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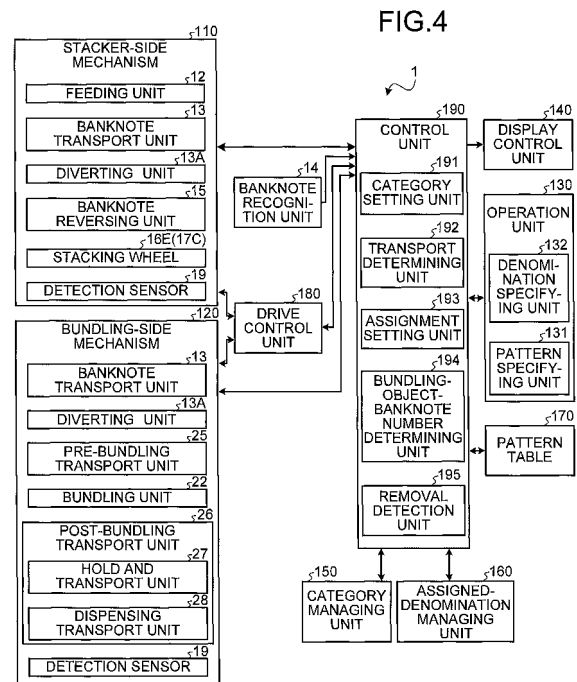
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(54) **BILL CATEGORIZING AND BUNDLING DEVICE AND METHOD FOR SETTING CATEGORIZATION AND COLLECTION OF BILL**

(57) A banknote sorting and bundling apparatus (1) includes a stacker (16) for sorting and stacking a banknote being transported, a bundling-side stacking unit (21) for sorting and stacking a banknote of a specific banknote-kind as a bundling-object-banknote, a category setting unit (191) that sets a category of a banknote to be stacked in the stacker (16) and the bundling-side stacking unit (21), and an assignment setting unit (193) that assigns, if there is no stacking unit for which a banknote-kind of the banknote being transported is set among the stackers (16) or the bundling-side stacking units (21) for which the category of the banknote being transported has been set, the banknote-kind of the banknote being transported as the stacking banknote for a stacking unit for which no stacking banknote has been set. Therefore, the work burden for setting the stacking category and the banknote-kind for the bundling-side stacking units (21) or the stackers (16) one by one is greatly reduced.



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Description

TECHNICAL FIELD

[0001] The present invention relates to a banknote sorting and bundling apparatus that have a banknote sorting and stacking function for sorting and stacking banknotes in continuous deposit transactions by denomination and a banknote bundling function for bundling a predetermined number of banknotes of a specific denomination, and a banknote sorting and stacking method thereof.

BACKGROUND ART

[0002] Conventionally, banknote sorting apparatuses that have a banknote sorting and stacking function for sorting and stacking banknotes in continuous deposit transactions by denomination are in widespread use (for example, see Patent Documents 1 and 2).

[0003] In the banknote sorting apparatus disclosed in Patent Document 1, a plurality of stackers are provided for sorting and stacking banknotes being transported. When a banknote being transported is detected, the denomination of the banknote is recognized, and it is determined as to whether a stacker has been assigned for the recognized denomination. If the denomination of the banknote is set to a stacker as the stacking banknote, the banknote is stacked in the stacker; otherwise, the banknote is stacked in a free stacker for which no stacking banknote has been set.

[0004] In the banknote sorting apparatus disclosed in Patent Document 2, a plurality of stackers are provided for sorting and stacking banknotes being transported. When a banknote being transported is detected, it is determined as to whether there is a stacker in which banknotes having the same denomination as that of the banknote being transported have been stacked. If there is a stacker in which banknotes of the same denomination are stacked, the banknote is stacked in the stacker; otherwise the banknote is stacked in a free stacker in which no banknotes are stacked. In addition, even when there is a stacker in which banknotes of the same denomination are stacked, if the number of stacked banknotes in the stacker has reached a predetermined value, the banknote is stacked in the free stacker.

[0005] A banknote sorting and bundling apparatus having a banknote bundling function for bundling one hundred banknotes of a specific denomination in addition to a banknote sorting function, includes a plurality of stackers for sorting and stacking the banknotes being transported, a plurality of bundling-side stacking units for sorting and stacking the banknotes of specific denominations as bundling-object-banknotes, and a bundling unit for bundling one hundred bundling-object-banknotes stacked in the bundling-side stacking unit with a bundling tape to make a bundle of banknotes.

[0006] For example, in a financial institution, both fit

and unfit banknotes of mixed denominations are deposited into the banknote sorting and bundling apparatus, and the fit notes are stacked in the stacker by denomination and are reused, whereas the unfit notes are stacked in the bundling-side stacking units by denomination and when one hundred banknotes have been stacked, the stacked unfit banknotes are bundled with a bundling tape into a bundle to be returned to the Central Bank.

[0007] [Patent Document 1] US Patent No. 6,860,375 [Patent Document 2] Japanese Patent No. 2639766

DISCLOSURE OF INVENTION

15 PROBLEM TO BE SOLVED BY THE INVENTION

[0008] However, in the conventional banknote sorting and bundling apparatuses mentioned above, an operator has to perform a complicated operation for setting, for example, fit notes for each of the stackers and unfit notes for each of the bundling-side stacking units, that is, the same category is set, one by one, for the stackers or the bundling-side stacking units. It is a great work burden of the operator to set the category and the denomination as the stacking banknotes for each of the stackers (sorting and stacking units) and the bundling-side stacking units.

[0009] Even if the conventional techniques disclosed in Patent Documents 1 and 2 are employed, the operator still has to perform the operation for setting the category of the stacking banknotes for each of stackers (sorting and stacking units) or each of bundling-side stacking units.

[0010] The present invention is made in view of the above discussion. It is an object of the present invention to provide a banknote sorting and bundling apparatus and a banknote sorting and stacking method that significantly reduce the work burden of the operator with regard to the operation for setting the category and a banknote-kind of the stacking banknote for all the sorting and stacking units or all the bundling-side stacking units.

MEANS FOR SOLVING THE PROBLEM

[0011] To achieve the above object, a banknote sorting and bundling apparatus according to an aspect of the present invention includes a feeding unit that feeds banknotes one by one; a recognition unit that recognizes a category and a banknote-kind of the banknote; a sorting and stacking unit for sorting and stacking the banknote therein; a bundling-side stacking unit for sorting and stacking the banknote for bundling therein; a bundling unit that bundles the banknotes stacked in the bundling-side stacking unit; a transport unit that transports the banknote recognized by the recognition unit to any one of the sorting and stacking unit and the bundling-side stacking unit; a category setting unit that sets, for each of the sorting and stacking unit and the bundling-side stacking

unit, a common category of the banknote to be stacked in for all of the sorting and stacking unit(s) or for all of the bundling-side stacking unit(s); an assignment setting unit that confirms, after a category and a banknote-kind of the banknote have been recognized by the recognition unit, whether there is a stacking unit for which a recognized banknote-kind has been assigned among a plurality of the stacking units for which a recognized category has been set based on category settings performed by the category setting unit, and if there is no stacking unit for which the recognized banknote-kind has been assigned, and there is an unassigned stacking unit for which no banknote-kind has been set, assigns the recognized banknote-kind to the unassigned stacking unit; and a control unit that controls the transport unit to transport the banknote to a corresponding stacking unit based on a recognition result obtained by the recognition unit and assignment performed by the assignment setting unit.

[0012] In a banknote sorting and bundling apparatus according to another aspect, in the banknote sorting and bundling apparatus according to the above aspect, the assignment setting unit includes a determining unit that determines, after the category and the banknote-kind have been recognized, whether there is a stacking unit for which the recognized banknote-kind has been set among a plurality of the stacking unit for which the recognized category has been set, and the assignment setting unit assigns, when the determining unit determines that there is no stacking unit for which the recognized banknote-kind has been set, and there is an unassigned stacking unit for which no banknote-kind has been set, the recognized banknote-kind to the unassigned stacking unit.

[0013] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspect, when the determining unit determines that there is a stacking unit for which the recognized banknote-kind has been set, the banknote is sorted and stacked in the stacking unit.

[0014] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspect, the assignment setting unit assigns, when removal of the banknotes stacked in the stacking unit is detected, the banknote-kind of the stacking unit from which the banknotes have been removed as unassigned.

[0015] A banknote sorting and bundling apparatus according to still another aspect, the banknote sorting and bundling apparatus according to the above aspect, further comprising: a specific stacking unit for sorting and stacking banknotes of a specific denomination from among denomination information included in the banknote-kinds, and wherein the assignment setting unit prohibits, if the recognized banknote-kind is the specific denomination, assignment of the recognized banknote-kind as the banknote-kind for the bundling-side stacking unit and as the banknote-kind for the sorting and stacking unit.

[0016] A banknote sorting and bundling apparatus according to still another aspect, the banknote sorting and bundling apparatus according to the above aspect, further comprising: a denomination specifying unit that specifies a denomination to be set as the banknote-kind for each of the sorting and stacking unit or the bundling-side stacking unit, according to a predetermined operation, and wherein the assignment setting unit prohibits, if the recognized banknote-kind of the banknote is any denomination other than the denomination specified by the denomination specifying unit, assignment of the recognized banknote-kind as the banknote-kind for the unassigned stacking unit.

[0017] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspect, the assignment setting unit set the banknote-kind for at least one of the stacking units among the bundling-side stacking units as unassigned.

[0018] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspect, the bundling-side stacking unit comprises stacking units of a plurality of banknote bundling devices, that are connected together, and each of the banknote bundling devices has three stacking units for stacking the banknotes for bundling.

[0019] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspects, the category of the banknote is classified into two categories to be stacked in the stacking unit, one category is fit banknotes among the banknotes, and the other category is unfit banknotes among the banknotes.

[0020] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspects, the category of the banknote is classified into two categories, one category is for stacking a new version banknote among the banknotes, and the other category is for stacking an old version banknote among the banknotes.

[0021] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspects, the banknote-kind is the denomination information that identifies a denomination of the banknote.

[0022] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspect, the banknote-kind includes banknote face/back information that identifies whether the banknote is face-up or face-down.

[0023] In a banknote sorting and bundling apparatus according to still another aspect, in the banknote sorting and bundling apparatus according to the above aspect, the banknote-kind includes portrait orientation information that identifies whether the portrait is upright or invert-

ed.

[0024] To achieve the above object, a banknote sorting and bundling method according to still another aspect of the present invention includes feeding banknotes one by one; recognizing a category and a banknote-kind of the banknote; sorting and stacking the banknote in a sorting and stacking unit; stacking the banknote in a bundling-side stacking unit for bundling; bundling the banknotes stacked in the bundling-side stacking unit; transporting the banknote recognized at the recognizing to any one of the sorting and stacking unit and the bundling-side stacking unit; setting a common category of the banknote to be stacked in for all of the sorting and stacking unit(s) or for all of the bundling-side stacking unit(s); assigning, after the category and the banknote-kind of the banknote have been recognized at the recognizing and confirmation whether there is a stacking unit for which a recognized banknote-kind has been set among a plurality of the stacking unit for which a recognized category has been set based on category settings performed by a category setting unit is achieved, if there is no stacking unit for which the recognized banknote-kind has been set and there is an unassigned stacking unit for which no banknote-kind has been set, the recognized banknote-kind to the unassigned stacking unit; and controlling the transporting of the banknote to transport and stack the banknote in a corresponding stacking unit based on a recognition result obtained at the recognizing and assignment performed at the assigning.

[0025] In a banknote sorting and stacking method according to still another aspect of the present invention, in the banknote sorting and stacking method according to the above aspect, the assigning includes determining, after the category and the banknote-kind have been recognized, whether there is the stacking unit for which the recognized banknote-kind has been set among a plurality of the stacking units for which the recognized category has been set, and assigning, if it is determined at the determining that there is no stacking unit for which the recognized banknote-kind has been set, and there is an unassigned stacking unit for which no banknote-kind has been set, the recognized banknote-kind to the unassigned stacking unit.

ADVANTAGES OF THE INVENTION

[0026] With the structure described above, in a banknote sorting and bundling apparatus according to the present invention, one category of a stacking banknote is set for all sorting and stacking units or all bundling-side stacking units, and upon recognition of a category and a banknote-kind of the banknote by a recognition unit, it is confirmed whether a stacking unit for the recognized banknote-kind is available among the stacking units for the recognized category based on category settings performed by a category setting unit. If no stacking unit for the recognized banknote-kind is available, but an unassigned stacking unit for which no banknote-kind has been

set is available, the recognized banknote-kind is assigned to the unassigned stacking unit. Thus, the same category of the banknote is set to all the sorting and stacking units or all the bundling-side stacking units, and if no stacking unit for the recognized banknote-kind is available, but an unassigned stacking unit for which no banknote-kind has been set is available, the recognized banknote-kind is assigned to the unassigned stacking unit. Consequently, the work burden of an operator for setting the category and the banknote-kind of the banknote for each of the sorting and stacking units and the bundling-side stacking units is greatly reduced.

[0027] In the banknote sorting and bundling apparatus according to the present invention, if there is no stacking unit for which the corresponding banknote-kind has been set, but an unassigned stacking unit for which no banknote-kind has been set is available among the stacking units for each of which the corresponding category has been set, the corresponding banknote-kind is assigned to the unassigned stacking unit. Thus, there is an advantage in addition to the above advantage in that if no stacking unit for the corresponding banknote-kind is available, but an unassigned stacking unit for which no banknote-kind has been set is available among the stacking units for the corresponding category, the corresponding banknote-kind is assigned to the unassigned stacking unit. Consequently, the work burden of the operator for setting the banknote-kind for the sorting and stacking units and the bundling-side stacking units is greatly reduced.

[0028] In the banknote sorting and bundling apparatus according to the present invention, if the stacking unit for the corresponding banknote-kind is available, the banknote is sorted and stacked in that stacking unit. Thus, there is an advantage in addition to the above advantages in that the banknote can be sorted and stacked in the stacking unit corresponding to the category and the banknote-kind of the banknote.

[0029] In the banknote sorting and bundling apparatus according to the present invention, when removal of the banknotes stacked in the stacking unit is detected, the banknote-kind setting of the stacking unit, from which the banknotes were removed, is set as unassigned. Thus, there is an advantage in addition to the above advantages in that the banknote-kind setting of the stacking unit can be dynamically changed.

[0030] In the banknote sorting and bundling apparatus according to the present invention, the apparatus includes a specific stacking unit for sorting and stacking the banknote of a specific denomination from among denominations included in the banknote-kind. If the banknote-kind of the banknote is the specific denomination, the assignment setting unit prohibits assignment of the specific denomination as the banknote-kind setting for any of the bundling-side stacking units or the sorting and stacking units. Thus, various sorting and stacking operation can be realized by sorting and stacking the banknote of the specific denomination in the specific stacking unit irrespective of the category of the banknote, and in

addition, by prohibiting the assignment of the specific denomination as the banknote-kind setting for any of the bundling-side stacking units and the sorting and stacking units, duplication of the banknote-kind setting, between the specific stacking unit and the bundling-side stacking unit and also between the specific stacking unit and the sorting and stacking unit, can be reliably avoided.

[0031] In the banknote sorting and bundling apparatus according to the present invention, a denomination that can be set as the banknote-kind setting for any of the sorting and stacking units or the bundling-side stacking units is specified, and the banknote-kind other than the specified denomination is prohibited to be assigned to the unassigned stacking unit. Thus, there is an advantage in addition to the above advantages in that the operator can specify the assigned denomination as the banknote-kind setting for the bundling-side stacking unit or the sorting and stacking unit.

[0032] In the banknote sorting and bundling apparatus according to the present invention, the banknote-kind setting of at least one of the stacking units among the bundling-side stacking units is set as unassigned. Thus, there is an advantage in addition to the above advantages in that there is always a stacking unit in which the banknote of the same category as that of the stacking unit can be stacked.

[0033] In the banknote sorting and bundling apparatus according to the present invention, the bundling-side stacking units comprises stacking units provided in a plurality of banknote bundling devices that are connected together, and each of the banknote bundling devices includes three stacking units for stacking the bundling-object-banknotes. Thus, there is an advantage in addition to the above advantages in that the number of the bundling-side stacking units can be increased by connecting an additional banknote bundling device to the apparatus.

[0034] In the banknote sorting and bundling apparatus according to the present invention, the category of the banknote is classified into fit note and unfit note. Thus, there is an advantage in addition to the above advantages in that fit note or unfit note can be set as the stacking category for all the sorting and stacking units or all the bundling-side stacking units at one time. For example, unfit note can be set as the banknote-kind setting for the bundling-side stacking units and fit note can be set as the banknote-kind setting for the sorting and stacking units at one time.

[0035] In the banknote sorting and bundling apparatus according to the present invention, the category of the banknote is classified into new version note and old version note. Thus, there is an advantage in addition to the above advantages in that new version note or old version note can be set as the stacking category for all the sorting and stacking units or all the bundling-side stacking units at one time. For example, old version note can be set as the banknote-kind setting for the bundling-side stacking units and new version note can be set as the banknote-kind setting for the sorting and stacking units at one time.

[0036] In the banknote sorting and bundling apparatus according to the present invention, the banknote-kind is denomination information that identifies a denomination of the banknote. Thus, there is an advantage in addition to the above advantages in that the denomination can be set as the banknote-kind setting for the bundling-side stacking unit and the sorting and stacking unit.

[0037] In the banknote sorting and bundling apparatus according to the present invention, the banknote-kind is banknote face/back information that identifies whether the banknote is face-up or face-down. Thus, there is an advantage in addition to the above advantages in that, in addition to the denomination, the face-up or the face-down can be set as the banknote-kind setting for the bundling-side stacking unit and the sorting and stacking unit.

[0038] In the banknote sorting and bundling apparatus according to the present invention, the banknote-kind is portrait orientation information that identifies whether a portrait on the banknote is upright or inverted. Thus, there is an advantage in addition to the above advantages in that, in addition to the denomination, the portrait orientation can be set as the banknote-kind setting of the bundling-side stacking unit and the sorting and stacking unit.

