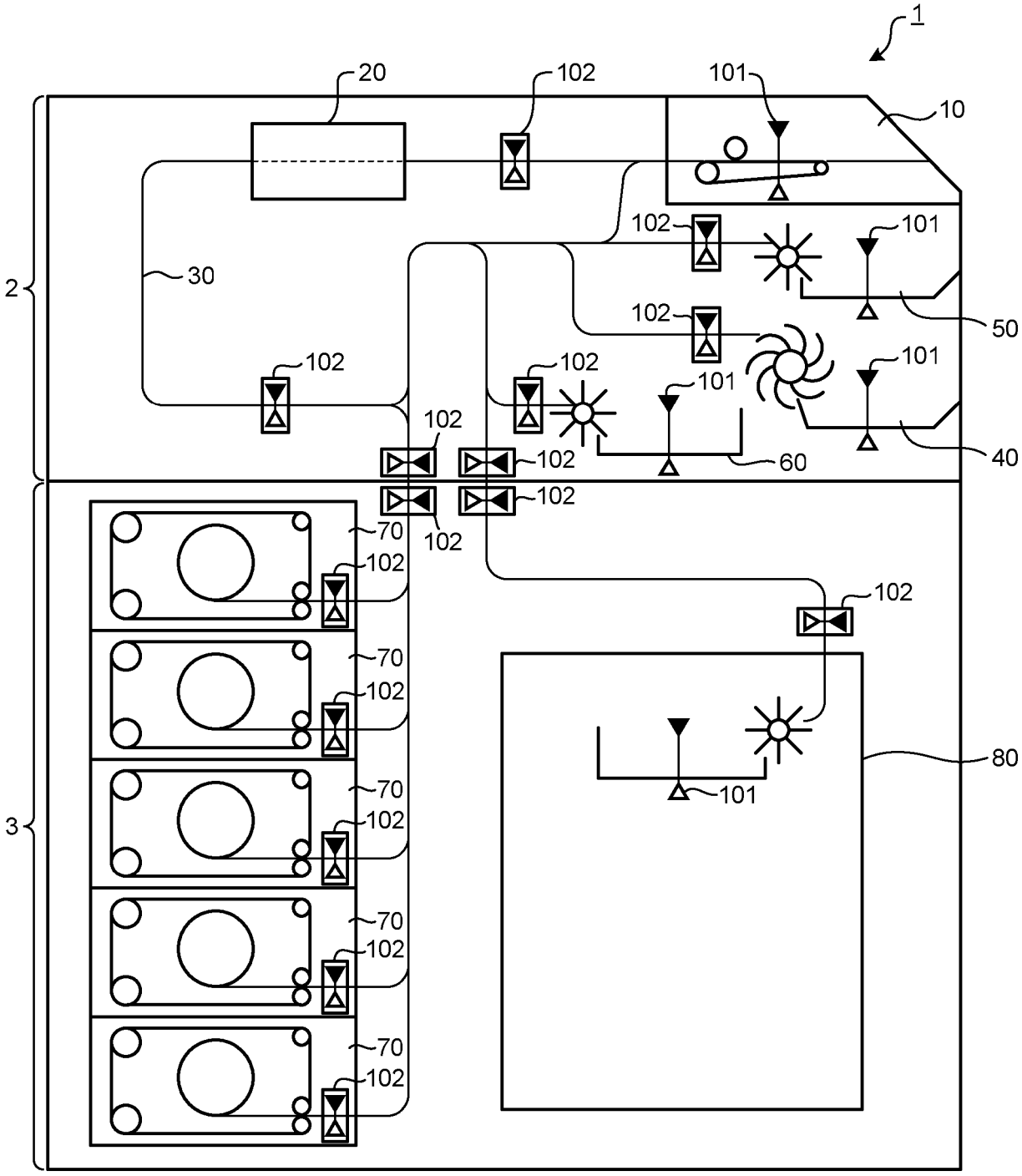


FIG.2

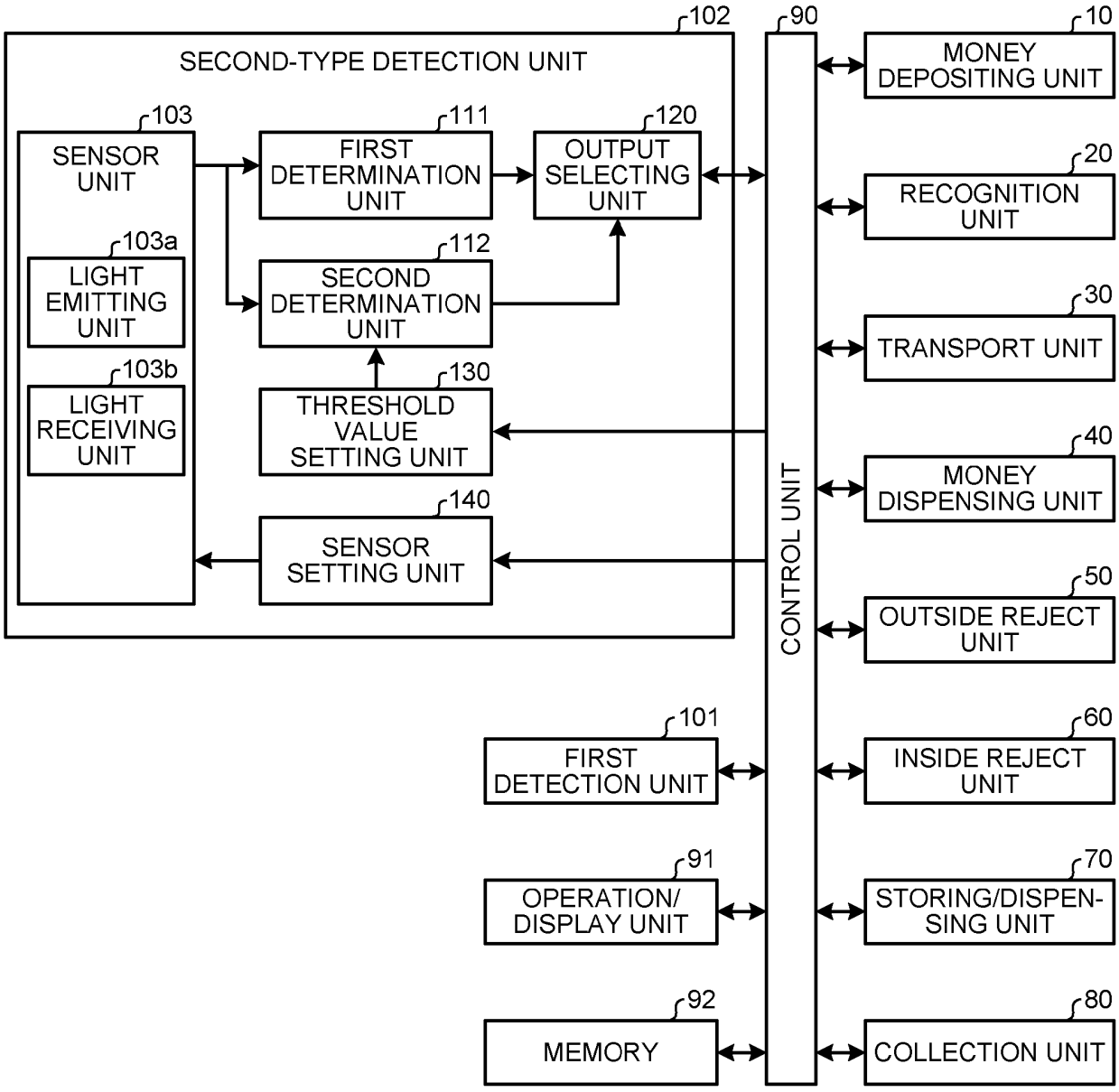

102
SECOND-TYPE DETECTION UNIT
103
SENSOR UNIT
103a
LIGHT EMITTING UNIT
103b
LIGHT RECEIVING UNIT
111
FIRST DETERMINATION UNIT
112
SECOND DETERMINATION UNIT
120
OUTPUT SELECTING UNIT
130
THRESHOLD VALUE SETTING UNIT
140
SENSOR SETTING UNIT
90
CONTROL UNIT
10
MONEY DEPOSITING UNIT
20
RECOGNITION UNIT
30
TRANSPORT UNIT
40
MONEY DISPENSING UNIT
50
OUTSIDE REJECT UNIT
60
INSIDE REJECT UNIT
70
STORING/DISPENSING UNIT
80
COLLECTION UNIT
101
FIRST DETECTION UNIT
91
OPERATION/ DISPLAY UNIT
92
MEMORY

