

PAPER SHEET HANDLING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates generally to paper sheet handling apparatus and, more particularly, to a paper sheet handling machine which is installed at
5 counters in financial institutions for being used by counter clerks or tellers.

Paper sheet handling machines are typically used at bank counters for laborsaving of banking works and include an automatic currency note arranging or
10 organizing machine, which is disclosed, for example, in JP-A-2000-259882.

SUMMARY OF THE INVENTION

Banknotes or bills handled by financial institutions are regularly flown back to the national
15 central bank. When doing so, it is often needed to return bills in the state in which these are properly aligned or oriented in a specified direction or orientation.

In cases where a prior known banknote
20 handling machine is used to arrange or organize bills for causing them to align in orientation, it has been required to employ a number of bill take-out ports corresponding in number to bill types to be sorted and many transport paths for sending bills to such takeout

ports. In addition, the bill organizing machine as taught from JP-A-2000-259882 requires the teller to set up its operation conditions, which is bothersome to the teller.

5 It is therefore an object of this invention to lighten the workload of tellers in the process of organizing various types of paper money, such as banknotes or bills, to thereby improve the labor efficiency of office counter works.

10 In accordance with one aspect of the invention, a paper sheet handling apparatus for performing receipt and pay-out of paper sheets is provided. The paper sheet handling apparatus is arranged to include a money entry port for receiving
15 paper sheets, one or a plurality of take-out ports used to pay out paper sheets, a return port for returning a paper sheet(s) to a customer, a temporary reserve unit for temporarily holding therein those paper sheets accepted from the money entry port, a discrimination
20 unit that distinctively detects the type, direction (or orientation) and/or damage degree of each paper sheet, a transport path for transportation of paper sheets among the respective components, a storage unit for storing therein data about types, directions (or
25 orientation) and/or damage degrees of paper sheets to be sent for collection at the money output port, and means for switching between paper-sheet delivery destination locations in accordance with the type,

direction (or orientation) and/or damage degree of a paper sheet, thereby permitting a specific type of paper sheets to be collected at the money output port.

According to this invention, it is possible
5 to discriminate paper sheets without the need for a teller in financial institution to set up the type, direction (orientation) and/or damage degree of every paper sheet individually. This makes it possible to lighten the teller's workload in the process of
10 arranging or organizing paper sheets.

Other objects, features and advantages of the invention will become apparent from the following description of the embodiments of the invention taken in conjunction with the accompanying drawings.

15 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing a configuration of a paper sheet handling machine.

Fig. 2 is a diagram schematically showing an internal structure of a paper sheet transport device.

20 Fig. 3 is a control block diagram of the paper sheet transport device.

Fig. 4 is a diagram showing an on-screen display image of a counter work menu.

Fig. 5 shows an on-screen display image of a
25 banknote-organizing work menu.

Fig. 6 is an onscreen display image of a processing result.

Fig. 7 is a flow diagram of an operation of bill-organizing work procedure.

Fig. 8 is a flow chart of a bill-organizing/counting operation of the paper sheet transport device.

Fig. 9 shows a flowchart of a procedure for control of a transport destination of bills.

Fig. 10 is a diagram showing an example of classification of orientations of banknotes.

Fig. 11 is a diagram showing an example of classification of dirtiness degrees of banknotes.

Fig. 12 is a diagram showing an example of classification of shape-related damage degrees of banknotes.

Fig. 13 is a diagram showing a banknote discrimination result.

Fig. 14 is a diagram showing a banknote discrimination result when the first one is rejected.

DETAILED DESCRIPTION OF THE EMBODIMENTS

One embodiment of this invention will be described with reference to the accompanying drawings below.

(Embodiment 1)

Referring to Fig. 1, a paper sheet handling machine in accordance with one embodiment of this invention is shown. In this embodiment, an explanation will be given of the case where the paper sheets to be

handled are banknotes or bills. A service counter terminal device 1 is a terminal device that enables a counter clerk or teller to deal with customer information and financial transaction information or
5 the like. This counter terminal device 1 is generally made up of a display unit which includes a cathode ray tube (CRT) or a liquid crystal display (LCD) monitor or else, a data input unit including a keyboard and/or a pointing device, called the "mouse", a communication
10 module for providing communications with a paper sheet transport device 2 which is linked thereto via a communications line 3, a control unit including a central processing unit (CPU) and so on, and a storage unit constituted of a hard disk drive (HDD) or the like
15 data storage devices.