[0039] With the structure described above, in a banknote sorting and stacking method according to the present invention, one category of the stacking banknote is set for all the sorting and stacking units or all the bundling-side stacking units, and upon recognition of the category and the banknote-kind of the banknote by the recognition unit, it is confirmed whether the stacking unit for the recognized banknote-kind is available among the stacking units for the recognized category based on category settings performed by the category setting unit. If no stacking unit for the recognized banknote-kind is available, but an unassigned stacking unit for which no banknote-kind has been set is available, the recognized banknote-kind is assigned to the unassigned stacking unit. Thus, the same category of the banknote is set to all the sorting and stacking units or all the bundling-side stacking units, and if no stacking unit for the recognized banknote-kind setting is available, but an unassigned stacking unit is available, the recognized banknote-kind is assigned to the unassigned stacking unit. Consequently, the work burden of the operator for setting the category and the banknote-kind of the banknote for each of the sorting and stacking units and the bundling-side stacking units is greatly reduced.

[0040] In the banknote sorting and stacking method according to the present invention, if there is no stacking unit for which the corresponding banknote-kind has been set, but an unassigned stacking unit for which no banknote-kind has been set is available among the stacking units for each of which the corresponding category has been set, the corresponding banknote-kind is assigned to the unassigned stacking unit. Thus, there is an advantage in addition to the above advantage in that if no stacking unit for the corresponding banknote-kind setting is available, but an unassigned stacking unit for which no

banknote-kind has been set is available among the stacking units for the corresponding category, the corresponding banknote-kind is assigned to the unassigned stacking unit. Consequently, the work burden of the operator for setting the banknote-kind for sorting and stacking units and the bundling-side stacking units is greatly reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0041]

FIG. 1 is a perspective view for clearly showing an appearance of a banknote sorting and bundling apparatus according to a first embodiment of the present invention.

FIG. 2 is a schematic drawing of an internal structure of the banknote sorting and bundling apparatus.

FIG. 3 is a drawing for clearly explaining a reversing process performed by a banknote reversing unit.

FIG. 4 is a schematic block diagram of an internal structure of the banknote sorting and bundling apparatus.

FIG. 5 is a drawing for explaining an example of combination patterns managed in a set pattern table.

FIGS. 6A to 6D are drawings for clearly explaining action transitions of a pre-bundling transport unit.

FIGS. 7A to 7G are drawings for clearly explaining action transitions of a hold and transport unit.

FIG. 8 is a flowchart of process procedures related to a pattern setting process performed by a control unit.

FIG. 9 is a flowchart of process procedures related to a transport destination determination process performed by the control unit.

FIG. 10 is a flowchart of process procedures related to a stacked-banknotes removal and updating process performed by the control unit.

FIG. 11 is a drawing for clearly explaining action transitions of an operation of sorting and stacking a banknote in a bundling-side stacking unit according to the first embodiment.

FIG. 12 is a drawing for clearly explaining action transitions of an operation of sorting and stacking a banknote in a bundling-side stacking unit according to a second embodiment.

EXPLANATIONS OF LETTERS OR NUMERALS

[0042]

1: Banknote sorting and bundling apparatus
2: Banknote processing device
3: Banknote bundling device
3A: Banknote bundling device
3B: Banknote bundling device
4: Display device
11: Hopper unit
12: Feeding unit

13: Banknote transport unit
13A: Diverting unit
14: Banknote recognition unit
15: Banknote reversing unit
5 15A: Reversing member
16: Stacker
16A: First stacker
16B: Second stacker
16C: Third stacker
10 16D: Fourth stacker
16E: Stacking wheel
17A: First reject unit
17B: First reject unit
17C: Stacking wheel
15 18: Banknote transport path
18A: First transport path
18B: Second transport path
18C: Third transport path
19: Detection sensor
20 20: Second reject unit
20A: Banknote aligner wheel
21: Bundling-side stacking unit
21A: First bundling-side stacking unit
21B: Second bundling-side stacking unit
25 21C: Third bundling-side stacking unit
21D: Fourth bundling-side stacking unit
21E: Fifth bundling-side stacking unit
21F: Sixth bundling-side stacking unit
22: Bundling unit
30 22A: Bundling stage
23: Bundle dispensing outlet
24: Loose-banknotes returning outlet
25: Pre-bundling transport unit
26: Post-bundling transport unit
35 27: Hold and transport unit
27A: Hold unit
28: Dispensing transport unit
31: Stacking space
32: Stage member
40 41: Hand unit
41A: Upper hand
41B: Lower hand
41C: Driving belt
42: Transport unit
45 43: Horizontal movement mechanism
44: Vertical movement mechanism
44A: Guiding shaft
44B: Driving belt
51: Bundling tape reel
50 52: Driving roller
53: Bundling tape stopper
54: Rotating arm
55: Printer
56: Cutter
55 57: Heater
61: Bundled-banknotes lifting unit
62: Pushing mechanism
63: Dispense/hold mechanism

63A: Bundled-banknotes stacking unit
 63B: Bundled banknotes stage
 110: Stacker-side mechanism
 120: Bundling-side mechanism
 130: Operating unit
 131: Pattern specifying unit
 132: Denomination specifying unit
 140: Display control unit
 150: Category managing unit
 160: Assigned-denomination managing unit
 170: Pattern table
 180: Drive control unit
 190: Control unit
 191: Category setting unit
 192: Transport determining unit
 193: Assignment setting unit
 194: Bundling-object-banknote number determining unit
 195: Removal detection unit
 P: Bundling-object-banknote
 P1: Bundled banknotes
 R: Bundling tape

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0043] Exemplary embodiments of a banknote bundling apparatus according to the present invention are explained below in detail with reference to the accompanying drawings.

[0044] An overview of an embodiment according to the present invention is explained first. The banknote sorting and bundling apparatus includes stackers for sorting and stacking banknotes being transported and bundling-side stacking units for sorting and stacking banknotes of predetermined banknote-kinds as bundling-object-banknotes. The banknote sorting and bundling apparatus also includes a category setting unit and an assignment setting unit. The category setting unit sets a category of the stacking banknote to all of the stackers or all of the bundling-side stacking units. The assignment setting unit, when the category and the banknote-kind of the banknote being transported are recognized and there is no stacker or the bundling-side stacking unit for which the recognized category and the recognized banknote-kind have been set, assigns the recognized banknote-kind as the stacking banknote to a stacking unit for which the recognized category has been set and no banknote-kind has been set.

[0045] Consequently, in the present embodiment, same category of the stacking banknote is set for all the stackers or all the bundling-side stacking units. In addition, the banknote-kind of the banknote being transported is assigned to a stacking unit, for which no stacking banknote has been set, from among the stackers or the bundling-side stacking units for which the category of the banknote being transported has been set. Thus, the work burden of an operator for setting the category and the

banknote-kind of the stacking banknote for each of the stackers and the bundling-side stacking units is greatly reduced.

5 [First Embodiment]

[0046] FIG. 1 is a perspective view for clearly showing an appearance of a banknote sorting and bundling apparatus according to a first embodiment of the present invention. FIG. 2 is a schematic drawing of an internal structure of the banknote sorting and bundling apparatus.

[0047] A banknote sorting and bundling apparatus 1 includes a banknote processing device 2, two banknote bundling devices 3 (3A and 3B), and a display device 4. The banknote processing device 2 accepts continuous deposits of banknotes in transaction, sorts and stacks the deposited banknotes by a stacking category and a banknote-kind, and counts the number of the deposited banknotes for each stacking category and banknote-kind. The two banknote bundling devices 3 (3A and 3B) bundle a predetermined number of banknotes, for example, every one hundred banknotes, of a specific stacking category and a specific banknote-kind sorted by the banknote processing device 2. The display device 4 displays various kinds of information such as a count result, etc.

[0048] The banknote processing device 2 includes a hopper unit 11 for depositing banknotes in transaction into the apparatus, a feeding unit 12 that feeds the banknotes, one by one, deposited in the hopper unit 11, a banknote transport unit 13, such as a transport belt, that transports the banknotes fed by the feeding unit 12, a banknote recognition unit 14 that recognizes the category and the banknote-kind transported by the banknote transport unit 13.

[0049] The banknote processing device 2 further includes a banknote reversing unit 15 that reverses the banknote transported by the banknote transport unit 13 based on face/back information obtained from the banknote recognition unit 14.

[0050] The banknote processing device 2 further includes four stackers 16 for sorting and stacking the banknotes transported by the banknote transport unit 13 according to the stacking category and banknote-kind, and two first reject units 17 (17A and 17B) for rejecting the banknotes that are not of the stacking category and the banknote-kind corresponding to the stackers 16 and the banknote bundling device 3. A stacking wheel 16E (17C) that stacks the banknote being transported, one at a time, at a predetermined position in a banknote stacking space, is arranged in each of the stackers 16 and the first reject units 17.

[0051] The four stackers 16 for sorting and stacking the transported banknotes based on the stacking category and the banknote-kind comprise a first stacker 16A, a second stacker 16B, a third stacker 16C, and a fourth stacker 16D. The term stacking category refers to fitness information that indicates whether a banknote is a fit note or an unfit note, printed version information that indicates

whether a banknote is a new version note or an old version note, etc. The term banknote-kind refers to, if US dollar is taken as an example, the seven denominations of U.S. dollar, namely, 1 U.S. dollar, 2 U.S. dollar, 5 U.S. dollar, 10 U.S. dollar, 20 U.S. dollar, 50 U.S. dollar, and 100 U.S. dollar, as well as authentication information that indicates whether a banknote is a genuine note or a counterfeit note for each denomination, portrait orientation information that indicates whether a portrait on a banknote is upright or inverted, face/back information that identifies whether a banknote is face-up or face-down, etc.

[0052] The banknote bundling device 3 includes the banknote transport unit 13 that transports the banknote of the specific stacking category and the specific banknote-kind from a banknote transport path 18 inside the banknote processing device 2 into the banknote bundling device 3, three bundling-side stacking units 21 that are arranged at three levels in a vertical direction inside the banknote bundling device 3 for sorting and stacking the transported banknotes of the specific stacking category and the specific banknote-kind, and a bundling unit 22 that is arranged below the three bundling-side stacking units 21 for bundling the bundling-object-banknotes sorted and stacked in the bundling-side stacking unit 21 when the number of bundling-object-banknotes reach a predetermined number, for example, one hundred.

[0053] The banknote bundling device 3 further includes a bundle dispensing outlet 23 that is located near the hopper unit 11 and that dispenses the banknotes bundled by the bundling unit 22, that is the bundle of banknotes, so that the operator can collect them, and a loose-banknotes returning outlet 24 that is located near the bundling-side stacking unit 21 and that dispenses loose banknotes stacked in the bundling-side stacking unit 21 at the end of a transaction so that the operator can collect them.

[0054] The banknote bundling device 3 includes a pre-bundling transport unit 25 that holds and transports the bundling-object-banknotes stacked in the bundling-side stacking unit 21 to the bundling unit 22 or the loose-banknotes returning outlet 24, and a post-bundling transport unit 26 that holds and transports the bundling-object-banknotes in the bundling unit 22 in a long-edge direction and that holds and transports a bundle of banknotes bundled by the bundling unit 22 to the bundle dispensing outlet 23.

[0055] The pre-bundling transport unit 25 holds, from a long-edge side, the one hundred bundling-object-banknotes from among the bundling-object-banknotes stacked in the bundling-side stacking unit 21 and transports the one hundred bundling-object-banknotes onto a bundling stage 22A inside the bundling unit 22. At the end of a transaction, the pre-bundling transport unit 25 holds the loose banknotes, whose number does not reach one hundred, from among the bundling-object-banknotes stacked in the bundling-side stacking unit 21 and transports the loose banknotes to the loose-banknotes returning outlet 24. The bundling stage 22A of the

bundling unit 22 corresponds to a bundling operation area of the bundling unit 22.

[0056] The post-bundling transport unit 26 includes a hold and transport unit 27 that, after the pre-bundling transport unit 25 transports the bundling-object-banknotes onto the bundling stage 22A of the bundling unit 22, holds a short-edge of the transported bundling-object-banknotes, adjusts the movement of the held bundling-object-banknotes in the long-edge direction of the banknote, and holds and transports the bundle of banknotes bundled by the bundling unit 22; and a dispensing transport unit 28 that transports the bundle of banknotes held and transported by the hold and transport unit 27 to the bundle dispensing outlet 23.

[0057] The hold and transport unit 27 holds, from the short-edge side, the bundling-object-banknotes at an operation preparation position after that are transported to the operation preparation position on the bundling stage 22A inside the bundling unit 22 by the pre-bundling transport unit 25 (see FIG. 7C that is described later). The pre-bundling transport unit 25 releases its hold of the long-edge of bundling-object-banknotes as the hold and transport unit 27 holds the bundling-object-banknotes from the short-edge side.

[0058] The operation preparation position is a position from where the bundling-object-banknotes are moved and adjusted toward a bundling operation position on the bundling stage 22A where a bundling operation is performed, that is, a position from where an adjustment of the bundling-object-banknote starts in a long-edge direction. The bundling operation position is a position at which the bundling-object-banknotes are bundled with the bundling tape.

[0059] Upon holding the bundling-object-banknotes at the operation preparation position on the bundling stage 22A of the bundling unit 22, the hold and transport unit 27 moves and adjusts the position of the bundling-object-banknotes in the long-edge direction so that the bundling position of the bundling-object-banknotes is set at the bundling operation position on the bundling stage 22A (see FIG. 7E that is described later). The bundling unit 22 wraps the bundling tape around the bundling-object-banknotes at the bundling position by setting the bundling position of the bundling-object-banknotes at the bundling operation position.

[0060] When bundling of the bundling-object-banknotes by the bundling unit 22 is completed at the bundling operation position on the bundling stage 22A in a state the bundling-object-banknotes are being held by the hold and transport unit 27 from the short-edge side, the hold and transport unit 27 transports the bundle of banknotes to the operation preparation position and subsequently into the dispensing transport unit 28.

[0061] The dispensing transport unit 28 includes a bundled-banknotes lifting unit 61 that transports the bundle of banknotes held and transported by the hold and transport unit 27 to an upper part of the banknote bundling device 3, a pushing mechanism 62 that pushes the bun-

dle of banknotes, transported to the upper part of the banknote bundling device 3 by the bundled-banknotes lifting unit 61, towards the bundle dispensing outlet 23 (towards a front side of the apparatus), and a dispense/hold mechanism 63 that receives the bundle of banknotes pushed to the front side of the apparatus by the pushing mechanism 62 and holds the bundle of banknotes at the position of the bundle dispensing outlet 23 for dispensing the bundle of banknotes.

[0062] The banknote sorting and bundling apparatus 1 further includes the banknote transport path 18 that includes a first transport path 18A that is connected to the hopper unit 11 and that is arranged above the stackers 16, a second transport path 18B that is connected to the first transport path 18A and that bends back in an arrangement direction of the stackers 16, and the third transport path 18C that is connected to the second transport path 18B, the stackers 16, and the bundling-side stacking unit 21. The banknote recognition unit 14 is arranged on the first transport path 18A and the banknote reversing unit 15 is arranged on the second transport path 18B. The second transport path 18B is configured as a removable unit that connects the first transport path 18A and the third transport path 18C of the banknote sorting and bundling apparatus 1.

[0063] On the banknote transport path 18, detection sensors 19 for detecting approaches or passes of banknotes at each branching point, merging point, and device linkage point between the devices are arranged at each of the above-mentioned points on the banknote transport path 18.

[0064] A second reject unit 20 is arranged at the end of the third transport path 18C. A banknote aligner wheel 20A that stacks the transported banknote, one at a time, at a predetermined position in a banknote stacking space is arranged in the second reject unit 20.

[0065] A diverting unit 13A is arranged at each of the branching points on the banknote transport path 18. The diverting unit 13A diverts the banknote transported through the banknote transport path 18 to the stackers 16, the bundling-side stacking unit 21, the first reject units 17A or the second reject unit 20. The diverting unit 13A is driven by a not shown solenoid when the detection sensor 19 detects an approach of a leading edge of the banknote, and performs the diverting of the banknote.

[0066] The banknote reversing unit 15 diverts the banknote, based on the face/back information obtained from the banknote recognition unit 14, into a reversing route or a non-reversing route by the diverting unit 13A that is arranged upstream of the banknote reversing unit 15 so that all the banknotes are transported through the third transport path 18C with faces in the same direction, either face-up or face-down.

[0067] The reversing route includes a reversing member 15A that has a curved surface and that extends along a transport direction of the banknote, a not shown transport belt that is wound obliquely relative to a longitudinal direction of the reversing member 15A with a part of the

transport belt running along the curved surface of the reversing member 15A, a not shown driving motor that drives the transport belt, and a not shown guide unit guiding the banknote while the banknote is transported, in the longitudinal direction of the reversing member 15A, in the state of being wrapped around the curved surface of the reversing member 15A and is held between the transport belt and the reversing member 15A (see Japanese Patent No. 4119664).

[0068] In the banknote reversing unit 15, when the transport belt is being driven by the driving motor, the banknote moves in the transport direction as the transport belt moves while the banknote is being held between the transport belt and the reversing member 15A. Because the transport belt is wound obliquely relative to the longitudinal direction of the reversing member 15A, the banknote is transported in the state of being wrapped around the curved surface and is reversed during the transport. During the reversing of the banknote, the guide unit ensures that the banknote is reversed properly by restricting a movement of the banknote and guiding so that the banknote is slid on the surface of the guide unit.

[0069] FIG. 3 is a drawing for clearly explaining a reversing process performed by the banknote reversing unit 15.

[0070] When transporting the banknote with an A face (front face), shown in FIG. 3, to the third transport path 18C, the banknote reversing unit 15 transports the banknote via a non-reversing route without performing a reversing process so that the banknote with the A face (front face) is transported to the third transport path 18C.

[0071] When transporting the banknote with a B face (back face), shown in FIG. 3, to the third transport path 18C, the banknote reversing unit 15 transports the banknote with the B face via a reversing route by performing a long-edge direction reversing process so that the banknote is reversed, and therefore, the banknote with the A face (front face) is transported to the third transport path 18C.

[0072] Three openings are provided through the back side wall of the bundling-side stacking unit 21 to allow a hand unit 41 (see FIG. 2) of the pre-bundling transport unit 25 to advance into the stacking space 31 and hold the bundling-object-banknotes stacked in the stacking space 31. A shutter mechanism that can be opened and closed is provided below the back side wall to allow the hand unit 41 to pull out the bundling-object-banknotes from the stacking space 31.