FIG.3

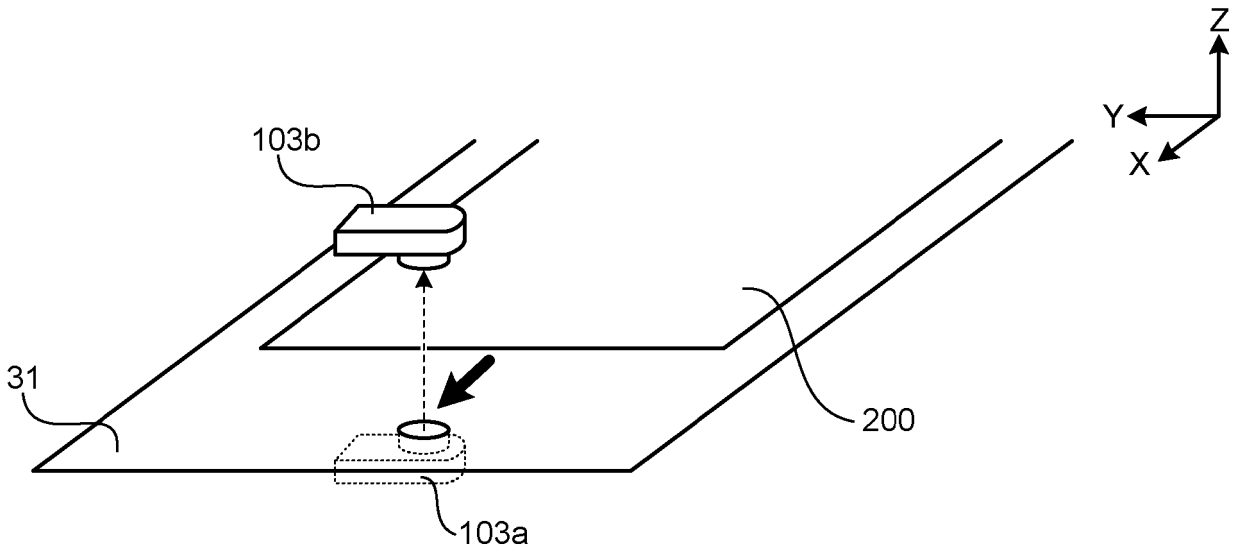


FIG.4A

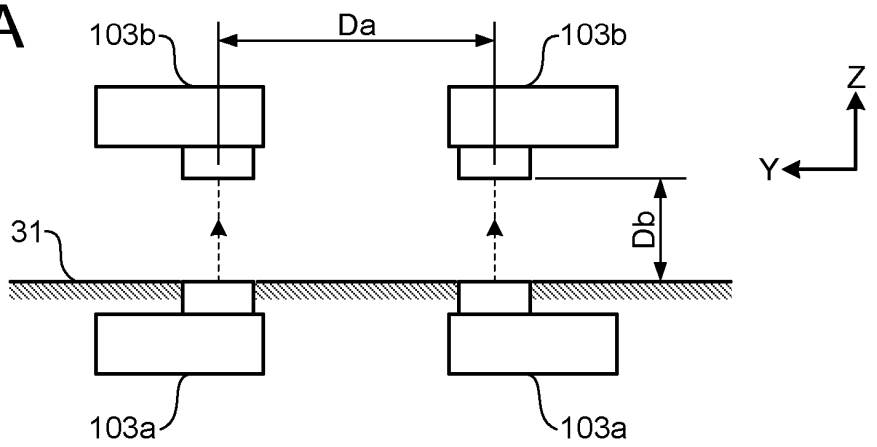


FIG.4B

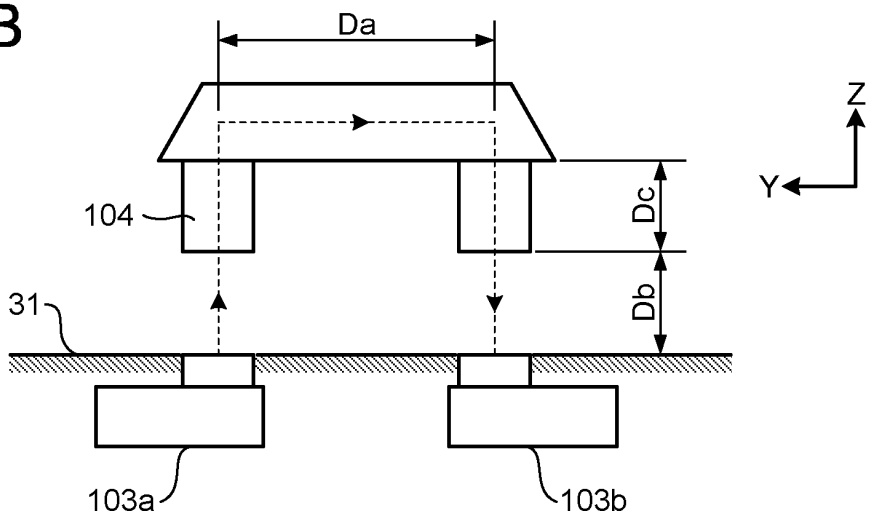


FIG.4C

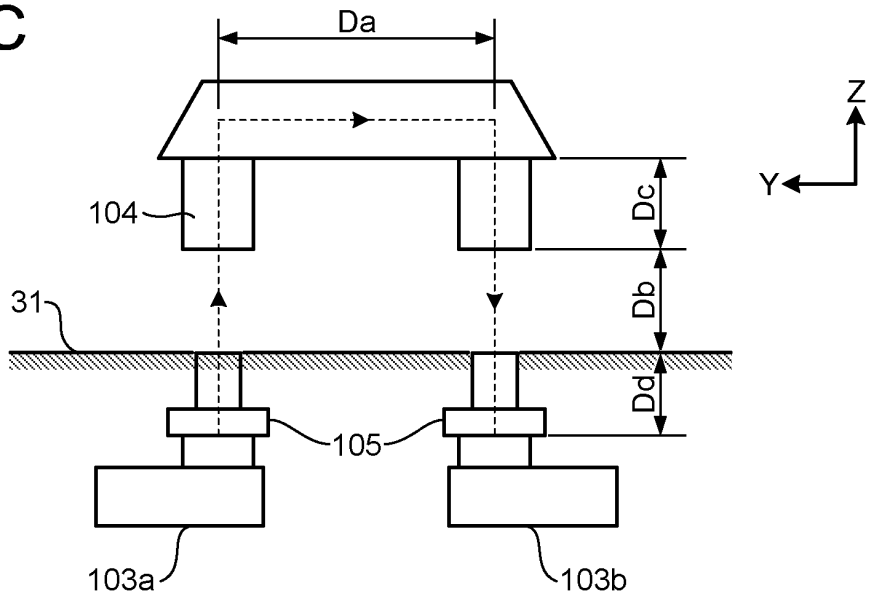


FIG.5

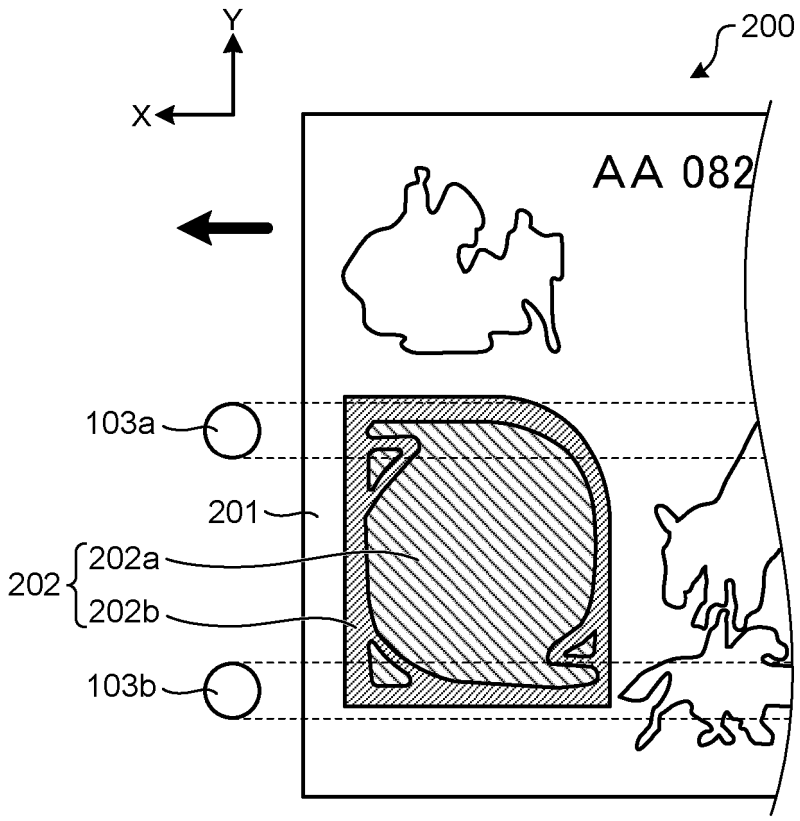


FIG.6A