The paper sheet transport device 2 performs pay-out or withdrawal and deposit of banknotes along with uniform alignment of banknotes. This transport device 2 is connected by the communications line 3 to
20 two separate counter terminal devices 1. Further linkable thereto is a management terminal device 9 for monitoring a present state of each device.

The paper sheet handling machine is made up of these counter terminal devices 1, management
25 terminal device 9 and paper sheet transport device 2.

A start button 4 is a button that is pushed down by a counter service staff or teller when he or she begins to perform a deposit service or uniform

alignment of paper money, e.g., banknotes or bills. A money entry port 5 is a slot through which the teller puts banknotes into the paper sheet transport device 2 when he/she deposits and organizes bills. A money
5 output port 6 is used to allow the teller to take withdrawn bills out of the transport device 2 in the process of conducting cash withdrawals or organizing banknotes. A return port 7 is used to return to the teller rejected banknotes as generated in the process
10 of handling check deposits or organizing banknotes.

Fig. 2 shows schematically an internal structure of the paper sheet transport device 2.

A temporary reserve unit 21 is a temporary holding box which temporarily accumulates counted
15 banknotes or bills gathered therein. A discrimination unit 22 functions to discriminate the type, authenticity, direction (orientation) and damage degree of every banknote involved. Bill accumulation units 23a to 23d, one unit for a different type of banknote,
20 are cash-keeping or "vault" boxes which each keep banknotes of a same type. A recovery unit 24 is a cashbox that holds therein those banknotes that are rejected by the discrimination unit 22. An upper transport path 25 is a conveyance passage for sending
25 banknotes through the money entry port 5, discrimination unit 22, temporary reserve unit 21, money output port 6 and return port 7 in a looping fashion. A lower transport path 26 is a conveying

route for sending again or "resending" banknotes from the upper transport path 25 through the bill accumulation units 23a-23d toward the upper transport path 25.

5 A money input port-associated transport path 27 is a conveyer for passing banknotes from the money entry port 5 to the upper transport path 25. A money output port-associated transport path 28 is a conveyer for sending banknotes from the upper transport path 25
10 to the money output port 6. A return port-associated transport path 29 is a conveyer for carrying banknotes from the upper transport path 25 to the return port 7. A temporary reserve unit feed-in transport path 30 is a conveyer for sending banknotes from the upper transport
15 path 25 to the temporary reserve unit 21. A temporary reserve unit take-out transport path 31 is a conveyance path for sending banknotes from the temporary reserve unit 21 to the upper transport path 25. Accumulation unit feed-in transport paths 32a to 32d are conveyance
20 passages for sending banknotes from the lower transport path 26 to the bill accumulation units 23a-23d, respectively. Accumulation unit take-out transport paths 33a-33d are conveyance passages for carrying banknotes from the accumulation units 23a-23d to the
25 lower transport path 26. A recovery unit-associated transport path 34 is a conveyer for sending banknotes from the lower transport path 26 to the recovery unit 24.

A transit sensor 35 is a sensor which detects that a banknote passes through. A gate 36 is for changeover of a direction in which a banknote is transported. A money entry port paper-sheet detection
5 sensor 37 is a sensor which detects whether there is a banknote(s) in the money entry port 5. A money output port paper-sheet detection sensor 38 is a sensor which detects whether there is a banknote(s) in the money output port 6. A return port paper-sheet detection
10 sensor 39 is a sensor which detects whether there is a banknote(s) in the return port 7.

Fig. 3 shows a control block diagram of the paper sheet transport device 2.

The paper sheet transport device 2 has a
15 control unit which consists of a business task processing unit 2a and a transport processing unit 2b. A task processing main control unit 101 provides exclusive controls over the two counter terminal devices 1 and the management terminal device 9 and also
20 controls respective components. An upper-level communication control unit 102 controls communications with any one of the counter terminal devices 1 and management terminal device 9. A button control unit 103 controls the start button 4. A buzzer control unit
25 104 controls issuance of alarm for warning notice. A lamp control unit 105 controls turn-on and off of lamps. A display control unit 106 controls the display device. A lower-level communication control unit 107

controls communications with the transport processing unit 2b. A clock control unit 108 performs control of a clock. A setup information storage unit 109 is a memory module for storing setup data or information of
5 the task processing unit 2a.