[0073] As shown in FIG. 2, the pre-bundling transport unit 25 includes a transport unit 42 that has the hand unit 41 that holds a long-edge of bundling-object-banknotes stacked in the bundling-side stacking unit 21, a horizontal movement mechanism 43 that moves the transport unit 42 forward and backward (horizontal direction), and a vertical movement mechanism 44 that moves the transport unit 42 upward and downward (vertical direction).

[0074] The vertical movement mechanism 44 includes a guiding shaft 44A that is vertically placed and that ex-

tends from a bottom end to a top end of the banknote bundling device 3, and a driving belt 44B that raises and lowers the transport unit 42 along the guiding shaft 44A.

[0075] The transport unit 42 arranged in the pre-bundling transport unit 25 includes the hand unit 41 that can be moved forward and backward by a driving belt 43A arranged in the horizontal movement mechanism 43. The hand unit 41 includes an upper hand 41A with three holding pawls and a lower hand 41B with three holding pawls facing each other and holds the bundling-object-banknotes stacked in the bundling-side stacking unit 21 with the opposing sets of holding pawls. The lower hand 41B is fixed whereas the upper hand 41A is movable up and down by a driving belt 41C.

[0076] The transport unit 42 holds, from the long-edge side, the bundling-object-banknotes by the opposing holding pawls of the upper hand 41A and the lower hand 41B, and transports the bundling-object-banknotes to the operation preparation position on the bundling stage 22A inside the bundling unit 22 or to the loose-banknotes returning outlet 24.

[0077] The pre-bundling transport unit 25 transports the one hundred bundling-object-banknotes, with the long-edge of the bundling-object-banknotes held by the transport unit 42, to the operation preparation position on the bundling stage 22A inside the bundling unit 22.

[0078] The hold and transport unit 27 holds, from the short-edge side, the one hundred bundling-object-banknotes at the operation preparation position on the bundling stage 22A inside the bundling unit 22 in a state the bundling-object-banknotes are being held from the long-edge side by the transport unit 42. As the hold and transport unit 27 holds the short-edge of the bundling-object-banknotes, the transport unit 42 inside the pre-bundling transport unit 25 releases its hold of the long-edge of the bundling-object-banknotes and moves to a standby position.

[0079] The hold and transport unit 27 includes a holding unit 27A having upper and lower hands that together hold the banknotes from the short-edge side. The holding unit 27A moves and adjusts the position of the bundling-object-banknotes from the operation preparation position, in the long-edge direction, so that the bundling position of the bundling-object-banknotes matches the bundling operation position on the bundling stage 22A.

[0080] When the bundling position of the bundling-object-banknotes is aligned with the bundling operation position on the bundling stage 22A in a state the short edge of the bundling-object-banknotes are being held by the holding unit 27A inside the hold and transport unit 27, the bundling unit 22 bundles the bundling-object-banknotes with the bundling tape at the bundling position.

[0081] The bundling unit 22 includes a bundling tape reel 51 on which the bundling tape is wound, a driving roller 52 that feeds the bundling tape from the bundling tape reel 51, a bundling tape stopper 53 that stops the leading edge of the bundling tape being drawn from the bundling tape reel 51 at the bundling position of the bun-

dling-object-banknotes that is aligned with the bundling operation position, and a rotating arm 54 that draws from the bundling tape reel 51 the bundling tape that has been stopped at the bundling position on the bundling-object-banknotes, and wraps the bundling tape around the bundling-object-banknotes at the bundling position.

[0082] The bundling unit 22 that makes the bundle of banknotes by bundling the bundling-object-banknotes with the bundling tape further includes a printer 55 that performs printing on the bundling tape, a cutter 56 that cuts the other end of the bundling tape wound at the bundling position of the bundling-object-banknotes, and a heater 57 that thermally bonds the other end of the bundling tape cut by the cutter 56.

[0083] The driving roller 52 feeds a bundling tape R from the bundling tape reel 51 by a forward rotation operation and rewinds the bundling tape R on the bundling tape reel 51 by a reverse rotation operation.

[0084] The printer 55 prints information on the bundling tape R when the bundling tape R passes over the printing head. The information printed on the bundling tape R includes a bundling date that indicates the date on which the bundling was done, an apparatus number that indicates the banknote bundling device 3, an operator name that indicates the operator, a bundle ID that distinguishes the bundle of banknotes, etc.

[0085] As shown in FIG. 2, when the bundling unit 22 completes the bundling operation of the bundling-object-banknotes, the holding unit 27A of the hold and transport unit 27 returns the bundle of banknotes to the operation preparation position and transports the bundle of banknotes into the bundled-banknotes lifting unit 61 of the dispensing transport unit 28 through a bundled-banknotes transport path. Moreover, once the bundle of banknotes is transported into the bundled-banknotes lifting unit 61, the hold and transport unit 27 releases its hold on the short-edge of the bundle of banknotes.

[0086] The bundled-banknotes lifting unit 61 transports the bundle of banknotes held and transported by the hold and transport unit 27 toward the pushing mechanism 62 in the upper part of the banknote bundling device 3.

[0087] The pushing mechanism 62 pushes and transports the bundle of banknotes to the dispense/hold mechanism 63 in a direction of the bundle dispensing outlet 23 (towards the front side of the apparatus) by pushing the bundle of banknotes transported to the upper part of the banknote bundling device 3 by the bundled-banknotes lifting unit 61.

[0088] The dispense/hold mechanism 63 includes a bundled-banknotes stacking unit 63A in which the bundle of banknotes, that is pushed and transported by the pushing mechanism 62, is stacked, and a bundled banknotes stage 63B for placing the bundle of banknotes stacked in the bundled-banknotes stacking unit 63A. The dispense/hold mechanism 63 adjusts a height of the bundled banknotes stage 63B so that the bundle of banknotes pushed by the pushing mechanism 62 comes to

rest on the topmost bundle of banknotes resting on the bundled banknotes stage 63B.

[0089] In the explanation so far, for the sake of simplicity, because the internal structures of the banknote bundling devices 3A and 3B are substantially identical, the internal structures of the banknote bundling devices 3A and 3B were collectively described as that of the banknote bundling device 3. The bundling-side stacking units 21 of the banknote bundling devices 3A comprise a first bundling-side stacking unit 21A, a second bundling-side stacking unit 21B, and a third bundling-side stacking unit 21C, and the ones of the banknote bundling devices 3B comprise a fourth bundling-side stacking unit 21D, a fifth bundling-side stacking unit 21E, and a sixth bundling-side stacking unit 21F.

[0090] FIG. 4 is a schematic block diagram of an internal structure of the banknote sorting and bundling apparatus 1.

[0091] The banknote sorting and bundling apparatus 1 shown in FIG. 4 includes, apart from the banknote recognition unit 14, a stacker-side mechanism 110 arranged in the banknote processing device 2, a bundling-side mechanism 120 arranged inside the banknote bundling device 3 (3A and 3B), an operation unit 130 for inputting various commands, and a display control unit 140 that performs a display control of the display device 4.

[0092] The banknote sorting and bundling apparatus 1 further includes a category managing unit 150 that manages stacking categories of the stackers 16 and the bundling-side stacking units 21, an assigned-denomination managing unit 160 that manages assigned banknote-kinds (stacking banknote), for example, assigned denominations, of the stackers 16 and the bundling-side stacking units 21, a pattern table 170 for managing combination patterns of the stacking categories and the assigned banknote-kinds, a drive control unit 180 that performs a drive control on the stacker-side mechanism 110 and the bundling-side mechanism 120, and a control unit 190 that performs an overall control of the banknote sorting and bundling apparatus 1.

[0093] The stacker-side mechanism 110 includes the feeding unit 12, the banknote transport unit 13, the banknote reversing unit 15, and the stacking wheel 16E (17C), and the detection sensors 19 and the diverting units 13A of the banknote processing device 2.

[0094] The bundling-side mechanism 120 includes the detection sensors 19, the banknote transport unit 13, the diverting units 13A, the bundling unit 22, the pre-bundling transport unit 25, and the post-bundling transport unit 26 of the banknote bundling device 3. The post-bundling transport unit 26 includes the hold and transport unit 27 and the dispensing transport unit 28.

[0095] The category managing unit 150 manages the stacking categories, such as fit note, unfit note, new version note, and old version note, currently set for the stackers 16 and the bundling-side stacking units 21. For example, as stacking categories, fit notes can be set as the stacking banknote for the stackers 16 and unfit notes can

be set as the stacking banknote for the bundling-side stacking units 21.

[0096] The assigned-denomination managing unit 160 manages the currently assigned banknote-kind (stacking banknote) of each of the stackers 16 and the bundling-side stacking units 21. The assigned-denomination managing unit 160, for example, manages the currently assigned denominations to the first stacker 16A to the fourth stacker 16D and the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F. The assigned denominations can be of a fixed type in which the stacking denomination for each of the stacking units is fixed, or auto-assignment type in which the stacking denomination of each of the stackers 16 or the bundling-side stacking units 21 is assigned dynamically. In the auto-assignment type, a denomination is not assigned in a fixed manner and, upon detection of the denomination of the banknote being transported, the detected denomination is dynamically assigned to each of the stackers 16 or the bundling-side stacking units 21.

[0097] The pattern table 170 manages the combination patterns of a plurality of the stacking categories and the assigned banknote-kinds (stacking banknote) of the stackers 16 and the bundling-side stacking units 21. The pattern table 170 can include the combination patterns. In the combination pattern, for example, as shown in FIG. 5, the stacking category for the first stacker 16A to the fourth stacker 16D is set to fit notes, the stacking category for the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F is set to unfit notes, and the assigned denomination for the first stacker 16A to the fourth stacker 16D and the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F is auto-assignment.

[0098] The operation unit 130 includes a pattern specifying unit 131 for selecting a combination pattern from among the combination patterns of the stacking categories and the assigned banknote-kinds managed in the pattern table 170 and a denomination specifying unit 132 for specifying a denomination for auto-assignment from among a plurality of the assigned banknote-kinds on a display screen of the display device 4.

[0099] The control unit 190, for example, performs assignment setting of the assigned banknote-kind (stacking banknote) to be stacked in each of the stackers 16, each of the first reject units 17A and 17B, the second reject unit 20, and each of the bundling-side stacking units 21.

[0100] For example, the control unit 190 sets, as the stacking category, fit notes to the stackers 16 and unfit notes to the bundling-side stacking units 21. The control unit 190 also sets, as the assigned banknote-kind, auto-assignment to the first stacker 16A to the fourth stacker 16D and the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F, and sets, as denominations that can be set for the auto-assignment, 1 U.S. dollar, 5 U.S. dollar, 10 U.S. dollar, 20 U.S. dollar, and 50 U.S. dollar. The assigned banknote-kind that can be set for the auto-assignment can be specified by the

denomination specifying unit 132. For example, fit notes of 1 U.S. dollar, 5 U.S. dollar, 10 U.S. dollar, and 20 U.S. dollar are assigned to the stackers 16, and unfit notes of 1 U.S. dollar, 5 U.S. dollar, 10 U.S. dollar, and 20 U.S. dollar are assigned to the bundling-side stacking units 21.

[0101] Furthermore, the control unit 190 sets, as the assigned banknote-kind of the first rejection unit 17A, the banknote-kinds other than those of the stackers 16 and the bundling-side stacking units 21. The control unit 190 also sets the banknotes, that have encountered some error during transport or recognition, are stacked in the first rejection unit 17A.

[0102] Furthermore, the control unit 190 identifies an error such as banknote clogging (jamming) on the transport path based on a detection result of the detection sensor 19.

[0103] The control unit 190 includes a category setting unit 191, a transport determining unit 192, an assignment setting unit 193, a bundling-object-banknote number determining unit 194, and a removal detection unit 195.

The category setting unit 191 sets the stacking category of the stackers 16 and the bundling-side stacking units 21. The transport determining unit 192 determines a transport destination of the banknote being transported based on the recognition result of the banknote obtained from the banknote recognition unit 14. The assignment setting unit 193 performs assignment setting of the assigned banknote-kind (stacking banknote) of each of the stackers 16 and the bundling-side stacking units 21. The bundling-object-banknote number determining unit 194 determines whether one hundred bundling-object-banknotes have been stacked in any one of the three bundling-side stacking units 21. The removal detection unit 195 detects an end of a banknote removal operation from the stackers 16 or the bundling-side stacking units 21.

[0104] The category setting unit 191 sets the stacking category for each of the stackers 16 and the bundling-side stacking units 21 based on, for example, stacking categories in the combination pattern specified by using the pattern specifying unit 131. Thus, the stacking categories currently set for the stackers 16 and the bundling-side stacking units 21 by the category setting unit 191 are managed by the category managing unit 150.

[0105] The transport determining unit 192 determines, based on the recognition result of the banknote by the banknote recognition unit 14, whether the category of the banknote being transported matches any stacking category currently set for the stackers 16 or the bundling-side stacking units 21. If the category of the banknote being transported matches a stacking category currently set for the stackers 16, the transport determining unit 192 determines whether the banknote-kind of the banknote matches any assigned banknote-kind of the stackers 16.

[0106] If the category of the banknote being transported matches the stacking categories currently set for the stackers 16, and the banknote-kind of the banknote being transported does not match any of the banknote-kinds assigned to the stackers 16, the transport determining

unit 192 determines whether any stacker 16 for which no assigned banknote-kind is set (hereinafter, "unassigned", that is, no stacking banknote is assigned) is available among a plurality of the stackers 16.

[0107] If the transport determining unit 192 determines that an unassigned stacker 16 is available, the assignment setting unit 193 assigns the banknote-kind of the banknote being transported to the unassigned stacker 16.

[0108] Once the assignment setting unit 193 assigns the banknote-kind of the banknote being transported to the unassigned stacker 16, the control unit 190 controls the banknote transport unit 13 and the diverting units 13A through the drive control unit 180, so that the banknote is transported to the assigned stacker 16.

[0109] If the transport determining unit 192 determines that no unassigned stacker 16 is available, the control unit 190 also determines that no unassigned stacker 16 is available, displays the message indicating the determined fact on the display device 4 through the display control unit 140, and controls the banknote transport unit 13 and the diverting units 13A through the drive control unit 180 so that the banknote is transported to the first reject unit 17A.

[0110] Furthermore, if the category of the banknote being transported matches the stacking categories set for the bundling-side stacking units 21, and the banknote-kind of the banknote being transported does not match any of the banknote-kinds assigned to the bundling-side stacking units 21, the transport determining unit 192 determines whether any unassigned bundling-side stacking unit 21 is available among a plurality of the bundling-side stacking units 21.

[0111] If the transport determining unit 192 determines that an unassigned bundling-side stacking unit 21 is available, the assignment setting unit 193 assigns the banknote-kind of the banknote being transported to the unassigned bundling-side stacking unit 21.

[0112] Once the assignment setting unit 193 assigns the banknote-kind of the banknote being transported to the unassigned bundling-side stacking unit 21, the control unit 190 controls the banknote transport unit 13 and the diverting units 13A through the drive control unit 180, so that the banknote is transported to the assigned bundling-side stacking unit 21.

[0113] If the transport determining unit 192 determines that no unassigned bundling-side stacking unit 21 is available, the control unit 190 also determines that no unassigned bundling-side stacking unit 21 is available, displays the message indicating the determined fact on the display device 4 through the display control unit 140, and controls the banknote transport unit 13 and the diverting units 13A through the drive control unit 180 so that the banknote is transported to the first reject unit 17A.

[0114] The removal detection unit 195, upon detecting all the banknotes stacked in any stacker 16 from among the first stacker 16A to the fourth stacker 16D have been removed, determines the detected operation as the ban-

knot removal operation for that stacker 16. Moreover, the removal detection unit 195, upon detecting the one hundred bundling-object-banknotes stacked in any bundling-side stacking unit 21 from among the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F have been removed by the pre-bundling transport unit 25, determines the detected operation as the banknote removal operation for that bundling-side stacking unit 21.

[0115] When the removal detection unit 195 detects that the banknote removal operation of the stacker 16 has ended, the assignment setting unit 193 assigns the assigned banknote-kind of the stacker 16, in which banknotes can be stacked again after the banknote removal operation, as unassigned. In addition, when the removal detection unit 195 detects that the banknote removal operation of the bundling-side stacking unit 21 has ended, the assignment setting unit 193 assigns the assigned banknote-kind of the bundling-side stacking unit 21, in which banknotes can be stacked again after the banknote removal operation, as unassigned.

[0116] If a denomination, that can be set as an assigned banknote-kind for the auto-assignment, is specified by the denomination specifying unit 132, the assignment setting unit 193 prohibits denominations other than the specified denomination are set automatically as the assigned banknote-kind. For example, in the first embodiment, the banknotes of 1 U.S. dollar, 5 U.S. dollar, 10 U.S. dollar, and 20 U.S. dollar are specified by the denomination specifying unit 132 as the denominations that can be used for auto-assignment

[0117] Based on the recognition result of the transported banknote obtained from the banknote recognition unit 14, if the transported banknote through the banknote transport path 18 is of the banknote category and the banknote-kind set for any of the stackers 16, the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the corresponding stacker 16.

[0118] If a transport error, etc., is detected by the detection sensors 19 when the banknote is downstream of the first reject unit 17B, the drive control unit 180 performs the drive control of the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the second reject unit 20.

[0119] Furthermore, if the banknote being transported through the banknote transport path 18 is of the banknote category and the banknote-kind set for any of the bundling-side stacking units 21, the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the corresponding bundling-side stacking unit 21.

[0120] The drive control unit 180 controls the pre-bundling transport unit 25 so that the transport unit 42 of the pre-bundling transport unit 25 draws out the bundling-object-banknotes stacked in the bundling-side stacking unit 21, and controls the holding unit 27A of the hold and transport unit 27 so that the bundling position of the bun-

dling-object-banknotes matches the bundling operation position on the bundling stage 22A of the bundling unit 22.

[0121] FIGS. 6A to 6D are drawings for clearly explaining action transitions of the pre-bundling transport unit 25.

[0122] When the bundling-object-banknotes stacked in the bundling-side stacking unit 21 are removed by the transport unit 42, the pre-bundling transport unit 25 moves, downward to a level of the lowermost edge, the stage member 32 arranged in the bundling-side stacking unit 21 in which the bundling-object-banknotes to be removed are stacked (see FIG. 6A).

[0123] The transport unit 42 of the pre-bundling transport unit 25, through the action of the driving belt 44B, moves downward along the guiding shaft 44A to a position corresponding to the bundling-side stacking unit 21 in which the bundling-object-banknotes to be removed are stacked, that is, to a position where an upper surface of the lower hand 41B is lower than the bottommost banknote of the bundling-object-banknotes stacked in the bundling-side stacking unit 21 (see FIG. 6A).