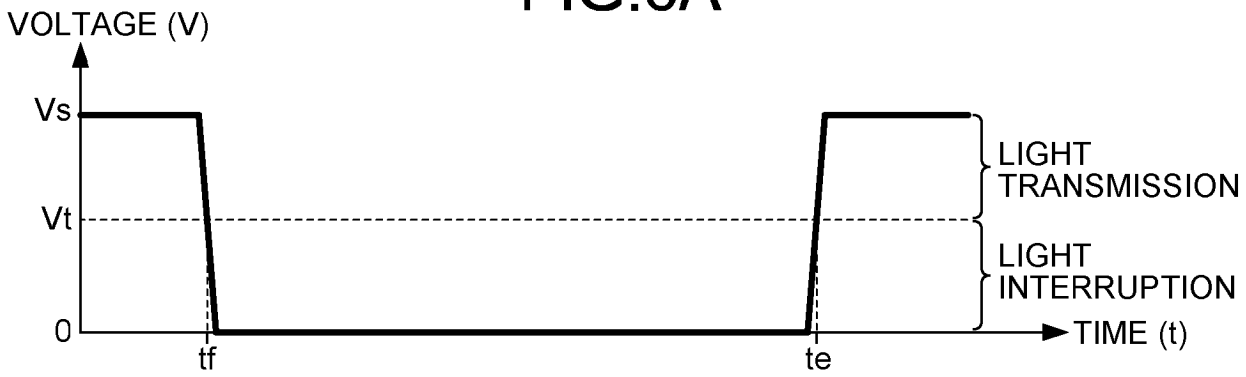

VOLTAGE (V)
Vs
Vt
0
tf
te
TIME (t)
LIGHT TRANSMISSION
LIGHT INTERRUPTION

FIG.6B

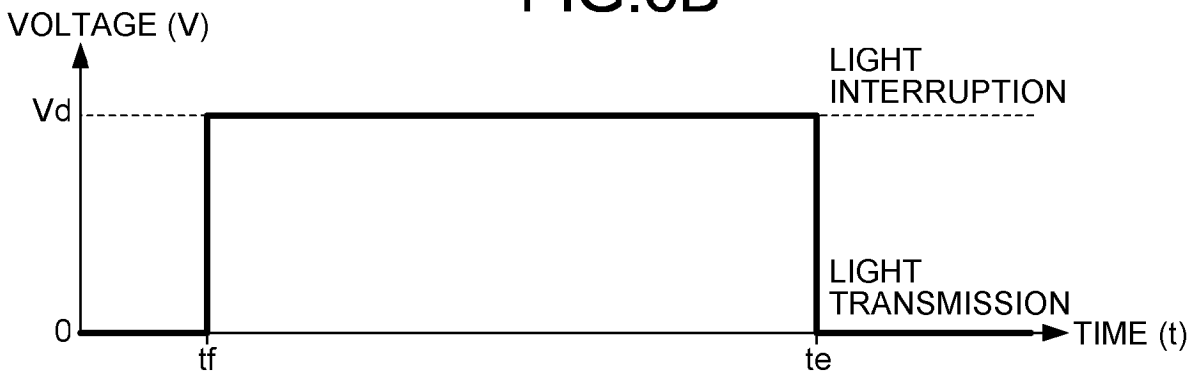

VOLTAGE (V)
Vd
0
tf
te
TIME (t)
LIGHT INTERRUPTION
LIGHT TRANSMISSION

FIG.7A

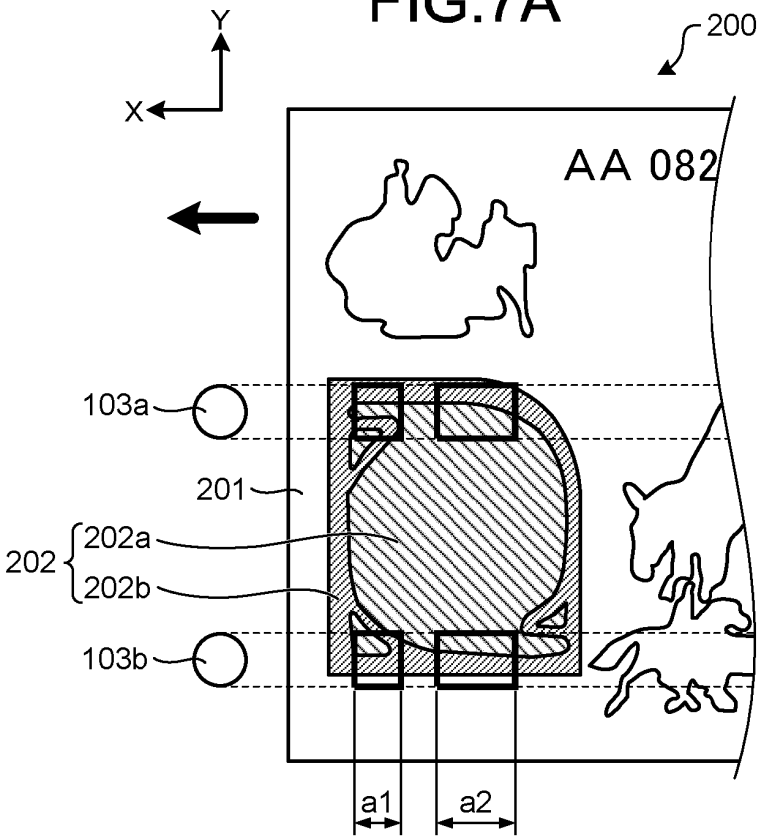


FIG.7B