In addition, a transport-processing main control unit 110 controls transportation of banknotes. An upper-level communication unit 111 controls communications with the task processing unit 2a. A
10 sensor control unit 112 controls the sensors. A gate control unit 113 controls the gate. A transport motor control unit 114 controls a motor(s) for the transportation use. A transport path movement distance counter unit 115 counts a moved amount of the transport
15 path. A discrimination processing unit 116 performs discrimination of banknotes. A money entry port control unit 117 controls the money entry port 5. A money output port control unit 118 controls the money output port 6. An accumulation unit control unit 119
20 controls the bill accumulation units 23a-23d. A temporary reserve unit control unit 120 controls the temporary reserve unit 21. A data storage unit 121 stores therein the setup information of the transport processor 2b along with data on a discrimination result
25 of a banknote that was first detected.

Fig. 4 shows an on-screen display image of a counter work menu 210 which is to be displayed on a display screen of the counter terminal device 1.

Fig. 5 shows a display image of a bill-organizing work menu 220 which is displayed on the display screen of counter terminal device 1. Fig. 6 is a display image of a processing result 230 to be displayed on the
5 screen of counter terminal device 1.

On the task menu screen 210 shown in Fig. 4, a plurality of task menu buttons 211 are provided. These on-screen task menu buttons 211 include button icons of "Money In", "Money Out", "sorting", etc. When
10 the "Sorting" button is chosen by a mouse cursor C from among the task menu buttons 211, transition is made to the bill-organizing task menu screen 220 shown in Fig. 5.

On the bill-organize task menu screen 220
15 shown in Fig. 5, some submenu items are provided, including a money type designation part 221 for use as a means for designating a denomination value(s) of banknotes to be collected, a quantity designation part 222 as a means for designating a number of paper moneys
20 to be collected, a direction distinction designating part 223 as a means for selecting whether directions (or orientations) of banknotes to be collected are to be distinguished or not, a direction designating part 224 as a means for designating a direction (or
25 orientation) of banknotes being collected, a dirtiness discrimination designating part 225 as a means for selecting whether the collected banknotes are needed to be distinguished in degree of dirtiness or

contamination, a dirtiness level designation part 226
as a means for designating a dirtiness degree of the
banknotes being collected, a shape discrimination
designating part 227 as a means for selecting whether
5 the banknotes being collected are to be distinguished
in degree of damage (breakage, crease, holes, etc.)
relating to the shape of banknotes, a shape level
designation part 228 as a means for designating a
degree of shape-related damage of the banknotes to be
10 collected, a non-designated paper-sheet delivery
destination designating part (hereinafter referred to
as "off-designation delivery destination designating
part") 229 as a means for designating a destination
location of those bills with directions, dirtiness
15 levels and shape-related damage levels which are not
selected as the banknotes to be collected, a processing
start button 230, and a cancel button 231.

The money type designation part 221 is a
combo box which permits selection of money type of
20 banknotes to be collected at the money output port 6.
In this embodiment, "Automatic Discern" is taken up,
which is for collecting to the money output port 6
those banknotes that are the same in money type as a
specific one of those banknotes as advanced from the
25 money entry port 5, which was first discriminated by
the discrimination unit 22; however, it is also
possible to designate other choice options, such as
"Ten-thousand Yen," "Five-thousand Yen" or "One-

thousand Yen", which is for designating a specific money type, "Only New-Print Bills" or "Only Old Bills" which is for designating distinction between new and old bills, or "All" for designating every money type
5 that is handled by the bill transport device 2.

The quantity designation part 222 is a text box which permits data input for designation of a number of banknotes to be collected at the money output port 6.

10 The direction distinction designating part 223 is a check box which permits selection of whether the banknotes being collected at the money output port 6 are to be distinguished in direction (or orientation). When it is needed to collect bills to
15 the money output port 6 with the bills aligned in direction, a check is added thereto. On the other hand, when these bills are collected at the money output port 6 without taking care of the directions or orientations, the check is removed.