[0124] Meanwhile, the upper hand 41A of the transport unit 42 of the pre-bundling transport unit 25 is moved upward, through the action of the driving belt 41C, to a position where a lower surface of the upper hand 41A is higher than the topmost banknote of the bundling-object-banknotes stacked in the bundling-side stacking unit 21 (see FIG. 6A). Thus, there is a wide gap between the upper hand 41A and the lower hand 41B.

[0125] The transport unit 42 is moved forward through the action of the driving belt 43A of the horizontal movement mechanism 43, and the movement causes the upper hand 41A and the lower hand 41B advance into the bundling-side stacking unit 21 through the opening 31C formed on the back side wall 31B of the bundling-side stacking unit 21 and be positioned such that the bundling-object-banknotes are disposed between the upper hand 41A and the lower hand 41B (see FIG. 6B).

[0126] The upper hand 41A of the transport unit 42 is moved downward through the action of the driving belt 41C, so that the bundling-object-banknotes on the stage member 32 are tightly held between the upper hand 41A and the lower hand 41B (see FIG. 6C).

[0127] Thereafter, the transport unit 42 moves backward through the action of the driving belt 43A of the horizontal movement mechanism 43, and thus, the bundling-object-banknotes P held by the upper hand 41A and the lower hand 41B are ready to be transported to the operation preparation position on the bundling stage 22A inside the bundling unit 22 or the loose-banknotes returning outlet 24 by the vertical movement mechanism 44 (see FIG. 6D).

[0128] The drive control unit 180 shown in FIG. 4 performs the drive control of the pre-bundling transport unit 25 so that, when the number of the bundling-object-banknotes P stacked in the bundling-side stacking unit 21 reaches one hundred, the hand unit 41 of the transport unit 42 inside the pre-bundling transport unit 25 advances into the stacking space 31 through the opening 31C of

the back side wall 31B, holds the long-edge of the bundling-object-banknotes P on the stage unit 32, and draws out the held bundling-object-banknotes P from the bundling-side stacking unit 21 in order to transport the removed bundling-object-banknotes P to the bundling unit 22 by the horizontal movement mechanism 43, the vertical movement mechanism 44 and the horizontal movement mechanism 43. The assignment setting unit 193 then assigns the assigned banknote-kind of the bundling-side stacking unit 21 from which the banknotes were removed by the banknote removal operation as unassigned.

[0129] Furthermore, at the end of the transaction when the number of the bundling-object-banknotes P stacked in the bundling-side stacking unit 21 does not reach one hundred, the drive control unit 180 performs the drive control of the pre-bundling transport unit 25 so that the hand unit 41 of the transport unit 42 advances into the stacking space 31 through the opening 31C of the back side wall 31B, holds the long-edge of the bundling-object-banknotes P on the stage unit 32, and draws out the held bundling-object-banknotes P from the bundling-side stacking unit 21 in order to transport the removed loose banknotes to the loose-banknotes returning outlet 24 by the horizontal movement mechanism 43, the vertical movement mechanism 44 and the horizontal movement mechanism 43. The assignment setting unit 193 then assigns the assigned banknote-kind of the bundling-side stacking unit 21 from which the banknotes were removed by the banknote removal operation as unassigned.

[0130] After the bundling-object-banknotes stacked in the bundling-side stacking unit 21 were removed, the drive control unit 180 raises the stage member 32 arranged in the bundling-side stacking unit 21 and returns it to a normal standby position for waiting banknotes to be stacked therein.

[0131] If a transport error of the banknote being transported is detected on the banknote transport path 18 by any of the detection sensors 19, the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is sequentially transported to the second reject unit 20. When transport errors, such as skewed state of the banknote on the banknote transport path 18, or chained banknotes on the banknote transport path 18, or double feed of the banknotes on the banknote transport path 18, etc., occur, recovery can be achieved quickly by transporting the error banknotes to the second reject unit 20, as compared with stopping the transport of the banknote.

[0132] FIGS. 7A to 7G are drawings for clearly explaining action transitions of the hold and transport unit 27.

[0133] In FIG. 7A to 7C, the transport unit 42 of the pre-bundling transport unit 25 holds the long-edge of the bundling-object-banknotes P stacked in the bundling-side stacking unit 21 and transports the bundling-object-banknotes P to near an entrance of the bundling unit 22 through the horizontal movement mechanism 43 and the vertical movement mechanism 44 (see FIG. 7A). As

shown in FIG. 7A, the holding unit 27A of the hold and transport unit 27 is arranged at the operation preparation position on the bundling stage 22A.

[0134] The transport unit 42 of the pre-bundling transport unit 25 transports the bundling-object-banknotes P onto the bundling stage 22A inside the bundling unit 22 through the horizontal movement mechanism 43 (see FIG. 7B), and subsequently to the operation preparation position on the bundling stage 22A (see FIG. 7C). As a result, the holding unit 27A of the hold and transport unit 27 holds the short-edge of the bundling-object-banknotes P at the operation preparation position as the bundling-object-banknotes P are transported to the operation preparation position by the transport unit 42 (see FIG. 7C).

[0135] As the holding unit 27A of the hold and transport unit 27 holds the bundling-object-banknotes P, the transport unit 42 of the pre-bundling transport unit 25 releases its hold of the long-edge of the bundling-object-banknotes P (see FIG. 7D), and returns to the normal standby position for the stacked bundling-object-banknotes.

[0136] The holding unit 27A of the hold and transport unit 27 moves the bundling-object-banknotes P in the long-edge direction so that the bundling position of the bundling-object-banknotes P is aligned with the bundling operation position on the bundling stage 22A (see FIG. 7E). Furthermore, the bundling unit 22 wraps the bundling tape R around the bundling-object-banknotes P at the bundling position that is aligned with the bundling operation position on the bundling stage 22A, and tightens the bundling tape R at the bundling position of the bundling-object-banknotes P in a state the short-edge of the bundling-object-banknotes P are being held by the holding unit 27A.

[0137] Thereafter, the holding unit 27A of the hold and transport unit 27 moves the bundled banknotes P1 that was aligned with the bundling operation position on the bundling stage 22A to the operation preparation position (see FIG. 7F) and transports it to the dispensing transport unit 28 (see FIG. 7G).

[0138] In the claims of the present application, a banknote sorting and bundling apparatus corresponds to the banknote sorting and bundling apparatus 1, a feeding unit corresponds to the hopper unit 11, a recognition unit corresponds to the banknote recognition unit 14, a sorting and stacking unit corresponds to the stacker 16, a bundling-side stacking unit corresponds to the bundling-side stacking unit 21, a bundling unit corresponds to the bundling unit 22, a transport unit corresponds to the banknote transport unit 13 and the pre-bundling transport unit 25, a category setting unit corresponds to the category setting unit 191, a stacking unit corresponds to the first stacker 16A to the fourth stacker 16D and the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F, an assignment setting unit corresponds to the assignment setting unit 193, a determining unit corresponds to the transport determining unit 192 and the removal detection unit 195, and a banknote bundling device

corresponds to the banknote bundling device 3 (3A and 3B).

[0139] Operations performed by the banknote sorting and bundling apparatus 1 according to the first embodiment are explained below. FIG. 8 is a flowchart of process procedures related to a pattern setting process performed by the control unit 190.

[0140] The pattern setting process shown in FIG. 8 is a process for setting the stacking categories and the assigned banknote-kind to the stackers 16 and the bundling-side stacking units 21 by a predetermined operation. For the sake of simplicity, the denomination of the banknote is taken as the assigned banknote-kind.

[0141] As shown in FIG. 8, the control unit 190 displays the combination patterns managed in the pattern table 170 on the display device 4 (Step S11), and detects a specification operation for specifying an intended combination pattern from the combination patterns displayed on the display screen with the pattern specifying unit 131 (Step S12).

[0142] Upon detection of a specification operation of a combination pattern, the control unit 190 sets, in the category managing unit 150, the stacking categories of the stackers 16 and the bundling-side stacking units 21 based on the combination pattern specified by the specification operation through the category setting unit 191, and sets, in the assigned-denomination managing unit 160, the assigned denominations of the stackers 16 and the bundling-side stacking units 21 based on the combination pattern specified by the specification operation through the assignment setting unit 193 (Step S13). Thereafter, the control unit 190 ends the process procedures shown in FIG. 8.

[0143] For example, upon detection of specification of a combination pattern A at Step S12, the control unit 190 sets, in the category managing unit 150, unfit notes as the stacking category for the bundling-side stacking units 21 and fit notes as the stacking category for the stackers 16 through the category setting unit 191, and sets, in the assigned-denomination managing unit 160, auto-assignment of the banknote denomination as the assigned banknote-kind for each of the first stacker 16A to the fourth stacker 16D as well as the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F through the assignment setting unit 193 (Step S13A), and ends the process procedures shown in FIG. 8.

[0144] Upon detection of specification of a combination pattern B at Step S12, the control unit 190 sets, in the category managing unit 150, fit notes as the stacking category for the bundling-side stacking units 21 and unfit notes as the stacking category for the stackers 16 through the category setting unit 191, and sets, in the assigned-denomination managing unit 160, auto-assignment of the banknote denomination as the assigned banknote-kind for each of the first stacker 16A to the fourth stacker 16D as well as the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F through the assignment setting unit 193 (Step S13B), and ends the process

procedures shown in FIG. 8.

[0145] Upon detection of specification of a combination pattern C at Step S12, the control unit 190 sets, in the category managing unit 150, old version notes as the stacking category for the bundling-side stacking units 21 and new version notes as the stacking category for the stackers 16 through the category setting unit 191, and sets, in the assigned-denomination managing unit 160, auto-assignment of the banknote denomination as the assigned banknote-kind for each of the first stacker 16A to the fourth stacker 16D as well as the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F through the assignment setting unit 193 (Step S13C) and ends the process procedures shown in FIG. 8.

[0146] Upon detection of specification of a combination pattern D at Step S12, the control unit 190 sets, in the category managing unit 150, new version notes as the stacking category for the bundling-side stacking units 21 and old version notes as the stacking category for the stackers 16 through the category setting unit 191, and sets, in the assigned-denomination managing unit 160, auto-assignment of the banknote denomination as the assigned banknote-kind for each of the first stacker 16A to the fourth stacker 16D as well as the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F through the assignment setting unit 193 (Step S13D) and ends the process procedures shown in FIG. 8.

[0147] That is, the control unit 190 sets the stacking category of the specified combination pattern as the stacking category of the bundling-side stacking units 21 and the stackers 16, and in addition, sets the banknote denomination of the specified combination pattern as the assigned banknote-kind for each of the first stacker 16A to the fourth stacker 16D and the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F.

[0148] In the pattern setting process shown in FIG. 8, upon detection of the specification operation of the intended combination pattern, the stacking category for the bundling-side stacking units 21 and the stackers 16 are set and managed in the category managing unit 150 based on the specified combination pattern, and in addition, the assigned denomination for each of the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F and the first stacker 16A to the fourth stacker 16D are assigned and set in the assigned-denomination managing unit 160 based on the specified combination pattern. Thus, the stacking category and the assigned denomination can be easily set for each of the stackers 16 or the bundling-side stacking units 21.

[0149] FIG. 9 is a flowchart of process procedures related to a transport destination determination process performed by the control unit 190. For the sake of simplicity, it is supposed that the banknote denomination (1 U.S. dollar, 5 U.S. dollar, 10 U.S. dollar, and 20 U.S. dollar) is auto-assigned to the stackers 16 and the bundling-side stacking units 21, and any banknote-kind other than the assigned banknote-kinds set for the stackers 16 and the bundling-side stacking units 21 is set as the as-

signed banknote-kind of the first reject unit 17A.

[0150] The transport destination determination process shown in FIG. 9 is a process of stacking the banknote being transported in the stacker 16 or the bundling-side stacking unit 21 corresponding to the category and the assigned denomination of the banknote. If there is no stacker 16 or bundling-side stacking unit 21 having the assigned denomination that matches the denomination of the banknote being transported, the denomination of the banknote being transported is set as the assigned denomination of an unassigned stacking unit 16 or an unassigned bundling-side stacking units 21 for which the category of the banknote being transported has been assigned and no banknote-kind has been assigned.

[0151] As shown in FIG. 9, upon acquiring the recognition result of the banknote being transported from the banknote recognition unit 14 (Step S21), the transport determining unit 192 of the control unit 190 determines, based on the recognition result of the banknote, whether the banknote is of a specific denomination (Step S22). The term specific denomination refers to, for example, a denomination such as 2 U.S. dollar and 100 U.S. dollar that do not circulate a lot.

[0152] If the banknote is not of the specific denomination (No at Step S22), the transport determining unit 192 determines, based on the recognition result of the banknote, whether the category of the banknote matches any of the stacking categories set for the bundling-side stacking units 21 (Step S23).

[0153] If the category of the banknote matches any of the stacking categories set for the bundling-side stacking units 21 (Yes at Step S23), the transport determining unit 192 determines, based on the recognition result of the banknote, whether the denomination of the banknote matches any of the assigned denominations of the bundling-side stacking units 21 (Step S24).

[0154] If the denomination of the banknote matches the assigned denomination of the bundling-side stacking unit 21 (Yes at Step S24), the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the corresponding bundling-side stacking unit 21 (Step S25) and ends the process procedures shown in FIG. 9.

[0155] If the denomination of the banknote does not match the assigned denominations of the bundling-side stacking units 21 (No at Step S24), the transport determining unit 192 determines whether an unassigned bundling-side stacking unit 21 is available among the bundling-side stacking units 21 (Step S26).

[0156] If an unassigned bundling-side stacking unit 21 is available (Yes at Step S26), the assignment setting unit 193 of the control unit 190 assigns the denomination of the banknote being transported to the unassigned bundling-side stacking unit 21 (Step S27). The assigned-denomination managing unit 160 manages the assigned denomination of the bundling-side stacking unit 21 for which the denomination of the banknote being transported is set as the assigned denomination.

[0157] Once the denomination of the banknote being transported is assigned to the unassigned bundling-side stacking unit 21 at Step S27, the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the bundling-side stacking unit 21 set for the banknote (Step S28), and ends the process procedures shown in FIG. 9.

[0158] If no unassigned bundling-side stacking unit 21 is available (No at Step S26), the control unit 190 displays on the display device 4, through the display control unit 140, a message indicating that no bundling-side stacking unit 21 is available, that is, there is no unassigned bundling-side stacking unit 21 (Step S29). The operator can understand, by looking at the message displayed on the display device 4, that the banknote has not been stacked because no bundling-side stacking unit 2 is available, that is, there is no unassigned bundling-side stacking unit 21.

[0159] Upon determining the unavailability of an unassigned bundling-side stacking unit 21 for the banknote being transported, the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the first reject unit 17A (Step S30), and ends the process procedures shown in FIG. 9.

[0160] If the category of the banknote being transported does not match any of the stacking categories set for the bundling-side stacking units 21 (No at Step S23), the transport determining unit 192 determines whether the category of the banknote matches any of the stacking categories set for the stackers 16 (Step S31).

[0161] If the category of the banknote matches the stacking category set for the stacker 16 (Yes at Step S31) the transport determining unit 192 determines, based on the recognition result of the banknote, whether the denomination of the banknote matches any of the assigned denominations of the stackers 16 (Step S32).

[0162] If the denomination of the banknote matches the assigned denomination of the stacker 16 (Yes at Step S32), the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the corresponding stacker (Step S33), and ends the process procedures shown in FIG. 9.

[0163] If the denomination of the banknote does not match any of the assigned denominations of the stackers 16 (No at Step S32), the transport determining unit 192 determines whether an unassigned stacker 16 is available (Step S34).

[0164] If an unassigned stacker 16 is available (Yes at Step S34), the assignment setting unit 193 of the control unit 190 assigns the denomination of the banknote being transported to the unassigned stacker 16 (Step S35). The assigned-denomination managing unit 160 manages the assigned denomination of the stacker 16 for which the denomination of the banknote being transported is set as the assigned denomination.

[0165] The drive control unit 180 controls the banknote

transport unit 13 and the diverting units 13A so that the banknote is transported to the stacker 16 set for the banknote (Step S36), and ends the process procedures shown in FIG. 9.

[0166] If no unassigned stacker 16 is available (No at Step S34), the control unit 190 displays on the display device 4, through the display control unit 140, a message indicating that no stacker 16 is available, that is, there is no unassigned stacker 16 (Step S37). The operator can understand by looking at the message displayed on the display device 4 that the banknote has not been stacked because no stacker 16 is available, that is, there is no unassigned stacker 16.

[0167] Upon determining the unavailability of an unassigned stacker 16 for the banknote being transported, the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the first reject unit 17A (Step S38), and ends the process procedures shown in FIG. 9.

[0168] Furthermore, if the category of the banknote being transported does not match any of the stacking categories set for the stackers 16 (No at Step S31), the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the second reject unit 20 (Step S39), and ends the process procedures shown in FIG. 9.

[0169] If the banknote being transported is of the specific denomination based on the recognition result of the banknote (Yes at Step S22), the drive control unit 180 controls the banknote transport unit 13 and the diverting units 13A so that the banknote is transported to the first reject unit 17A (Step S40), and ends the process procedures shown in FIG. 9. If the banknote being transported is a 2 U.S. dollar banknote or a 100 U.S. dollar banknote, it is transported to the first reject unit 17A.

[0170] In the transport destination determination process shown in FIG. 9, if the category of the banknote being transported matches the stacking category set for the bundling-side stacking unit 21, and in addition, the denomination of the banknote matches the assigned denomination of the bundling-side stacking unit 21, the banknote is transported to the corresponding bundling-side stacking unit 21. Thus, the banknote can be sorted and stacked in the bundling-side stacking unit 21 corresponding to the category and the denomination of the banknote.

[0171] In the transport destination determination process, even if no bundling-side stacking unit 21 is available corresponding to the category and the denomination of the banknote being transported, if an unassigned bundling-side stacking unit 21 is available corresponding to the category of the banknote being transported, the denomination of the banknote is assigned to the unassigned bundling-side stacking unit 21. Thus, the banknote can be sorted and stacked in the bundling-side stacking unit 21 corresponding to the category and the denomination of the banknote.