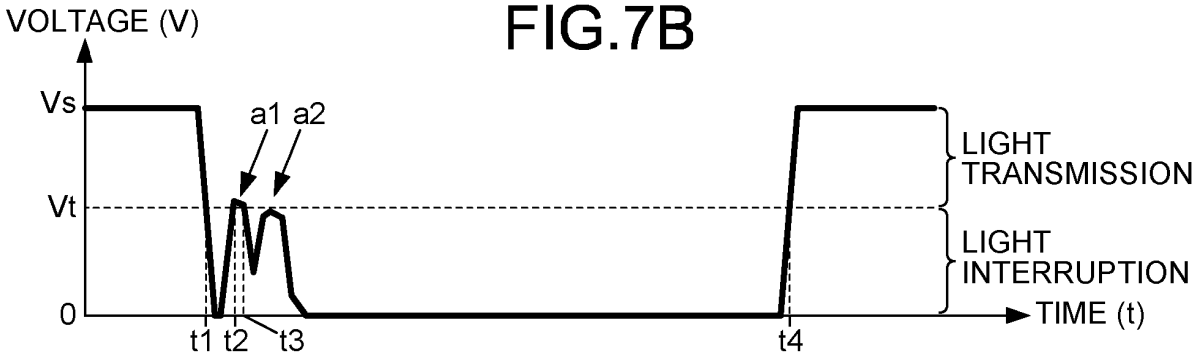


FIG.7C

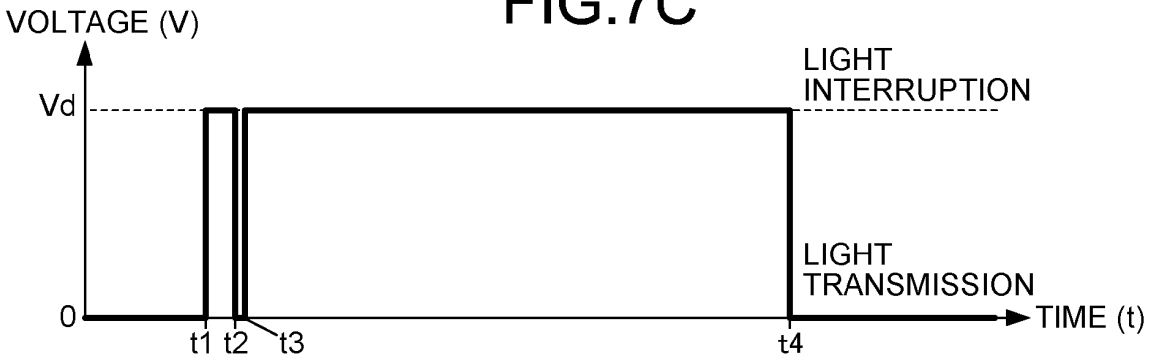


FIG.8A

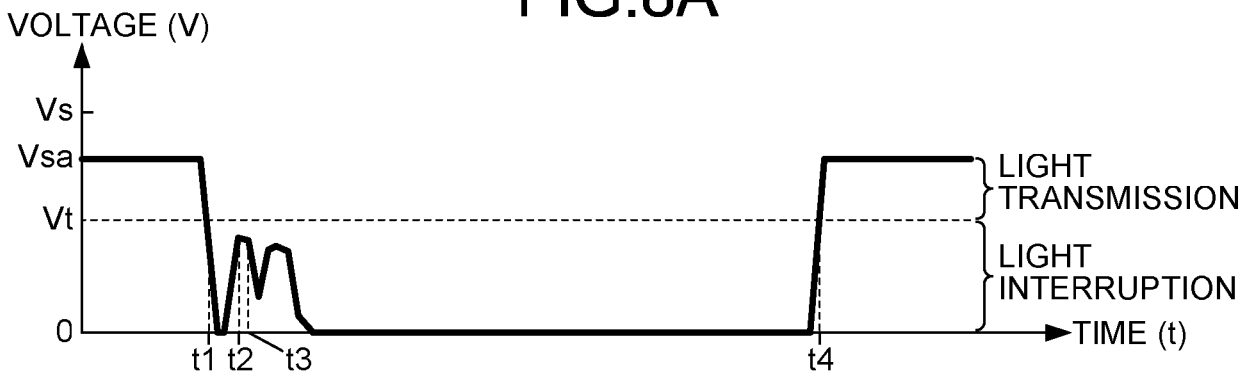

VOLTAGE (V)
Vs
Vsa
Vt
0
t1
t2
t3
t4
LIGHT TRANSMISSION
LIGHT INTERRUPTION
TIME (t)

FIG.8B

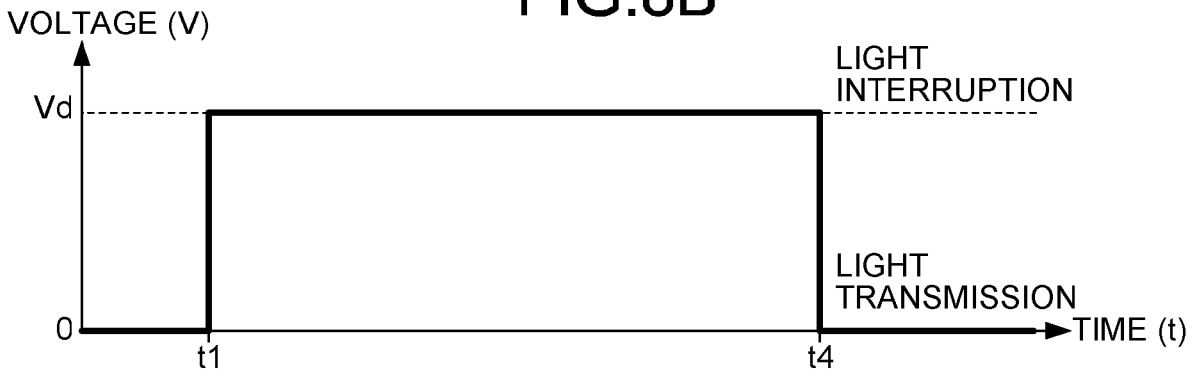