20 The direction designation part 224 is a combo box which permits selection of a direction (orientation) of banknotes to be collected to the money output port 6.

Fig. 10 shows an example of classification of
25 banknote directions or orientations. In the case where directions of bills are classified as shown in Fig. 10, the discrimination unit 22 distinguishes and detects the exact direction or orientation of a bill whenever

it passes through this unit: if the bill is with a direction of "face-up & Upright", then let a discrimination result to set at 1; if a direction of "Face-up & Upside-down" then let the discrimination
5 result be 2; if a direction of "Face-down & Upright" then let the discrimination result be 3; and, if a direction of "face-down & Upside-down" then let the result be 4.

Although in this embodiment the "Auto-
10 discern" is exemplified, which is for collecting to the money output port 6 only those of the banknotes advanced from the money entry port 5 which are the same in orientation as a specific one that was first recognized by the discrimination unit 22, it is also
15 possible to designate any one of other options for designation of a specific direction, such as "Face-up & Upright", "Face-down & Upright", "Face-down & Upright", "Face-down & Upside-down", "Face-up", "Facedown", "Upright" or "Upside-down".

20 The dirtiness discrimination designating part 225 is a check box which allows selection of whether the banknotes to be collected at the money output port 6 are needed to be distinguished in dirtiness degree. When these banknotes being collected to the money
25 output port 6 are to be made equal in dirtiness degree to each other, a check is marked in this part. When the banknotes are collected at the money output port 6 while taking no care of the dirtiness degree, the check

is removed.

The dirtiness level designation part 226 is a
combo box which permits selection of a dirtiness degree
of the banknotes to be collected at the money output
5 port 6.

Fig. 11 is a diagram showing an example of
classification of the dirtiness degree of banknotes.
In the case of the banknote dirtiness degrees being
classified as shown in Fig. 11, the discrimination unit
10 22 distinguishes and detects the dirtiness degree of a
bill whenever it passes therethrough: if the bill is in
a state that is almost free from dirtiness ("High
Quality"), then set a discrimination result to 1; if
the bill is in a state with a slight dirtiness ("Middle
15 Quality") then set the discrimination result at 2; and,
if it is in a state with heavy dirtiness ("Low
Quality") then let the discrimination result be 3.

Although in this embodiment the "Auto-
discern" is exemplified, which is for collecting to the
20 money output port 6 only certain banknotes which are
advanced from the money entry port 5 and which are
equal in dirtiness degree to or less dirty than a
specific banknote which was first discriminated by the
discrimination unit 22, it is also possible to
25 designate any one of other choice options, such as
"High Quality" for collecting grime-free banknotes
only, "Low Quality" for collecting heavily dirtied
bills only, and "High to Mid Quality" for collecting

those bills with their dirtiness degrees ranging from middle to high levels.

Although in this embodiment the dirtiness degrees are classified in three steps, it is also
5 possible to classify them more finely.

The shape discrimination designating part 227 is a check box that permits selection of whether the banknotes to be collected at the money output port 6 are distinguished in shape-related damage degree. When
10 it is necessary to collect those bills at the money output port 6 that are uniform in shape-related damage degree, a check is added thereto. When these bills are collected to the money output port 6 while taking no care of their shape-related damage degrees, the check
15 is cleared.

The shape level designation part 228 is a combo box for permitting selection of a shape-related damage degree of banknotes to be collected at the money output port 6.

20 Fig. 12 is a diagram showing an example of classification of shape damage degrees. In the case of the shape-related damage degrees being classified as shown in Fig. 12, the discrimination unit 22 distinctly detects the shape-related damage degree of a banknote
25 whenever it passes therethrough: if the banknote is in a state that is almost free from breakages ("High Quality"), then let a discrimination result be set to 1; if the bill is in a state with a slight breakage

("Middle Quality") then let the discrimination result be 2; and, if it is heavily damaged ("Low Quality") then let the discrimination result be 3.