[0172] In the transport destination determination process, if no bundling-side stacking unit 21 is available cor-

responding to the category and the denomination of the banknote being transported, and moreover, no unassigned bundling-side stacking unit 21 is available, the banknote is transported to the first reject unit 17A. Thus, when there is no available bundling-side stacking unit 21 for stacking the banknote, the banknote can be sorted and stacked in the first reject unit 17A.

[0173] In the transport destination determination process, if the category of the banknote being transported matches the stacking category set for the stacker 16, and in addition, the denomination of the banknote matches the assigned denomination of the stacker 16, the banknote is transported to the corresponding stacker 16. Thus, the banknote can be sorted and stacked in the stacker 16 corresponding to the category and the denomination of the banknote.

[0174] In the transport destination determination process, even if no stacker 16 is available corresponding to the category and the denomination of the banknote being transported, if an unassigned stacker 16 is available corresponding to the category of the banknote being transported, the denomination of the banknote is assigned to the unassigned stacker 16. Thus, the banknote can be sorted and stacked in the stacker 16 corresponding to the category and the denomination of the banknote.

[0175] In the transport destination determination process, if no stacker 16 is available corresponding to the category and the denomination of the banknote being transported, and moreover, no unassigned stacker 16 is available, the banknote is transported to the first reject unit 17A. Thus, when there is no stacker 16 available for stacking the banknote, the banknote is sorted and stacked in the first reject unit 17A.

[0176] In the transport destination determination process, if the banknote being transported is of a specific denomination, it is transported to the first reject unit 17A. Thus, the banknotes of specific denominations are sorted and stacked in the first reject unit 17A.

[0177] FIG. 10 is a flowchart of process procedures related to a stacked-banknotes removal and updating process performed by the control unit 190.

[0178] The stacked-banknotes removal and updating process shown in FIG. 10 is a process of changing the assigned denomination set for the stacker 16 or the bundling-side stacking unit 21 to unassigned when the removal detection unit 195 detects that the banknote removal operation of the stacker 16 or the bundling-side stacking unit 21 has ended.

[0179] As shown in FIG. 10, the removal detection unit 195 of the control unit 190 determines whether the banknotes stacked in the bundling-side stacking unit 21 have been removed by the transport unit 42 of the pre-bundling transport unit 25, that is, whether the banknote removal operation of the bundling-side stacking unit 21 has ended (Step S51). The banknote removal operation of the bundling-side stacking unit 21 includes the banknote removal operation performed for transporting one hundred bundling-object-banknotes to the bundling unit 22 and the

banknote removal operation performed for transporting the loose bundling-object-banknotes to the loose-banknotes returning outlet 24.

[0180] If the banknote removal operation of the bundling-side stacking unit 21 has ended (Yes at Step S51), the assignment setting unit 193 changes the assigned denomination of the bundling-side stacking unit 21, in which banknotes can be stacked again after the banknotes have been removed, to unassigned (Step S52), and ends the process procedures shown in FIG. 10. The assigned-denomination managing unit 160 updates the assigned denomination of the bundling-side stacking unit 21 to unassigned.

[0181] If the banknote removal operation of the bundling-side stacking unit 21 has not ended (No at Step S51), the removal detection unit 195 determines whether the banknotes stacked in the stacker 16 have been removed, that is, whether the banknote removal operation of the stacker 16 has ended (Step S53).

[0182] If the banknote removal operation of the stacker 16 has ended (Yes at Step S53), the assignment setting unit 193 changes the assigned denomination of the stacker 16, in which banknotes can be stacked again after the banknotes have been removed, to unassigned (Step S54), and ends the process procedures shown in FIG. 10. The assigned-denomination managing unit 160 manages the assigned denomination of the bundling-side stacking units 21 that has been set for the denomination of the banknote being transported.

[0183] If the banknote removal operation of the stacker 16 has not ended (No at Step S53), the assignment setting unit 193 goes back to Step S51 to monitor whether the banknote removal operation of the bundling-side stacking unit 21 has ended.

[0184] In the stacked-banknotes removal and updating process shown in FIG. 10, after the banknote removal operation of the bundling-side stacking unit 21 has ended, the assigned denomination of the bundling-side stacking unit 21, in which banknotes can be stacked again after the banknotes have been removed, is changed to unassigned. Thus, the bundling-side stacking unit 21 can be procured for sorting and stacking the banknote being transported having a denomination that is not set as the assigned denominations of the bundling-side stacking units 21. Consequently, the possibility of sorting and stacking the banknote, which ought to be stacked in the bundling-side stacking unit 21, in the first reject unit 17A is suppressed to the maximum extent.

[0185] In the stacked-banknotes removal and updating process, after the banknote removal operation of the stacker 16 has ended, the assigned denomination of the stacker 16, in which banknotes can be stacked again after the banknotes have been removed, is changed to unassigned. Thus, the stacker 16 can be procured for sorting and stacking the banknote being transported having a denomination that is not set as the assigned denominations of the stackers 16. Consequently, the possibility of sorting and stacking the banknote, which ought

to be stacked in the stacker 16, in the first reject unit 17A is suppressed to the maximum extent.

[0186] An operation of sorting and stacking the banknote being transported in the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F according to the first embodiment is explained next. FIG. 11 is a drawing for clearly explaining action transitions of the operation of sorting and stacking the banknotes being transported in the bundling-side stacking units 21 according to the first embodiment.

[0187] In the banknote sorting and bundling apparatus 1, the stacking category is set as unfit notes and the assigned denomination is set as auto-assignment for the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F. It is supposed that banknotes that are of mixed denominations of 1 U.S. dollar, 2 U.S. dollar, 5 U.S. dollar, 10 U.S. dollar, 20 U.S. dollar, 50 U.S. dollar, and 100 U.S. dollar, but that have been sorted by denomination are placed in the hopper unit 11.

[0188] For example, if the banknote being transported is detected to be an unfit 1 U.S. dollar banknote, the control unit 190 assigns 1 U.S. dollar as the assigned denomination of the unassigned first bundling-side stacking unit 21A of the banknote bundling device 3A, and sorts and stacks the unfit 1 U.S. dollar banknote in the first bundling-side stacking unit 21A (Status 1).

[0189] When one hundred unfit 1 U.S. dollar banknotes have been stacked in the first bundling-side stacking unit 21A (Status 2), the one hundred unfit 1 U.S. dollar banknotes stacked in the first bundling-side stacking unit 21A are removed through the transport unit 42 arranged in the pre-bundling transport unit 25 controlled by the control unit 190. In the meantime, if a new version banknote being transported is detected to be an unfit 1 U.S. dollar banknote, the control unit 190 assigns 1 U.S. dollar as the assigned denomination of the unassigned second bundling-side stacking unit 21B, and changes the assigned denomination of the first bundling-side stacking unit 21A, in which banknotes can be stacked again after the 1 U.S. dollar banknotes have been removed, to unassigned (Status 3).

[0190] Thereafter, if the next banknote being transported is detected to be an unfit 5 U.S. dollar banknote, the control unit 190 assigns 5 U.S. dollar as the assigned denomination of the unassigned first bundling-side stacking unit 21A of the banknote bundling device 3A, and sorts and stacks the unfit 5 U.S. dollar banknote in the first bundling-side stacking unit 21A (Status 4).

[0191] When one hundred unfit 5 U.S. dollar banknotes have been stacked in the first bundling-side stacking unit 21A (Status 5), the one hundred unfit 5 U.S. dollar banknotes stacked in the first bundling-side stacking unit 21A are removed through the transport unit 42 arranged in the pre-bundling transport unit 25 controlled by the control unit 190. In the meantime, if a new version banknote being transported is detected to be an unfit 5 U.S. dollar banknote, the control unit 190 assigns 5 U.S. dollar as the assigned denomination of the unassigned third bun-

dling-side stacking unit 21C, and changes the assigned denomination of the first bundling-side stacking unit 21A, in which banknotes can be stacked again after the 5 U.S. dollar banknotes have been removed, to unassigned (Status 6).

[0192] Thereafter, if the next banknote being transported is detected to be an unfit 10 U.S. dollar banknote, the control unit 190 assigns 10 U.S. dollar as the assigned denomination of the unassigned first bundling-side stacking unit 21A of the banknote bundling device 3A, and sorts and stacks the unfit 10 U.S. dollar banknote in the first bundling-side stacking unit 21A (Status 7).

[0193] When one hundred unfit 10 U.S. dollar banknotes have been stacked in the first bundling-side stacking unit 21A (Status 8), the one hundred unfit 10 U.S. dollar banknotes stacked in the first bundling-side stacking unit 21A are removed through the transport unit 42 arranged in the pre-bundling transport unit 25 controlled by the control unit 190. In the meantime, if a new version banknote being transported is detected to be an unfit 10 U.S. dollar banknote, the control unit 190 assigns 10 U.S. dollar as the assigned denomination of the unassigned fourth bundling-side stacking unit 21D of the banknote bundling device 3B, and changes the assigned denomination of the first bundling-side stacking unit 21A, in which banknotes can be stacked again after the 10 U.S. dollar banknotes have been removed, to unassigned (Status 9).

[0194] Thereafter, if the next banknote being transported is detected to be an unfit 20 U.S. dollar banknote, the control unit 190 assigns 20 U.S. dollar as the assigned denomination of the unassigned first bundling-side stacking unit 21A of the banknote bundling device 3A, and sorts and stacks the unfit 20 U.S. dollar banknote in the first bundling-side stacking unit 21A (Status 10).

[0195] When one hundred unfit 20 U.S. dollar banknotes have been stacked in the first bundling-side stacking unit 21A (Status 11), the one hundred unfit 20 U.S. dollar banknotes stacked in the first bundling-side stacking unit 21A are removed through the transport unit 42 arranged in the pre-bundling transport unit 25 controlled by the control unit 190. In the meantime, if a new version banknote being transported is detected to be an unfit 20 U.S. dollar banknote, the control unit 190 assigns 20 U.S. dollar as the assigned denomination of the unassigned fifth bundling-side stacking unit 21E of the banknote bundling device 3B, and changes the assigned denomination of the first bundling-side stacking unit 21A, in which banknotes can be stacked again after the 20 U.S. dollar banknotes have been removed, to unassigned (Status 12). The process procedures described above are repeated. In the banknote sorting and bundling apparatus 1 according to the first embodiment, banknotes of a maximum of up to six denominations can be sorted and stacked in the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F.

[0196] In the first embodiment, the same category of the stacking banknotes is set for all the stackers 16 or all

the bundling-side stacking units 21, and it is determined whether there is a stacking unit, that is the stacker 16 or the bundling-side stacking unit 21 for which the category and the banknote-type (stacking banknote) of the banknote being transported has been set. If there is no stacking unit with the assigned banknote-kind (stacking banknote) that matches the banknote-kind of the banknote being transported, the banknote-kind of the banknote being transported is assigned, as the stacking banknote, to the unassigned stacking unit from among the stackers 16 or the bundling-side stacking units 21 for which the category of the banknote being transported has been set. Thus, the work burden of the operator for setting the banknote-kind, as the stacking banknote, to each of the stackers 16 and the bundling-side stacking units 21 is greatly reduced because the same category of the stacking banknotes is set for all the stackers 16 or all the bundling-side stacking units 21, and even when no stacking unit is available for stacking the banknote being transported, if an unassigned stacking unit among the stackers 16 or the bundling-side stacking units 21 with the category that matches the category of the banknote being transported is available, the banknote-kind of the banknote being transported is assigned to the unassigned stacking unit.

[0197] Furthermore, in the first embodiment, if a stacking unit with the assigned banknote-kind (stacking banknote) that matches the banknote-kind of the banknote being transported, among the first bundling-side stacking units 21A to the sixth bundling-side stacking unit 21F and the first stacker 16A to the fourth stacker 16D, is available, the banknote is sorted and stacked in the stacking unit. Thus, the banknote being transported can be sorted and stacked in the stacking unit corresponding to the category and the banknote-kind of the banknote.

[0198] Furthermore, in the first embodiment, when removal of the banknotes stacked in a stacking unit, among the first bundling-side stacking unit 21A to the sixth bundling-side stacking unit 21F and the first stacker 16A to the fourth stacker 16D, is detected, the assigned banknote-kind of the stacking unit, from which the banknotes were removed, is changed to unassigned. Thus, the assigned banknote-kind of the stacking unit can be changed dynamically.

[0199] Furthermore, in the first embodiment, the first reject units 17A and 17B are available for sorting and stacking the banknotes of a specific denomination from among banknote-kinds that can be used for auto-assigned denominations, and if the banknote-kind of the banknote being transported is the specific denomination, the assignment setting unit 193 prohibits to assign the specific denomination, as the stacking banknote, to any of the bundling-side stacking units 21 or the stackers 16. Thus, various sorting and stacking operation can be realized, and in addition, by prohibiting the assignment of the specific denomination as the assigned banknote-kind (stacking banknote) for each of the bundling side stacking units 21 or the stackers 16, duplication of the assigned

banknote-kind, between the first reject units 17A and 17B and the bundling-side stacking units 21 and also between the first rejection units 17A and 17B and the stackers 16, can be reliably avoided.

[0200] Furthermore, in the first embodiment, the denomination specifying unit 132 is used for specifying the denominations that can be set as the stacking banknote for each of the stackers 16 or the bundling-side stacking units 21. If the denomination of the banknote being transported is any denomination other than the specified denominations, assignment of the banknote-kind of the banknote being transported as the assigned banknote-kind (stacking banknote) of any unassigned stacking unit is prohibited. Thus, the operator can specify the assigned denominations (stacking banknote) for the bundling-side stacking units 21 or the stackers 16.

[0201] Furthermore, in the first embodiment, a configuration in which six bundling-side stacking units 21 are provided between the two interlinked banknote bundling devices 3A and 3B is presented, that is, a configuration in which the banknote bundling device 3A includes the first bundling-side stacking unit 21A to the third bundling-side stacking unit 21C, and the banknote bundling device 3B includes the fourth bundling-side stacking unit 21D to the sixth bundling-side stacking unit 21F. However, additional banknote bundling devices can be connected to the existing ones to increase the number of the bundling-side stacking units 21.

[0202] Furthermore, in the first embodiment, the category of the stacking banknotes can be classified into fit note and unfit note, and fit note or unfit note can be set as the stacking category for all the stackers 16 or all the bundling-side stacking units 21 at one time. For example, unfit note can be set as the stacking banknote for the bundling-side stacking units 21 and fit note can be set as the stacking banknote for the stackers 16 at one time.

[0203] In the first embodiment described above, the denomination of the banknote is taken as the banknote-kind. Thus, the assigned denomination can be set as the assigned banknote-kind (stacking banknote) for the bundling-side stacking units 21 and the stackers 16.

[0204] In the first embodiment described above, the denomination of the banknote being transported is assigned as the assigned denomination to the bundling-side stacking units 21 in the order of the first bundling-side stacking unit 21A, the second bundling-side stacking unit 21B, the third bundling-side stacking unit 21C, the fourth bundling-side stacking unit 21D, the fifth bundling-side stacking unit 21E, and the sixth bundling-side stacking unit 21F, as shown in FIG. 11. Thus, a processing load is greater on the banknote bundling device 3A in comparison to the banknote bundling device 3B. As a solution to the above problem, in a second embodiment according to the present invention, the processing loads can be evenly distributed between the banknote bundling devices 3A and 3B by assigning the denomination of the banknote being transported as the assigned denomination alternately to the bundling-side stacking units 21 of

the banknote bundling device 3A and the bundling-side stacking units 21 of the banknote bundling device 3B.

[Second Embodiment]

[0205] FIG. 12 is a drawing for clearly explaining action transitions of an operation of sorting and stacking banknotes being transported in the bundling-side stacking units 21 according to the second embodiment. The same reference numerals are assigned to parts that are identical to those of the banknote sorting and bundling apparatus 1 according to the first embodiment, and the repeating description thereof is omitted.

[0206] In the banknote sorting and bundling apparatus 1 according to the second embodiment, when a first denomination of the first banknote being transported is detected, the first denomination is assigned as the assigned denomination of the third bundling-side stacking unit 21C of the banknote bundling device 3A. If a second denomination of the banknote being transported is detected thereafter, the second denomination is assigned as the assigned denomination of the sixth bundling-side stacking unit 21F of the banknote bundling device 3B. If a third denomination of the banknote being transported is further detected thereafter, the third denomination is assigned as the assigned denomination of an unassigned bundling-side stacking unit 21 in the banknote bundling device 3A. If a fourth denomination of the banknote being transported is further detected thereafter, the fourth denomination is assigned as the assigned denomination of an unassigned bundling-side stacking unit 21 in the banknote bundling device 3B.

[0207] The assigned banknote-kind of at least one of the bundling-side stacking units 21 from among the first bundling-side stacking unit 21A to the third bundling-side stacking unit 21C of the banknote bundling device 3A is set to unassigned, and similarly, the assigned banknote-kind of at least one of the bundling-side stacking units 21 from among the fourth bundling-side stacking unit 21D to the sixth bundling-side stacking unit 21F of the banknote bundling device 3B is set to unassigned.

[0208] For example, as shown in FIG. 12, if the banknote being transported is detected to be an unfit 1 U.S. dollar banknote, the control unit 190 assigns 1 U.S. dollar as the assigned denomination of the unassigned third bundling-side stacking unit 21C of the banknote bundling device 3A, and sorts and stacks the unfit 1 U.S. dollar banknote in the third bundling-side stacking unit 21C (Status 21). The reason why the banknote detected first is stacked in the third bundling-side stacking unit 21C rather than the first bundling-side stacking unit 21A is because a transport distance, for transporting the bundling-object-banknotes by the pre-bundling transport unit 25 from the bundling-side stacking unit 21 to the bundling unit 22 arranged in the banknote bundling device 3A, is the shortest among the first bundling-side stacking unit 21A to the third bundling-side stacking unit 21C, leading to increase of work efficiency.

[0209] Thereafter, when one hundred unfit 1 U.S. dollar banknotes have been stacked in the third bundling-side stacking unit 21C (Status 22), the one hundred unfit 1 U.S. dollar banknotes stacked in the third bundling-side stacking unit 21C are removed through the transport unit 42 arranged in the pre-bundling transport unit 25 controlled by the control unit 190. In the meantime, if a new version banknote being transported is detected to be an unfit 1 U.S. dollar banknote, the control unit 190 assigns 1 U.S. dollar as the assigned denomination of the unassigned second bundling-side stacking unit 21B, and changes the assigned denomination of the third bundling-side stacking unit 21C, in which banknotes can be stacked again after the 1 U.S. dollar banknotes have been removed, to unassigned (Status 23).