VOLTAGE (V)
Vd
0
t1
t4
LIGHT INTERRUPTION
LIGHT TRANSMISSION
TIME (t)

FIG.9A


VOLTAGE (V)
Vs
Vta
Vt
0
t1
t2
t3
t4
LIGHT TRANSMISSION
LIGHT INTERRUPTION
TIME (t)

FIG.9B

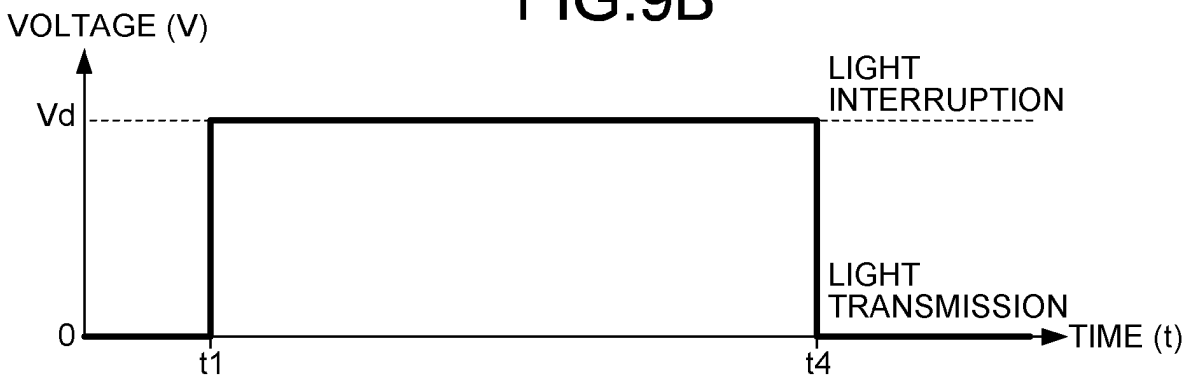

VOLTAGE (V)
Vd
0
t1
t4
LIGHT INTERRUPTION
LIGHT TRANSMISSION
TIME (t)