Although this embodiment exemplifies the

5 "Auto-discern" which is for collecting to the money output port 6 only certain banknotes which are advanced from the money entry port 5 and which are equal in shape-related damage degree to or less damaged than the banknote that was first recognized by the

10 discrimination unit 22, it is also possible to designate any one of other options, such as "High Quality" for collecting only those bills which are almost free from shape-related damages, "Low Quality" for collecting extremely shape-damaged bills only, and

15 "High to Mid Quality" for collecting those bills with their shape damage degrees ranging from a mid to high level.

While in this embodiment the dirtiness degrees are classified in three ranks, it is also

20 possible to classify them more finely.

The off-designation delivery destination designating part 229 is a combo box which permits, when banknotes being put into the money entry port 5 contain a bill with its direction or orientation and dirtiness

25 and shape that are not selected as a bill to be collected, selection of one of destination locations to which this bill is to be sent—for example, selecting that this bill should be sent to which one of "Return

Port" and "Temporary Reserve Unit".

Although in this embodiment all-at-once selection is performed with respect to the direction or orientation, dirtiness and shape, it is also possible
5 to allow individual selection of the direction or orientation, dirtiness and shape.

The processing start button 230 is a button which becomes, when selected by the mouse cursor C, a trigger for instructing the bill transport device 2 to
10 start a bill organizing operation required.

The cancel button 231 is a button which causes, when selected by the mouse cursor C, the system routine to exit the bill-organizing task menu screen 220 and then return to the main task menu screen 210
15 shown in Fig. 4.

On a processing result display screen 240 shown in Fig. 6, several items are provided, including a money type indication part 241 which indicates one or more money types of the banknotes collected at the
20 money output port 6, a quantity indicator unit 242 which indicates the number of bills collected, a designation content indicator 243 which shows the contents selected on the bill-organizing task menu screen 220 of Fig. 5, a continuance button 244 for
25 continuing the bill-organizing task, and an end button 245 for completion of the bill-organizing task.

When selecting the continue button 244 by the mouse cursor C, the system routine returns to the bill-

organize task menu screen 220, followed by transition to the next bill-organizing work. Upon selection of the end button 245 by the mouse cursor C, the bill-organizing task is ended, returning to the main task menu 210.

An explanation will next be given, using Figs. 7-9 and 13, of the case where a bank teller attempts to organize banknotes while selecting relevant conditions in a way which follows: auto-discrimination of money type is turned on; the number of bank notes is set to a hundred (100); the banknote direction (orientation) discrimination is made effective; the auto-discern of direction (orientation) is enabled; and, the money-type other than designated money type (hereinafter referred to as "off-designation money type") is to be sent to the return port 7.

Fig. 7 is a flow diagram of operations of the bank teller, his or her counter terminal device 1 and the bill transport device 2.

The bank teller selects a mode of bill-organizing task in the counter terminal device 1 (at step S1). Thereafter, the teller pushes down the on-screen processing start button being displayed at the counter terminal device 1 (step S2).

The counter terminal device 1 issues an instruction of the selected bill-organizing/counting mode and then sends it to the bill transport device 2 through the communications line 3 (at step S3).

The task-processing main control unit 101 of the bill transport device 2 is responsive to receipt of the bill-organize/count startup instruction, for determining whether the bill-organizing processing
5 required is executable or not. If possible then instruct the lamp control unit 105 to turn an indicator lamp 8 on (at step S4).

In addition, the task-processing main control unit 101 causes the instructed bill-organize/count mode
10 to be stored in the storage unit 109 (step S5).

Fig. 13 is a diagram showing a banknote sorting result. The bank teller puts a bundle of bills into the money entry port 5 of the bill transport device 2, which bundle of bills is a mixture of a
15 plurality of money types with their directions or orientations being non-uniformly aligned (step S6); then, the teller depresses the start button 4 of bill transport device 2 (step S7).

Upon detection of the push-down of the start
20 button 4 by the teller, the bill transport device 2 starts a bill-organizing/counting operation (step S8). Details of this operation of bill transport device 2 will be described later with reference to Fig. 8.

Note here that the trigger for startup of the
25 bill-organizing/counting operation should not be limited only to the method of pushing down the start button 4 and may alternatively be arranged so that the teller notifies it via the counter terminal device 1.

Still alternatively, the bill transport device 2 may be arranged to start it automatically after the money entry port paper-sheet detection sensor 37 detects that there are banknotes in the money entry port 5.