[0210] Thereafter, if the next banknote being transported is detected to be an unfit 5 U.S. dollar banknote, the control unit 190 assigns 5 U.S. dollar as the assigned denomination of the unassigned sixth bundling-side stacking unit 21F of the banknote bundling device 3B, and sorts and stacks the unfit 5 U.S. dollar banknote in the sixth bundling-side stacking unit 21F (Status 24). The reason why the banknote is stacked in the sixth bundling-side stacking unit 21F rather than the fourth bundling-side stacking unit 21D of the banknote bundling device 3B is because a transport distance, for transporting the bundling-object-banknotes by the pre-bundling transport unit 25 from the bundling-side stacking unit 21 to the bundling unit 22 arranged in the banknote bundling device 3B, is the shortest among the fourth bundling-side stacking unit 21D to the sixth bundling-side stacking unit 21F, leading to increase of work efficiency.

[0211] When one hundred unfit 5 U.S. dollar banknotes have been stacked in the sixth bundling-side stacking unit 21F (Status 25), the one hundred unfit 5 U.S. dollar banknotes stacked in the sixth bundling-side stacking unit 21F are removed through the transport unit 42 arranged in the pre-bundling transport unit 25 controlled by the control unit 190. In the meantime, if a new version banknote being transported is detected to be an unfit 5 U.S. dollar banknote, the control unit 190 assigns 5 U.S. dollar as the assigned denomination of the unassigned fifth bundling-side stacking unit 21E, and changes the assigned denomination of the sixth bundling-side stacking unit 21F, in which banknotes can be stacked again after the 5 U.S. dollar banknotes have been removed, to unassigned (Status 26).

[0212] Thereafter, if the next banknote being transported is detected to be an unfit 10 U.S. dollar banknote, the control unit 190 assigns 10 U.S. dollar as the assigned denomination of the unassigned third bundling-side stacking unit 21C of the banknote bundling device 3A, and sorts and stacks the unfit 10 U.S. dollar banknote in the third bundling-side stacking unit 21C (Status 27).

[0213] When one hundred unfit 10 U.S. dollar banknotes have been stacked in the third bundling-side stacking unit 21C (Status 28), the one hundred unfit 10 U.S. dollar banknotes stacked in the third bundling-side

stacking unit 21C are removed through the transport unit 42 arranged in the pre-bundling transport unit 25 controlled by the control unit 190. In the meantime, if a new version banknote being transported is detected to be an unfit 10 U.S. dollar banknote, the control unit 190 assigns 10 U.S. dollar as the assigned denomination of the unassigned first bundling-side stacking unit 21A of the banknote bundling device 3A, and changes the assigned denomination of the third bundling-side stacking unit 21C, in which banknotes can be stacked again after the 10 U.S. dollar banknotes have been removed, to unassigned (Status 29).

[0214] Thereafter, if the next banknote being transported is detected to be an unfit 20 U.S. dollar banknote, the control unit 190 assigns 20 U.S. dollar as the assigned denomination of the unassigned sixth bundling-side stacking unit 21F of the banknote bundling device 3B, and sorts and stacks the unfit 20 U.S. dollar banknote in the sixth bundling-side stacking unit 21F (Status 30).

[0215] When one hundred unfit 20 U.S. dollar banknotes have been stacked in the sixth bundling-side stacking unit 21F (Status 31), the one hundred unfit 20 U.S. dollar banknotes stacked in the sixth bundling-side stacking unit 21F are removed through the transport unit 42 arranged in the pre-bundling transport unit 25 controlled by the control unit 190. In the meantime, if a new version banknote being transported is detected to be an unfit 20 U.S. dollar banknote, the control unit 190 assigns 20 U.S. dollar as the assigned denomination of the unassigned fourth bundling-side stacking unit 21E of the banknote bundling device 3B, and changes the assigned denomination of the sixth bundling-side stacking unit 21F, in which banknotes can be stacked again after the 20 U.S. dollar banknotes have been removed, to unassigned (Status 32). The process procedures described above are repeated.

[0216] In the second embodiment, the denomination of the new version banknote being transported is assigned as the assigned denomination, in an alternating manner, to the bundling-side stacking units 21 of the banknote bundling device 3A and the bundling-side stacking units 21 of the banknote bundling device 3B. Thus, the processing load is evenly distributed between the banknote bundling devices 3A and 3B.

[0217] Furthermore, in the second embodiment, the assigned banknote-kind (stacking banknote) of at least one of the bundling-side stacking units 21 among the first bundling-side stacking unit 21A to the third bundling-side stacking unit 21C of the banknote bundling device 3A is set as unassigned. Similarly, the assigned banknote-kind (stacking banknote) of at least one of the bundling-side stacking units 21 among the fourth bundling-side stacking unit 21D to the sixth bundling-side stacking unit 21F of the banknote bundling device 3B is set as unassigned. Thus, a banknote-kind of a banknote having the same category as the stacking category of the bundling-side stacking units 21 in the banknote bundling device 3A (3B) can be set as an assigned banknote-kind (stacking bank-

knote) of an unassigned bundling-side stacking unit 21 and the banknote can always be stacked in the bundling-side stacking unit 21 set for the banknote.

[0218] Furthermore, in the present embodiments, the category of the stacking banknotes is classified into fit note and unfit note. However, the category of the stacking banknotes can be classified into new version note and old version note, and new version note or old version note can be set as the stacking category for all the stackers 16 or all the bundling-side stacking units 21 at one time. For example, old version note can be set as the stacking banknote for the bundling-side stacking units 21 and new version note can be set as the stacking banknote for the stackers 16 at one time.

[0219] In the present embodiments, the denominations of U.S. dollar banknotes are taken as the banknote-kind, for the sake of convenience. However, banknote front/back information for identifying the front face or the back face of the banknote is included in the banknote-kind. Thus, in addition to the denomination, front face or back face can also be set as the stacking banknote for the bundling-side stacking units 21 and the stackers 16.

[0220] In the present embodiments, although the denominations of U.S. dollar banknotes are taken as the banknote-kind, banknote portrait orientation information that identifies the portrait-upright/portrait-inverted orientation of the banknote is also included in the banknote-kind. Thus, in addition to the denomination, the portrait orientation can also be set as the stacking banknote for the bundling-side stacking units 21 and the stackers 16.

[0221] In the present embodiments, when the number of the bundling-object-banknotes P stacked in the bundling-side stacking unit 21 reaches one hundred, the transport unit 42 of the pre-bundling transport unit 25 draws out the bundling-object-banknotes P and transports them onto the bundling stage 22A arranged in the bundling unit 22. However, the same advantages can be realized even when the transport unit 42 transports the removed bundling-object-banknotes P to near an entrance of the bundling unit 22, where the holding unit 27A of the hold and transport unit 27 holds the short-edge of the bundling-object-banknotes P and transports them to the operation preparation position on the bundling stage 22A.

[0222] In the second embodiment described above, the banknote of the first denomination is stacked inside the banknote bundling device 3A, the banknote of the second denomination is stacked inside the banknote bundling device 3B, the banknote of the third denomination is stacked inside the banknote bundling device 3A, and the banknote of the fourth denomination is stacked inside the banknote bundling device 3B. The processing load on the bundling units 22 of the banknote bundling devices 3A and 3B can be evened out even if the banknotes of the first and second denominations are assigned to be stacked inside the banknote bundling device 3A, and when the banknote of the second denomination is being stacked inside the banknote bundling device 3A,

the banknotes of the third and fourth denominations are assigned to be stacked inside the banknote bundling device 3B.

[0223] In the above embodiment, the banknote bundling device 3 that bundles the bundling-object-banknotes P with the bundling tape R is explained as an example. However, the same advantages can be realized even if paper sheets such as gift coupons and valuable securities are bundled with the bundling tape R.

[0224] Although the invention has been described with respect to a specific embodiment for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art which fairly fall within the basic teaching herein set forth. The advantages of the present embodiment are not limited to those stated here.

[0225] All the automatic processes explained in the present embodiment can be, entirely or in part, carried out manually by a known method. Similarly, all the manual processes explained in the present embodiment can be, entirely or in part, carried out automatically by a known method. The process procedures, the control procedures, specific names, and data, including various parameters, mentioned in the description and drawings can be changed as required unless otherwise specified.

[0226] The constituent elements of the apparatus illustrated are merely conceptual and may not necessarily physically resemble the structures shown in the drawings. For example, the apparatus need not necessarily have the structure that is illustrated. The apparatus as a whole or in parts can be broken down or integrated either functionally or physically in accordance with the load or how the apparatus is to be used.

[0227] Each processing function performed by the apparatus can be entirely or partially performed by a CPU (Central Processing Unit) (or a micro computer such as an MPU (Micro Processing Unit) and an MCU (Micro Controller Unit)), or a computer program executed by the CPU (or the microcomputer such as an MPU and an MCU), or a hardware using wired logic.

INDUSTRIAL APPLICABILITY

[0228] In the banknote sorting and bundling apparatus according to the present invention, a common category of the stacking banknote is set for all the sorting and stacking units and a common category of the stacking banknote is set for all the bundling-side stacking units, and in addition, the banknote-kind of the banknote being transported is set for the unassigned stacking unit among the sorting and stacking units or the unassigned bundling-side stacking units for which the category of the banknote being transported has been set and no banknote-kind has been set. Consequently, the work burden of setting the category and the banknote-kind for each of the sorting and stacking units and the bundling-side stacking units is greatly reduced. Thus, the banknote

sorting and bundling apparatus according to the present invention is useful in financial establishments, etc.

Claims

1. A banknote sorting and bundling apparatus comprising:

a feeding unit that feeds banknotes one by one; 10
 a recognition unit that recognizes a category and a banknote-kind of the banknote;
 a sorting and stacking unit for sorting and stacking the banknote therein;
 a bundling-side stacking unit for sorting and stacking the banknote for bundling therein; 15
 a bundling unit that bundles the banknotes stacked in the bundling-side stacking unit;
 a transport unit that transports the banknote recognized by the recognition unit to any one of the sorting and stacking unit and the bundling-side stacking unit; 20
 a category setting unit that sets a common category of the banknote for all of the sorting and stacking unit(s) or for all of the bundling-side stacking unit(s); 25
 an assignment setting unit that confirms, after a category and a banknote-kind of the banknote have been recognized by the recognition unit, whether there is a stacking unit for which a recognized banknote-kind has been assigned among a plurality of the stacking units for which a recognized category has been set based on category settings performed by the category setting unit, and if there is no stacking unit for which the recognized banknote-kind has been assigned, and there is an unassigned stacking unit for which no banknote-kind has been set, assigns the recognized banknote-kind to the unassigned stacking unit; and 30
 a control unit that controls the transport unit to transport the banknote to a corresponding stacking unit based on a recognition result obtained by the recognition unit and assignment performed by the assignment setting unit. 45

2. The banknote sorting and bundling apparatus according to Claim 1, wherein 50
 the assignment setting unit includes a determining unit that determines, after the category and the banknote-kind have been recognized, whether there is a stacking unit for which the recognized banknote-kind has been set among a plurality of the stacking unit for which the recognized category has been set, and
 the assignment setting unit assigns, when the determining unit determines that there is no stacking unit for which the recognized banknote-kind has been

set, and there is an unassigned stacking unit for which no banknote-kind has been set, the recognized banknote-kind to the unassigned stacking unit.

3. The banknote sorting and bundling apparatus according to Claim 2, wherein when the determining unit determines that there is a stacking unit for which the recognized banknote-kind has been set, the banknote is sorted and stacked in the stacking unit. 10
4. The banknote sorting and bundling apparatus according to Claim 1, wherein the assignment setting unit assigns, when removal of the banknotes stacked in the stacking unit is detected, the banknote-kind of the stacking unit from which the banknotes have been removed as unassigned. 15
5. The banknote sorting and bundling apparatus according to Claim 1, further comprising: 20
 a specific stacking unit for sorting and stacking banknotes of a specific denomination from among denomination information included in the banknote-kinds, and
 wherein the assignment setting unit prohibits, if the recognized banknote-kind is the specific denomination, assignment of the recognized banknote-kind as the banknote-kind for the bundling-side stacking unit and as the banknote-kind for the sorting and stacking unit. 25
6. The banknote sorting and bundling apparatus according to Claim 1, further comprising: 30
 a denomination specifying unit that specifies a denomination to be set as the banknote-kind for each of the sorting and stacking unit or the bundling-side stacking unit, according to a predetermined operation, and
 wherein the assignment setting unit prohibits, if the recognized banknote-kind of the banknote is any denomination other than the denomination specified by the denomination specifying unit, assignment of the recognized banknote-kind as the banknote-kind for the unassigned stacking unit. 35
7. The banknote sorting and bundling apparatus according to Claim 1, wherein the assignment setting unit sets the banknote-kind for at least one of the stacking units among the bundling-side stacking units as unassigned. 40
8. The banknote sorting and bundling apparatus according to Claim 1, wherein the bundling-side stacking unit comprises stacking units of a plurality of banknote bundling devices, that are connected together, and each of the banknote bundling devices has three 45

stacking units for stacking the banknotes for bundling.

9. The banknote sorting and bundling apparatus according to any one of Claims 1 to 8, wherein the category of the banknote is classified into two categories to be stacked in the stacking unit, one category is fit banknotes among the banknotes, and the other category is unfit banknotes among the banknotes. 5
10
10. The banknote sorting and bundling apparatus according to any one of Claims 1 to 8, wherein the category of the banknote is classified into two categories, one category is for stacking a new version banknote among the banknotes, and the other category is for stacking an old version banknote among the banknotes. 15
11. The banknote sorting and bundling apparatus according to any one of Claims 1 to 8, wherein the banknote-kind is the denomination information that identifies a denomination of the banknote. 20
12. The banknote sorting and bundling apparatus according to Claim 11, wherein the banknote-kind includes banknote face/back information that identifies whether the banknote is face-up or face-down. 25
13. The banknote sorting and bundling apparatus according to Claim 11, wherein the banknote-kind includes portrait orientation information that identifies whether the portrait is upright or inverted. 30
14. A banknote sorting and stacking method comprising: 35
 - feeding banknotes one by one;
 - recognizing a category and a banknote-kind of the banknote;
 - sorting and stacking the banknote in a sorting and stacking unit; 40
 - stacking the banknote in a bundling-side stacking unit for bundling;
 - bundling the banknotes stacked in the bundling-side stacking unit; 45
 - transporting the banknote recognized at the recognizing to any one of the sorting and stacking unit and the bundling-side stacking unit;
 - setting a common category of the banknote for all of the sorting and stacking unit(s) or for all of the bundling-side stacking unit(s); 50
 - assigning, after the category and the banknote-kind of the banknote have been recognized at the recognizing and confirmation whether there is a stacking unit for which a recognized banknote-kind has been assigned among a plurality of the stacking unit for which a recognized category has been set based on category settings 55

performed by a category setting unit is achieved, if there is no stacking unit for which the recognized banknote-kind has been set and there is an unassigned stacking unit for which no banknote-kind has been set, the recognized banknote-kind to the unassigned stacking unit; and controlling the transporting of the banknote to transport the banknote to a corresponding stacking unit based on a recognition result obtained at the recognizing and assignment performed at the assigning.

15. The banknote sorting and stacking method according to Claim 14, wherein the assigning includes determining, after the category and the banknote-kind have been recognized, whether there is the stacking unit for which the recognized banknote-kind has been set among a plurality of the stacking units for which the recognized category has been set, and assigning, if it is determined at the determining that there is no stacking unit for which the recognized banknote-kind has been set, and there is an unassigned stacking unit for which no banknote-kind has been set, the recognized banknote-kind to the unassigned stacking unit.