FIG.10A

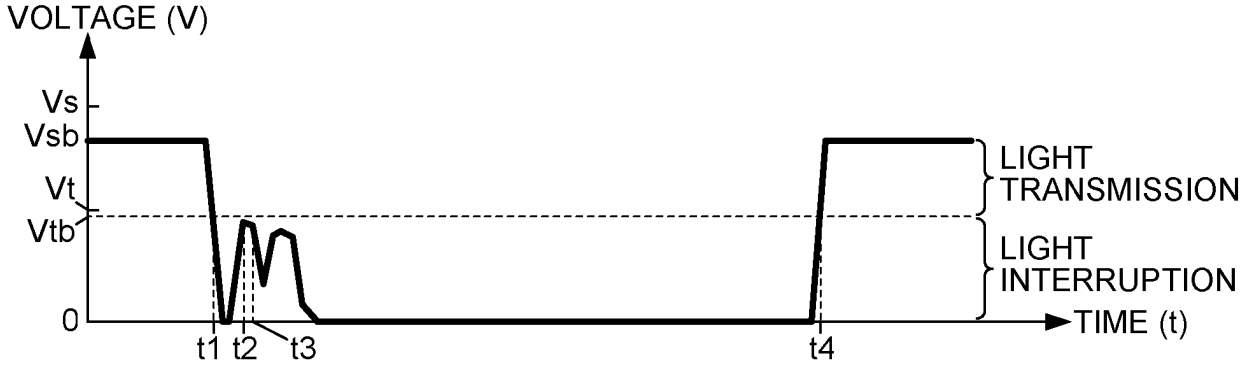


FIG.10B

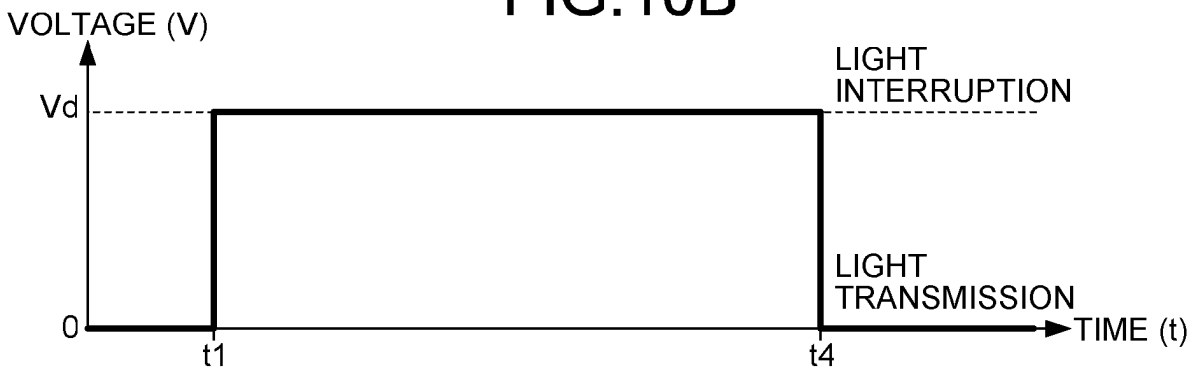


FIG.11A

CURRENCY	DENOMINATION	MATERIAL	WINDOW PART	BANKNOTE DETECTION SETTING				PROCESSING TARGET DENOMINATION
				DETERMINATION UNIT	OUTPUT VOLTAGE	THRESHOLD VOLTAGE	PRIORITY	
X	A	PAPER	NO	FIRST DETERMINATION UNIT	Vs	Vt	4	
	B	POLYMER	NO	FIRST DETERMINATION UNIT	Vs	Vt	4	
	C	POLYMER	YES	SECOND DETERMINATION UNIT	Vsa	Vt	3	
	D	POLYMER	YES	SECOND DETERMINATION UNIT	Vs	Vta	2	
	E	POLYMER	YES	SECOND DETERMINATION UNIT	Vsb	Vtb	1	
Y	F	...						
	G							
	⋮							
⋮								

FIG.11B

STORING UNIT	DENOMINATION	STORING TARGET DENOMINATION	DEPOSITING TARGET DENOMINATION
FIRST STORING/DISPENSING UNIT	B		
SECOND STORING/DISPENSING UNIT	B		
THIRD STORING/DISPENSING UNIT	C		
FOURTH STORING/DISPENSING UNIT	D		
FIFTH STORING/DISPENSING UNIT	E		
COLLECTION UNIT	A～E		