5 After completion of the bill-organizing/counting operation, the task-processing main control unit 101 notifies the counter terminal device 1 of the completion of the bill-organizing/counting operation via the upper-level communication control
10 unit 102; in responding thereto, the counter terminal device 1 displays on its screen a result of the bill-organizing/counting operation (step S9).

 In case there are banknotes returned to the return port 7 of the bill transport device 2, the
15 teller gets them out (step S10), and thereafter takes out those bills that are collected at the money output port 6 (step S11). In case the bills which are taken out of the return port 7 include certain bills that the teller wants to collect to the money output port 6, she
20 or he may enter them again into the money entry port 5 and repeats the bill-organizing work.

 When ending the bill-organizing work, the teller depresses an organizing task end button, which is present on the display screen of counter terminal
25 device 1 (step S12).

 The counter terminal device 1 instructs completion of the bill-organizing/counting operation to the bill transport device 2 via the communication line

3 (step S13).

Upon receipt of the bill-organize processing end instruction, the task-processing main control unit 101 of the bill transport device 2 instructs the lamp control unit 105 to turn the indicator lamp 8 off (step 5 S14), and then releases the bill-organizing/counting operation mode being stored in the storage unit 109 (step S15).

Fig. 8 is a flowchart of a paper-sheet 10 organizing/counting operation of the banknote transport device 2. The paper-sheet organizing/counting operation of this paper-sheet transport device will be described in detail with reference to Fig. 8 below.

When the bank teller depresses the start 15 button 4, the task-processing main control unit 101 of the paper-sheet transport device 2 receives from the button control unit 103 a notice of push-down of the start button 4 and then instructs the transport-processing main control unit 110 via the lower-level 20 communication control unit 107 to start transportation of banknotes as the bill-organize/count mode gets started.

The transport-processing main control unit 110 instructs the transport motor control unit 114 to 25 render respective transport paths 25-34 operative (step S101).

The transport-processing main control unit 110 uses the money entry port paper-sheet detection

sensor 37 to determine or "judge" whether there are banknotes in the money entry port 5 (step S102). If there are bills therein, it instructs the money entry port control unit 117 to advance these bills from money entry port 5 (step S103). If no bills are found in money entry port 5 then instruct the transport motor control unit 114 to stop respective transport paths 25-34 (step S107).

The banknotes that are advanced from the money entry port 5 are conveyed on the money input port transport path 27. When these pass through the discrimination unit 22, the discrimination processing unit 116 distinctly detects the money type, authenticity, direction or orientation, dirtiness degree and shape-related damage degree of every banknote that has passed through.

The transport-processing main control unit 110 acquires a discrimination result from the discrimination processing unit 116 (step S104) and determines a transport destination of banknotes (step S105). Regarding this banknote destination determining processing, an explanation will be given later using Fig. 9.

The transport-processing main control unit 110 judges whether a designated number of target banknotes to be collected at the money output port 6 have already been collected (step S106). In case a present number has reached the designated number, the

main control unit 110 instructs the transport motor control unit 114 to stop each of the transport paths 25-35 (step S107). In case a present number has not yet reached the designated number, repeat the
5 processing stated above.

The transport-processing main control unit 110 judges whether there are certain kinds of banknotes in the return port 7, which include rejected bills and/or those with their money types or directions
10 (orientations) that are not target ones to be collected (at step S108). If it is detected by the return port paper-sheet detection sensor 39 that there are banknotes in the return port 7, then wait for completion of removal of these banknotes from the
15 return port 7 (step S109).

After the bank teller removed banknotes from the return port 7, when it is detected by the return port paper-sheet detection sensor 39 that there are no banknotes in return port 7, the main control unit 110
20 subsequently determines whether there are banknotes in the temporary reserve unit 21 (step S110).

In case there are banknotes in the temporary reserve unit 21, the transport-processing main control unit 110 instructs the transport motor control unit 114
25 to activate its associated transport path (step S111) and then instructs the temporary reserve control unit 120 to advance banknotes from the temporary reserve unit 21 (step S112).

The transport-processing main control unit 110 judges whether the return port 7 is full of banknotes or not or, alternatively, determines whether the temporary reserve unit 21 is empty or not (step 5 S113) and repeats an operation of sending banknotes from the temporary reserve unit 21 to the return port 7 until all of the banknotes have gone away from the temporary reserve unit 21.