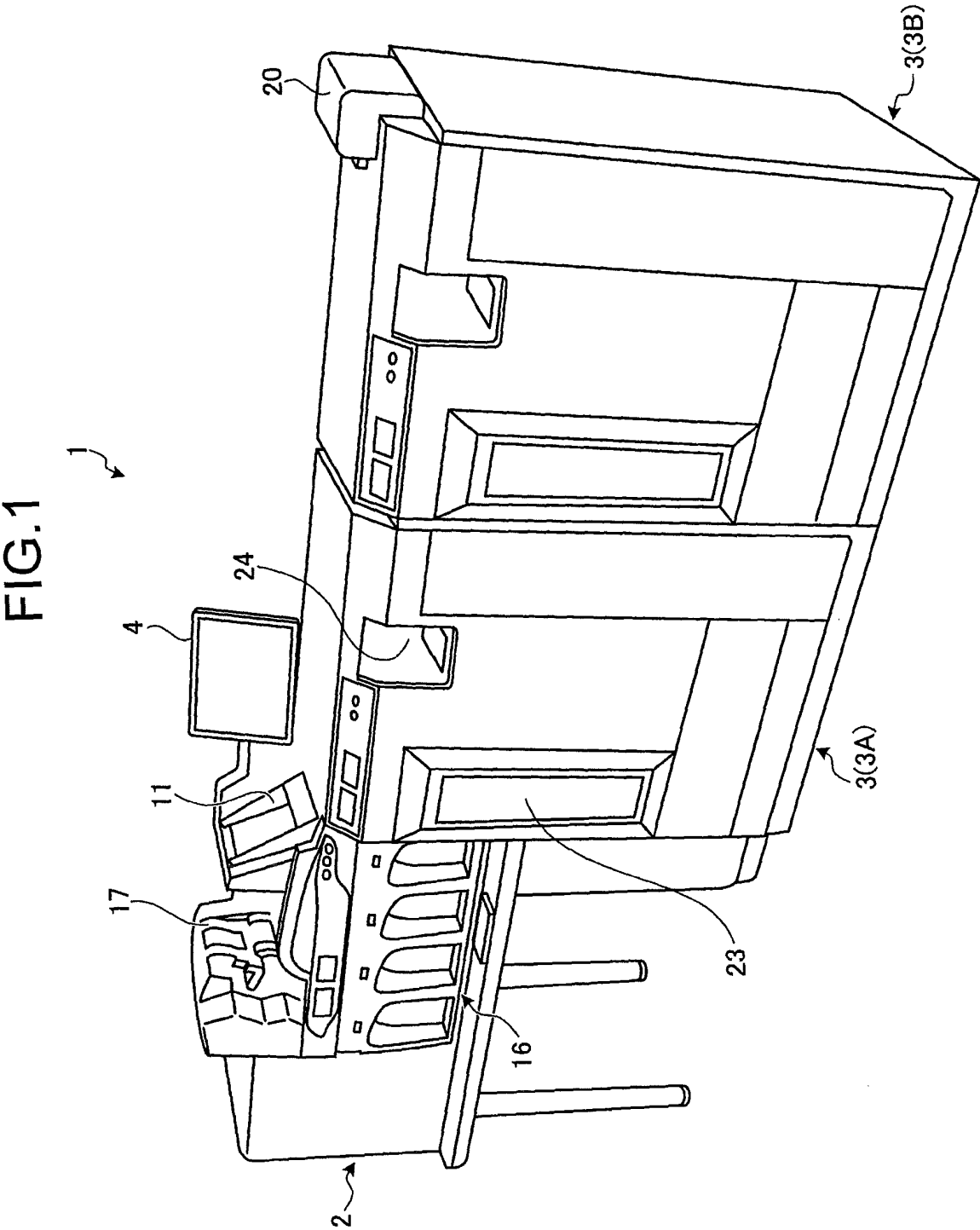


FIG.2

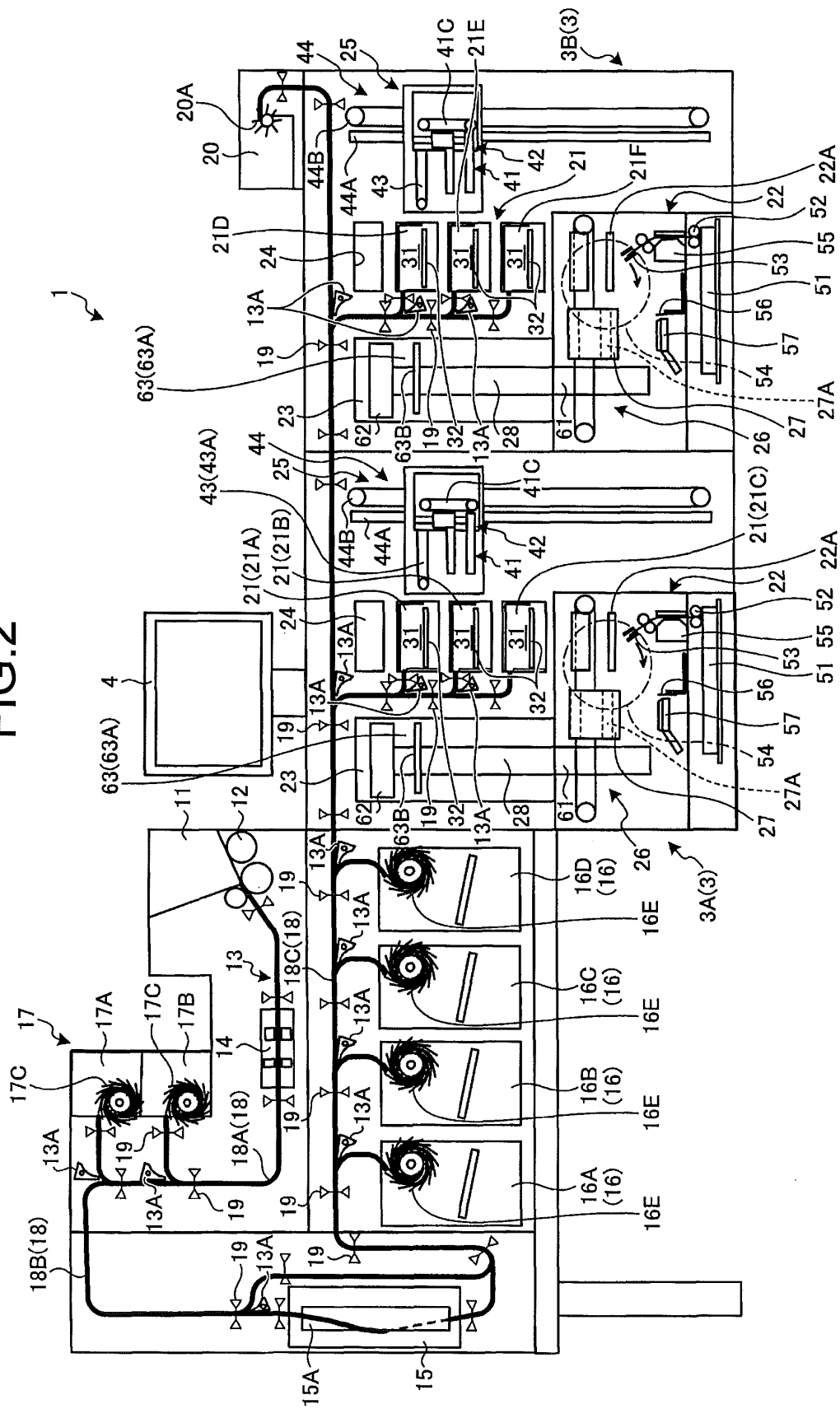


FIG.3

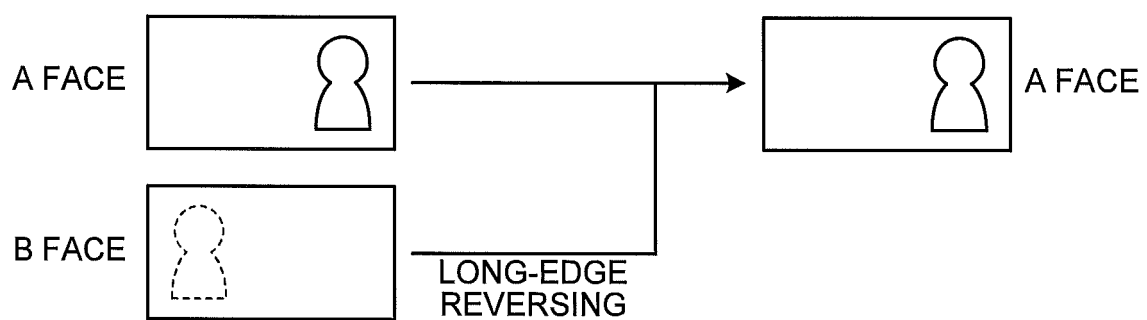


FIG.4

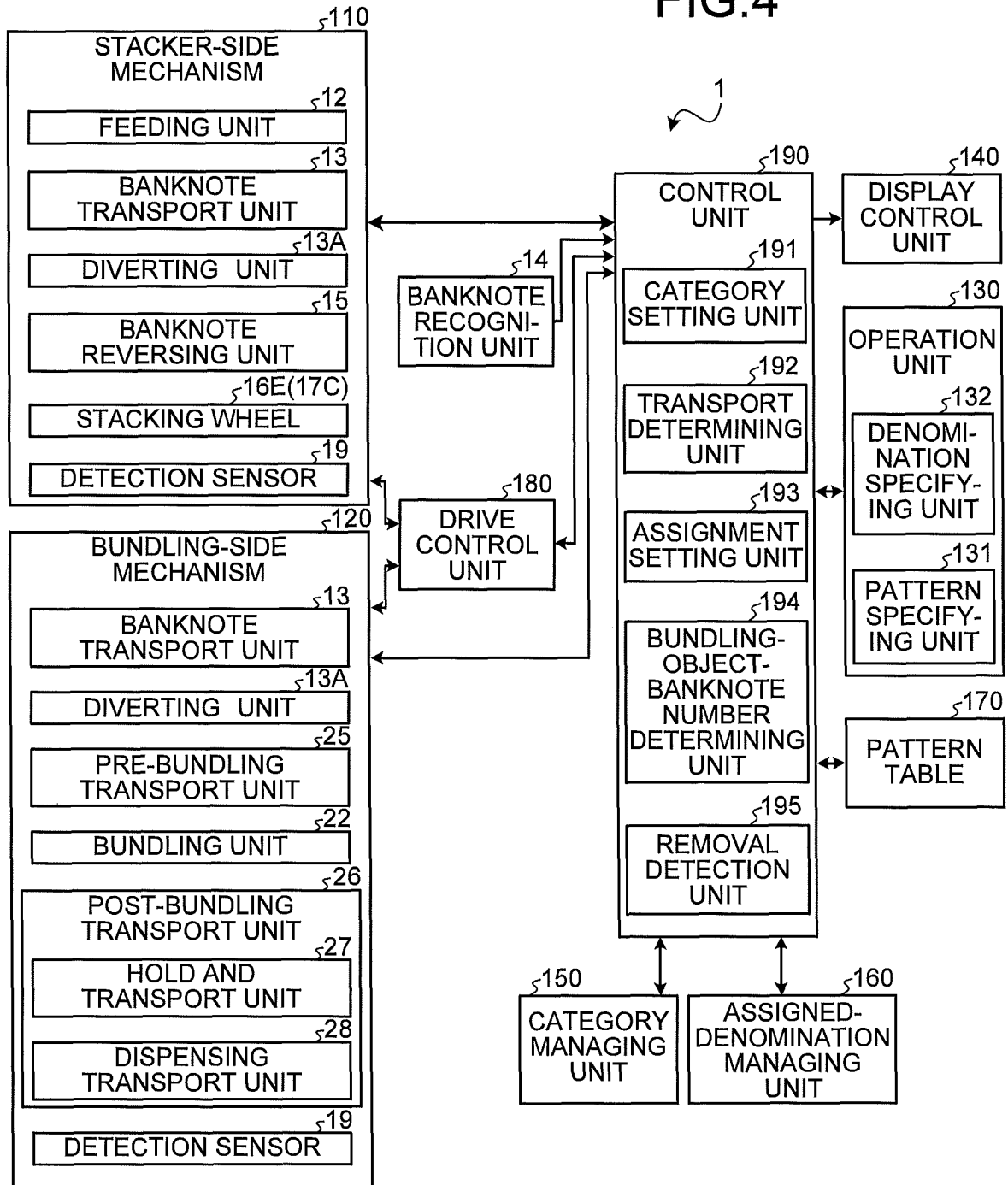


FIG.5

	FIRST STACKER	SECOND STACKER	THIRD STACKER	FOURTH STACKER	FIRST BUNDLING- SIDE STACKING UNIT	SECOND BUNDLING- SIDE STACKING UNIT	THIRD BUNDLING- SIDE STACKING UNIT	FOURTH BUNDLING- SIDE STACKING UNIT	FIFTH BUNDLING- SIDE STACKING UNIT	SIXTH BUNDLING- SIDE STACKING UNIT
CATEGORY	FIT NOTE	FIT NOTE	FIT NOTE	FIT NOTE	UNFIT NOTE	UNFIT NOTE	UNFIT NOTE	UNFIT NOTE	UNFIT NOTE	UNFIT NOTE
DENOMI- NATION	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT	AUTO- ASSIGN- MENT

FIG.6A

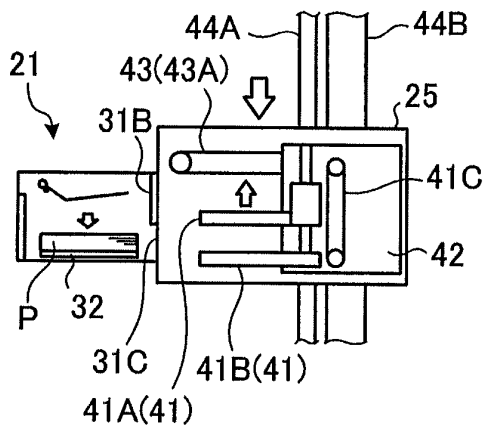


FIG.6B

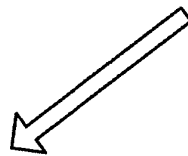
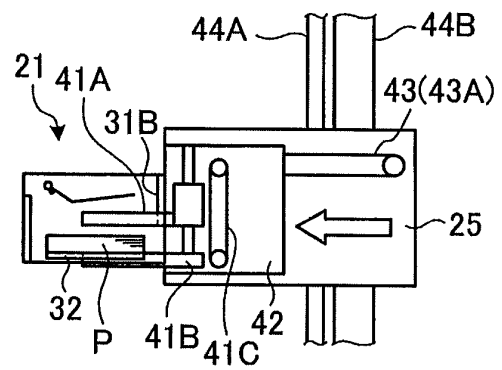


FIG.6C

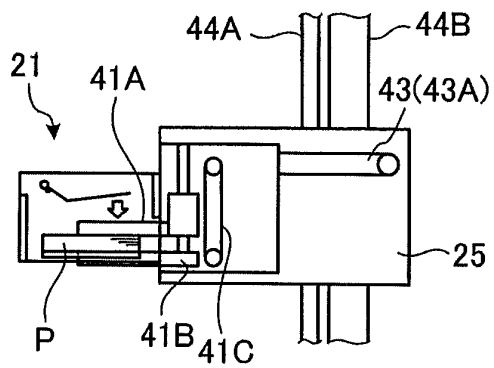
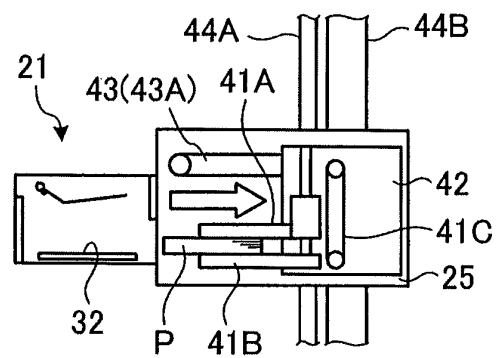