FIG.12

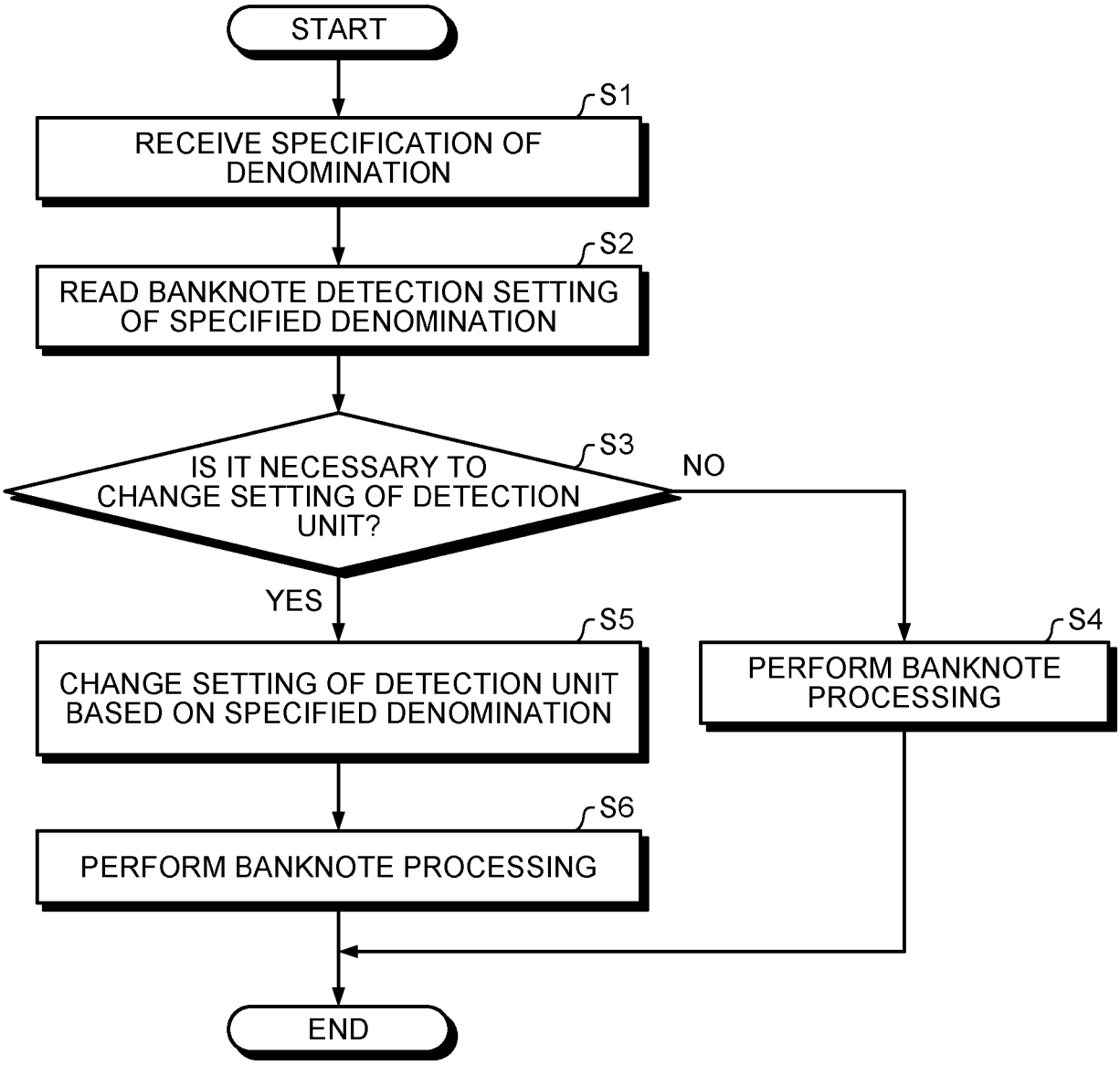

START
S1
RECEIVE SPECIFICATION OF DENOMINATION
S2
READ BANKNOTE DETECTION SETTING OF SPECIFIED DENOMINATION
S3
IS IT NECESSARY TO CHANGE SETTING OF DETECTION UNIT?
NO
YES
S5
CHANGE SETTING OF DETECTION UNIT BASED ON SPECIFIED DENOMINATION
S4
PERFORM BANKNOTE PROCESSING
S6
PERFORM BANKNOTE PROCESSING
END

FIG.13

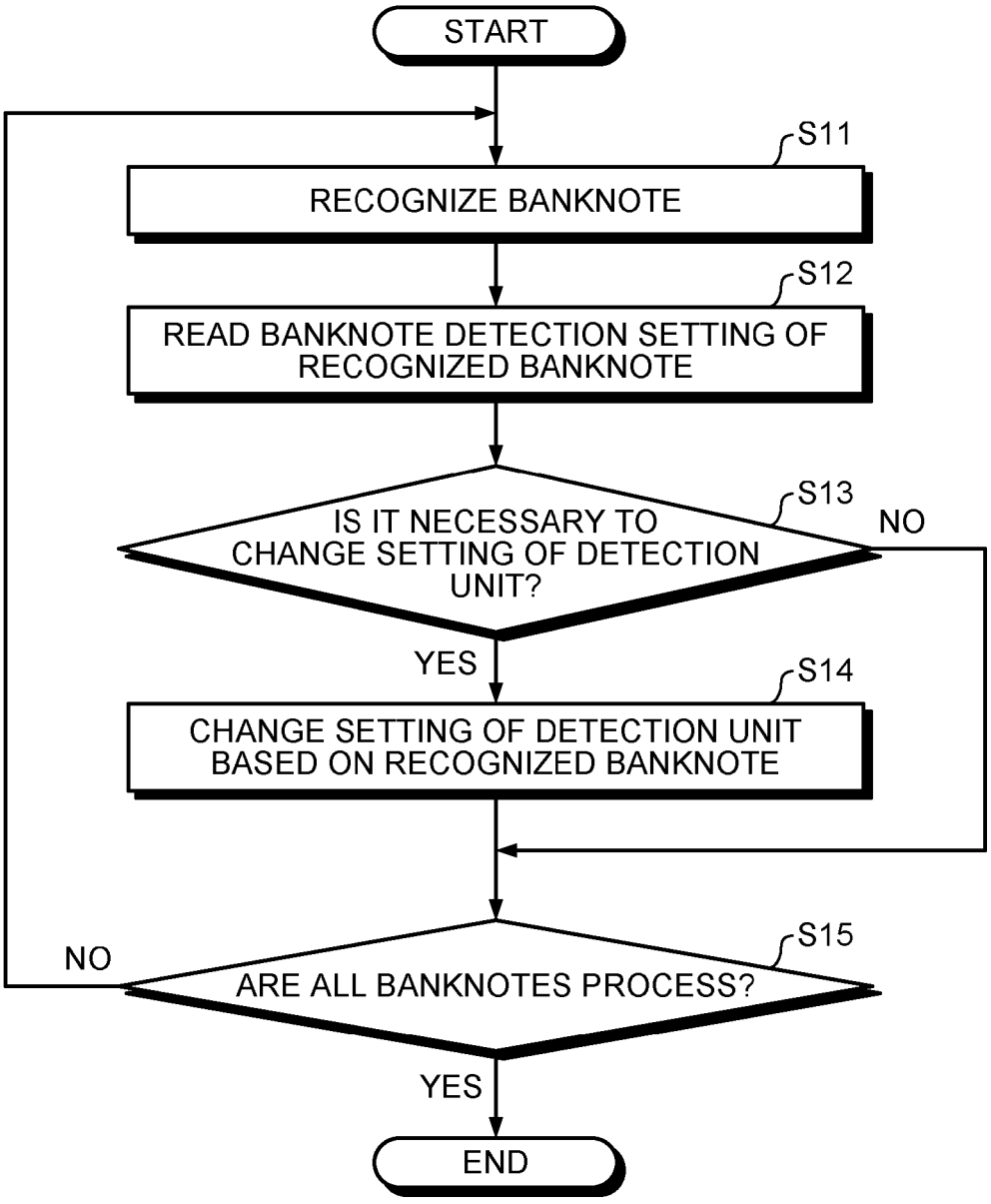

START
S11
RECOGNIZE BANKNOTE
S12
READ BANKNOTE DETECTION SETTING OF RECOGNIZED BANKNOTE
S13
IS IT NECESSARY TO CHANGE SETTING OF DETECTION UNIT?
NO
YES
S14
CHANGE SETTING OF DETECTION UNIT BASED ON RECOGNIZED BANKNOTE
S15
NO
ARE ALL BANKNOTES PROCESS?
YES
END