When no banknotes are left in both the return 10 port 7 and the temporary reserve unit 21, the transport-processing main control unit 110 instructs the money output port control unit 118 to open a shutter door of the money output port 6 in order to allow the teller to take the collected bills out of the 15 money output port 6 and then waits for completion of removal of the banknotes from the money output port 6 (step S114).

When the money output port paper-sheet detection sensor 38 detects absence of banknotes, the 20 transport-processing main control unit 110 notifies, via the upper-level communication unit 111, the task-processing main control unit 101 of the fact that the bill-organize/count operation has been completed (step S115).

25 Fig. 9 is a diagram showing a flowchart of a procedure for controlling a transport destination of banknotes. A detailed explanation of destination determining processing will be given using Fig. 9

below.

The transport-processing main control unit 110 judges whether a banknote being presently tested is the first one of those bills with money types which
5 could be distinguished by the discrimination unit 22 while an automatic money type detection mode is designated in the bill-organize/count mode (step S201).

In this embodiment, the money type is set to be detected in an automated way; so, if the banknote
10 detection result indicates the banknote of interest is the first banknote, the transport-processing main control unit 110 stores the money type of this banknote in the storage unit 121 as the money type to be collected to the money output port 6 (step S202).

15 In the case of the bundle of banknotes shown in Fig. 13, the money type of the first banknote is "Ten-thousand Yen" so that the detection result of the discrimination processing unit 116 becomes "10K"; thus, "10K" is stored in the storage unit 121 as the money
20 type of the banknotes to be collected at the money output port 6.

Subsequently, the transport-processing main control unit 110 determines whether the money type of this banknote corresponds to the money type to be
25 collected at the money output port 6, which is stored in the storage unit 121 (step S203). In case it is different from the money type to be collected, the transport-processing main control unit 110 instructs

the gate control unit 113 to change over the gate to a direction for sending the banknote to the return port 7 (step S217).

In the case of the bundle of banknotes shown
5 in Fig. 13, the money type of a seventh banknote is "One-thousand Yen" and an eighth banknote's money type is "Five-thousand Yen". Thus, the discrimination processing unit 116's detection results become "1K" and "5K" respectively, each of which is different from the
10 money type "10K" that is stored in the storage unit 121. Accordingly, these banknotes are gathered in the return port 7.

Next, the transport-processing main control unit 110 determines whether the direction (orientation)
15 discrimination mode is designated or not (step S204). In case the direction (orientation) detection mode is designated, the main control unit 110 sequentially determines if a banknote being presently tested is the first one or not while the automatic direction
20 (orientation) detection mode is designated (step S205).

In this embodiment, the mode is set to detect the direction (orientation) in an automated way; so, if a detection result indicates this banknote is the first banknote, the transport-processing main control unit
25 110 stores this banknote's direction in the storage unit 121 as the direction (orientation) to be collected at the money output port 6 (step S206).

In the case of the bundle of banknotes shown

in Fig. 13, the first banknote's direction
(orientation) is "Face-up & Upright" direction so that
the discrimination processing unit 116's detection
result becomes "1," which is stored in the storage unit
5 121 as the direction (orientation) of the banknote to
be collected at the money output port 6.

Subsequently, the transport-processing main
control unit 110 determines if this banknote's
direction (orientation) corresponds to the orientation
10 of banknote to be collected at the money output port 6
(step S207).

In the case of the first banknote, this
becomes the banknote to be collected at the money
output port 6. Thus, the transport-processing main
15 control unit 110 instructs the gate control unit 113 to
switch the gate to a direction of sending the banknote
to the money output port 6. In the case of a second
bill et seq., the transport-processing main control
unit 110 judges whether this banknote's orientation is
20 the same as the collection orientation being stored in
the storage unit 121. In case it is different from the
collection orientation, the main control unit 110
instructs the gate control unit 113 to switch the gate
to a direction of sending banknotes to a location which
25 is specified by the off-designation delivery
destination designation part 229 (step S218). In this
embodiment, it is the "Temporary Reserve Unit"; so, let
the gate be switched to the direction toward the

temporary reserve unit 21.