FIG.6D



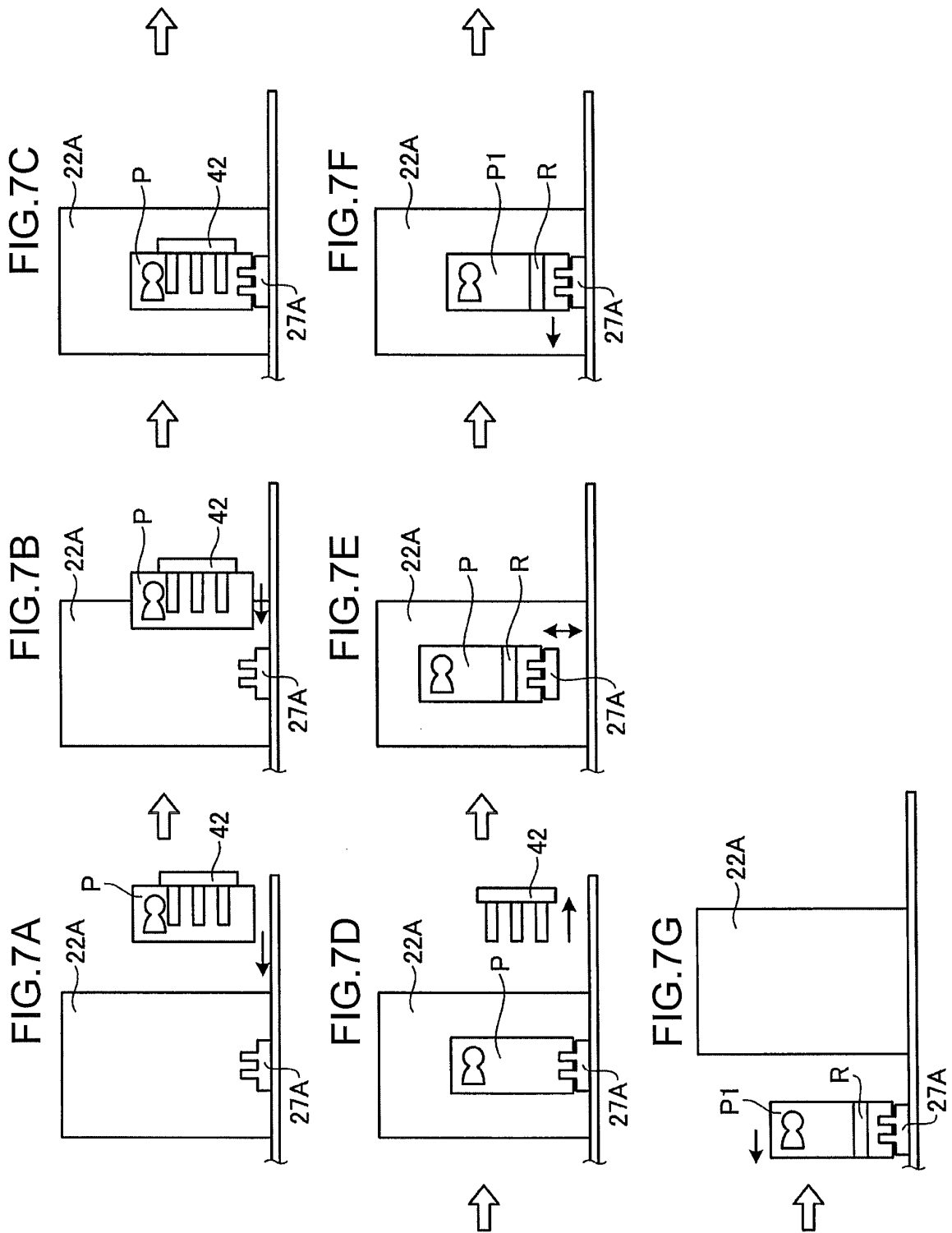


FIG.8

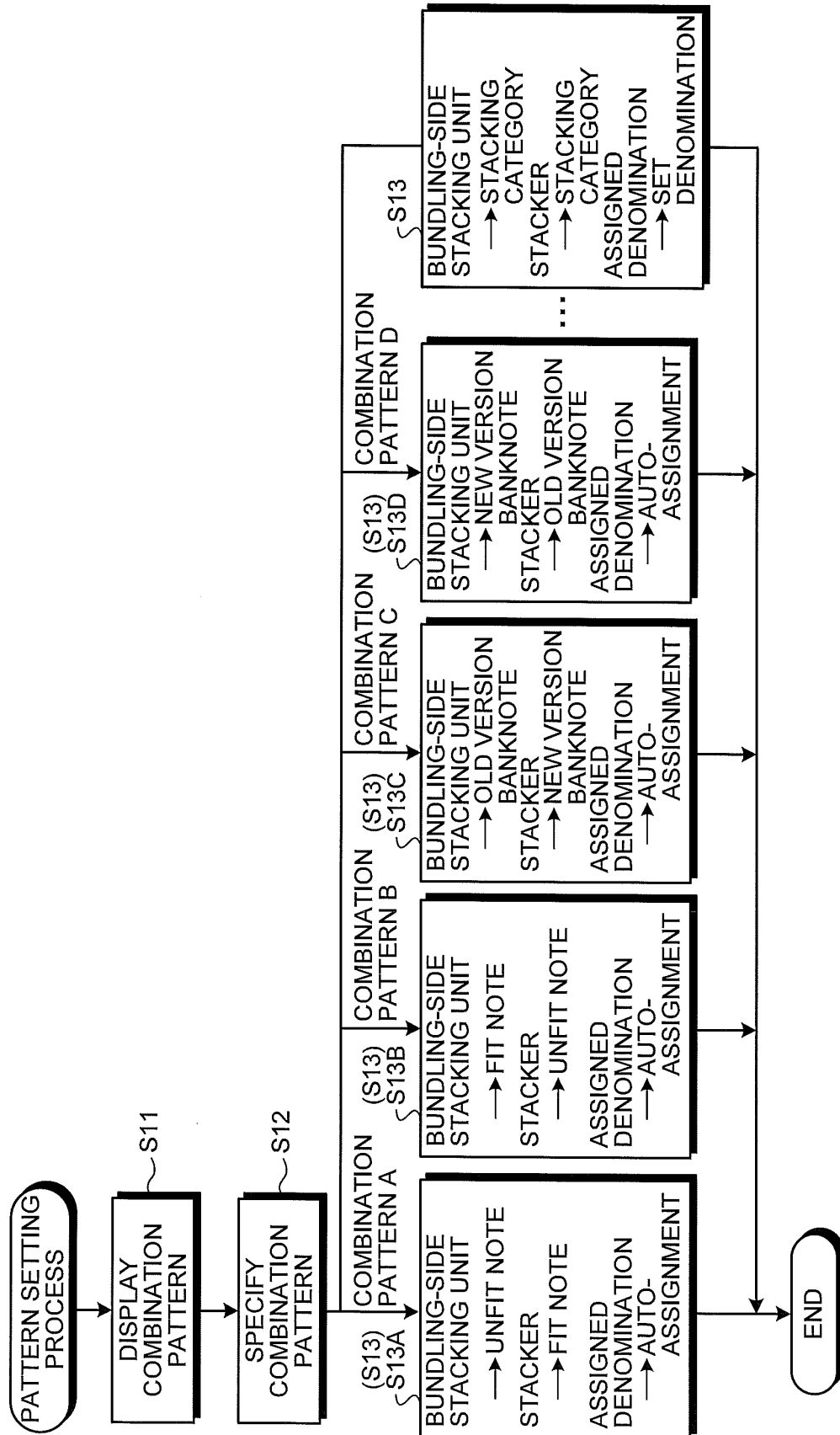


FIG.9

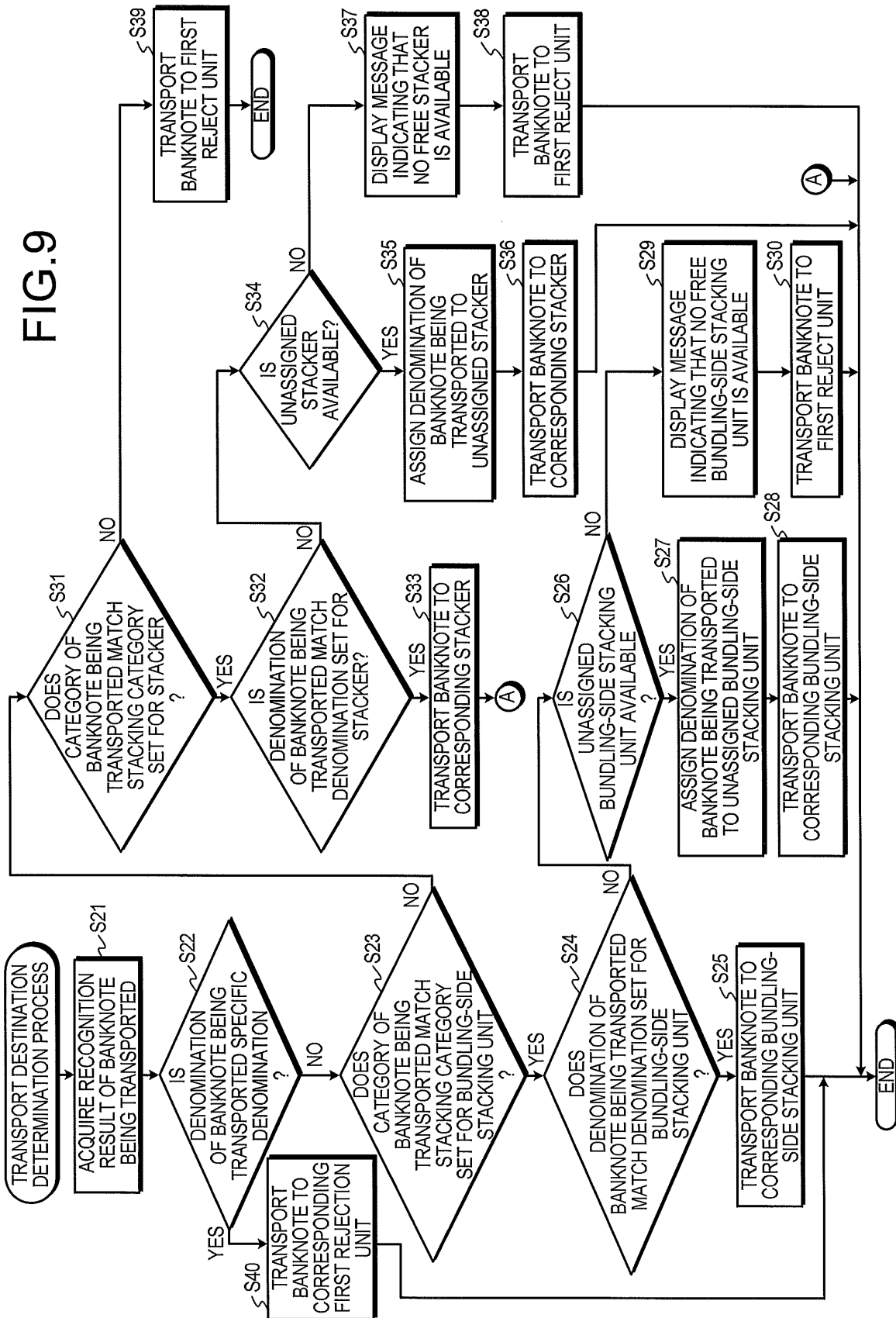


FIG.10

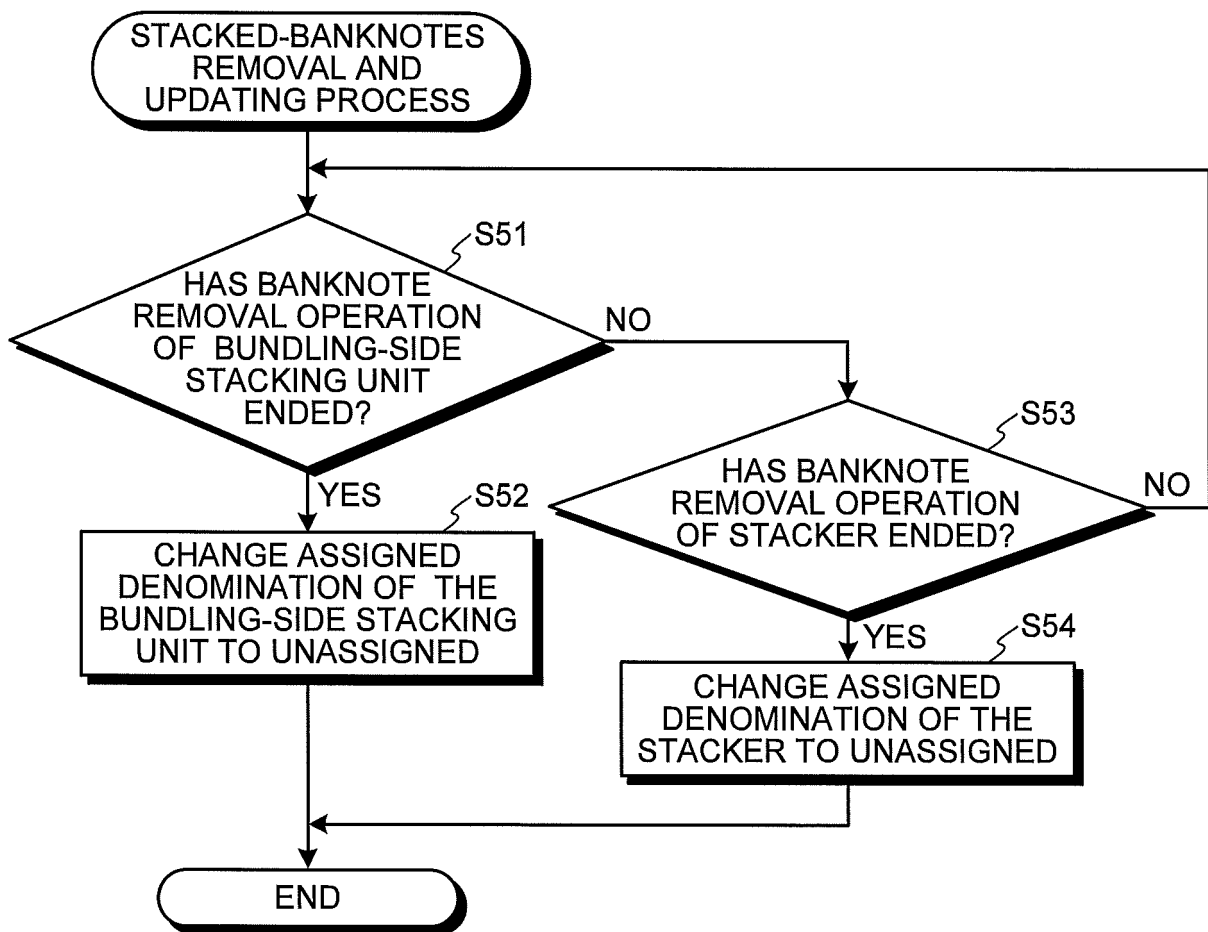


FIG.11

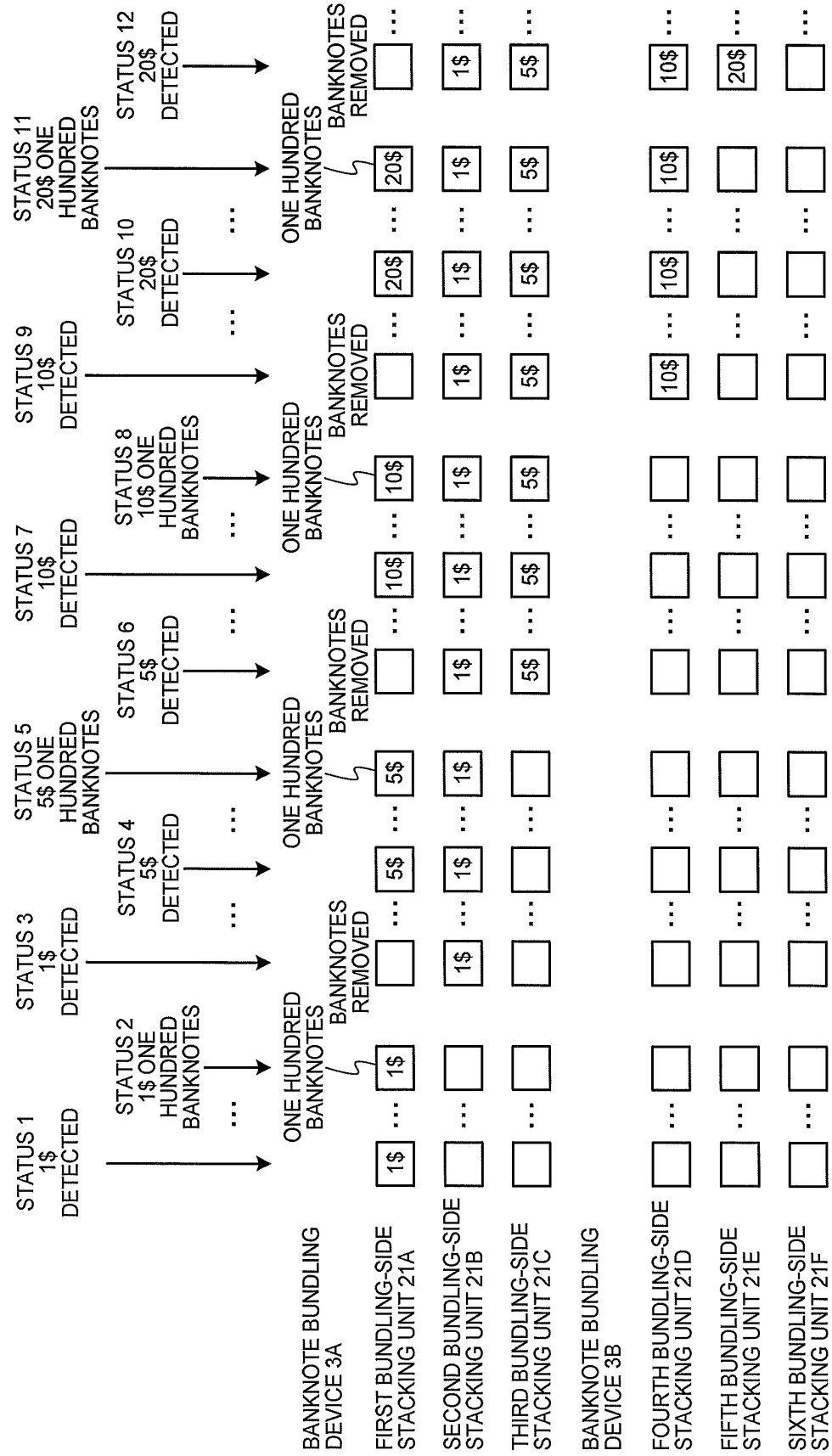
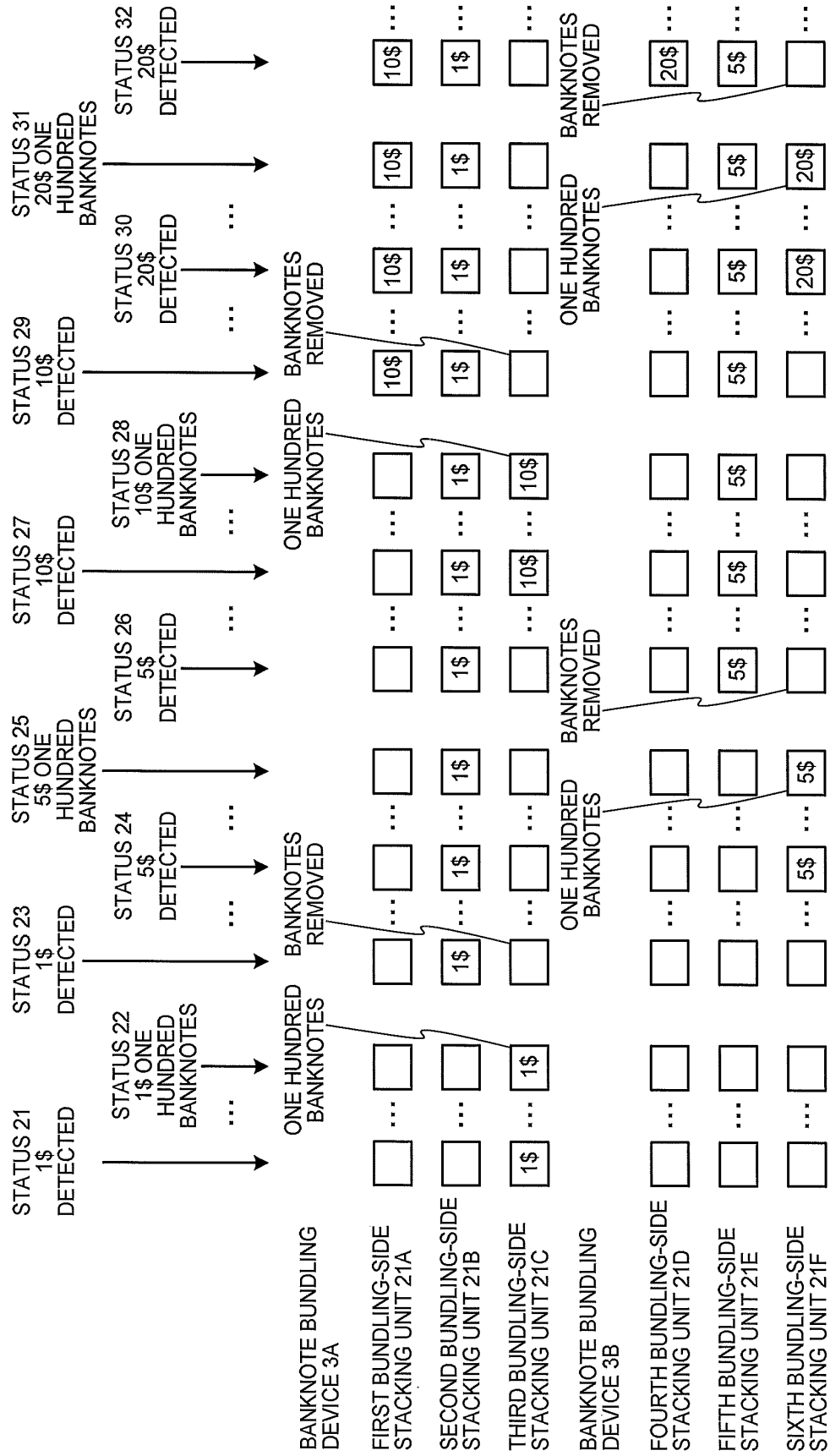


FIG.12



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/056192

A. CLASSIFICATION OF SUBJECT MATTER

G07D9/00(2006.01) i, G07D3/00(2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G07D9/00, G07D3/00

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2006-107211 A (Glory Ltd.), 20 April, 2006 (20.04.06), Full text; all drawings & US 2006/0076212 A1 & EP 1643462 A2 & EP 1998294 A1 & KR 10-2006-0051996 A	1-15

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

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"&" document member of the same patent family

Date of the actual completion of the international search
03 June, 2009 (03.06.09)Date of mailing of the international search report
16 June, 2009 (16.06.09)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6860375 B [0007]
- JP 2639766 B [0007]
- JP 4119664 B [0067]