FIG.14

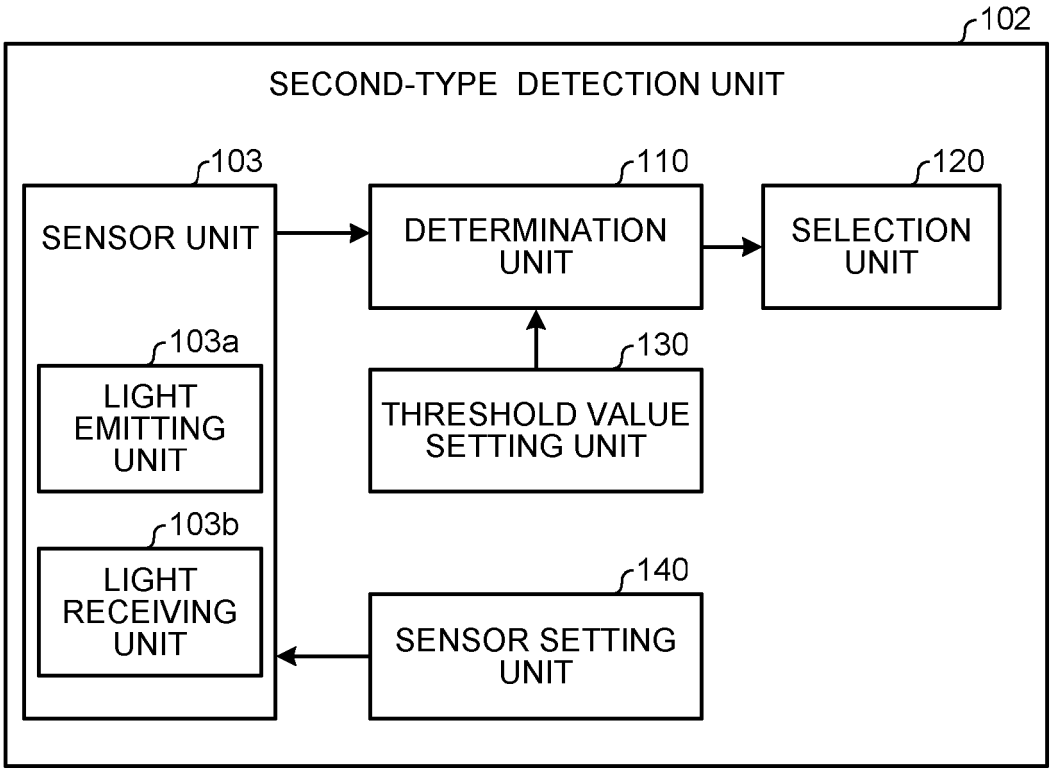

102
SECOND-TYPE DETECTION UNIT
103
SENSOR UNIT
103a
LIGHT EMITTING UNIT
103b
LIGHT RECEIVING UNIT
110
DETERMINATION UNIT
120
SELECTION UNIT
130
THRESHOLD VALUE SETTING UNIT
140
SENSOR SETTING UNIT

FIG.15

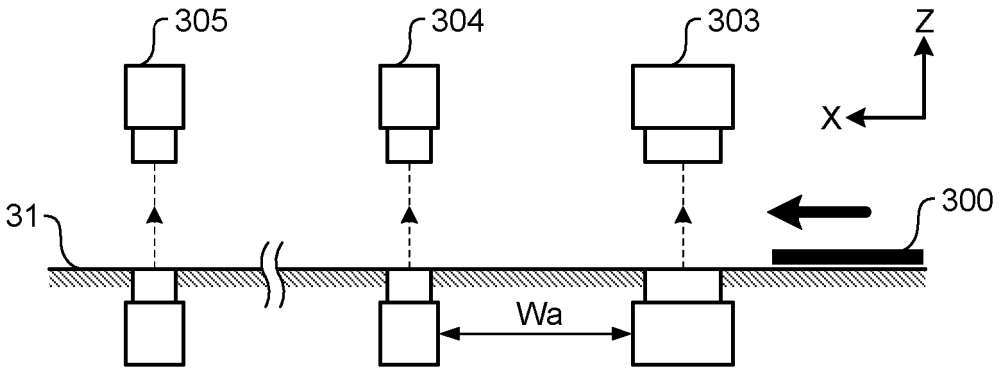


FIG.16A

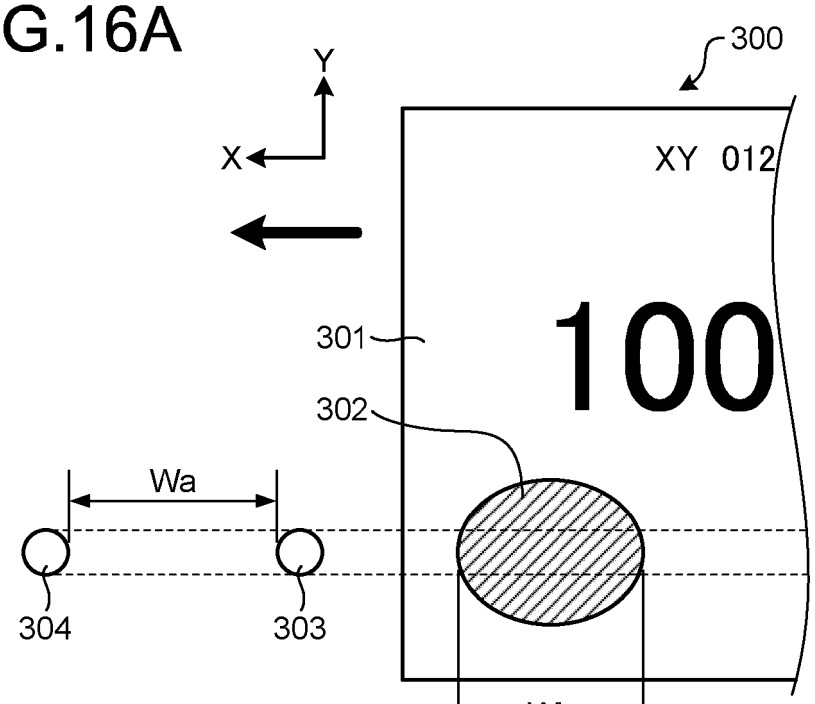


FIG.16B

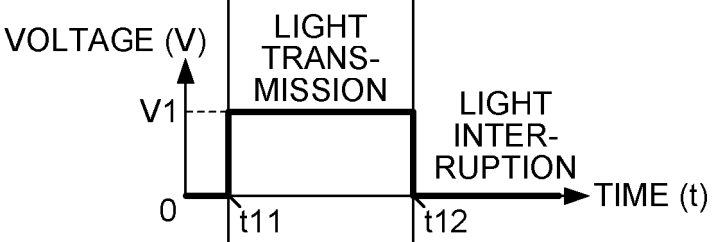
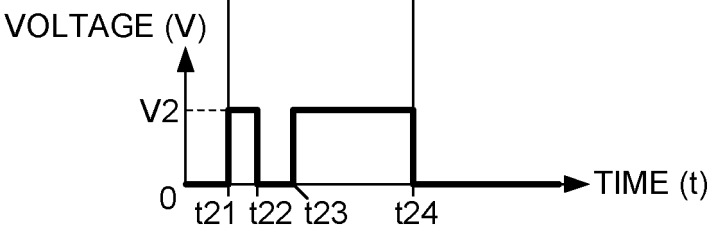


FIG.16C



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2009075015 A **[0003]**
- US 6237739 B1 **[0004]**