In the case of the bundle of banknotes shown in Fig. 13, the orientation of a third banknote is "Face-up & Upside-down", the orientation of a fifth
5 banknote is "Face-down & Upside-down", and the direction of a sixth banknote is "Face-down & Upright". Accordingly, detection results of the discrimination processing unit 116 become "2", "4" and "3", respectively. Each of them is different from the
10 orientation "1" that is stored in the storage unit 121. Thus, these banknotes are gathered at the return port 7.

Next, the transport-processing main control unit 110 determines whether the dirtiness detection
15 mode is designated or not (step S208). When the dirtiness detection mode is designated, this controller 110 sequentially judges whether a banknote being tested is the first one or not while the automatic dirtiness detection mode is designated (step S209). In the case
20 of conditions being met, the transport-processing main control unit 110 stores a dirtiness level of this banknote (e.g., significance of dirtiness, color density of dirtiness, number of dirty spots, etc.) in the storage unit 121 as a standard or "reference" of
25 the dirtiness level of banknotes to be collected at the money output port 6 (step S210).

Next, the transport-processing main control unit 110 judges whether the dirtiness level of this

banknote corresponds to the dirtiness level of banknotes to be collected at the money output port 6—that is, whether this level is of less dirtiness than the dirtiness level being stored (step S211).

5 In case it does not correspond to the dirtiness level of banknotes to be collected at the money output port 6, i.e., if the banknote is of a level dirtier than the dirtiness level stored, the transport-processing main control unit 110 instructs
10 the gate control unit 113 to switch the gate to a direction of sending banknotes toward a location which is designated by the off-designation delivery destination designation part 229 (step S218).

 Next, the transport-processing main control
15 unit 110 determines whether a shape discrimination mode is designated or not (step S212). In case the shape discrimination mode is designated, it sequentially judges whether a banknote being tested is the first one or not while the automatic shape discrimination mode is
20 designated (step S213). In the case of conditions being satisfied, the transport-processing main control unit 110 stores a damage level with this banknote's shape-related damage degree (e.g., significance of damage, number of damaged portions, damaged locations,
25 direction of damage, etc.) being ranked stepwise in the storage unit 121 as the reference of the shape level of banknotes to be collected at the money output port 6 (step S214).

Next, the transport-processing main control unit 110 determines whether the shape-related damage level of this banknote corresponds to the shape-related damage level of banknotes to be collected at the money output port 6, i.e., whether it is a level less damaged than the shape-related damage level being stored (e.g., the damage significance is less, the number of damages is less, the damaged location is not an important location, the damage direction does not affect the discrimination, etc.) (step S215).

In case it does not correspond to the shape-related damage level of banknotes to be collected at the money output port 6, i.e., it is of a level more damaged than the shape-related damage level stored (e.g., the damage significance is great, the number of damages is great, the damaged location is an important location, the damage direction affects the discrimination, etc.), the transport-processing main control unit 110 instructs the gate control unit 113 to switch the gate to a direction of sending banknotes to a location which is designated by the off-designation delivery destination designation part 229 (step S218).

The discrimination about the banknote's transport destination is done in the way stated above, and in case the banknote being checked is judged to be the banknote to be collected at the money output port 6, the transport-processing main control unit 110 instructs the gate control unit 113 to switch the gate

to the direction of sending banknotes toward the money output port 6 (step S216).

In case the bundle of ten-thousand yen (¥10,000) bills with non-uniform orientations contains
5 bills of one-thousand yen (¥1,000) and five-thousand yen (¥5,000) as shown in Fig. 13, when "Return Port" is selected in the off-designation delivery destination designation part 229, it is required for the bank teller to repeat manual operation of putting a bill
10 into the money entry port 5 four times in order to complete uniform alignment of orientations of bills because in this case bills are collected without sorting the different orientations of ¥1,000, ¥5,000 and ¥10,000; however, in the case of "Temporary Reserve
15 Unit" being selected, the teller is required to repeat the operation only three times because the execution of the first operation enables successful bill collection with the ¥10,000 bills of different orientation being discriminated and sorted from ¥1,000 and ¥5,000 bills.
20 Thus, it is possible to lighten the teller's workload while at the same time shortening the length of a time period for discrimination required.

In addition, owing to having the temporary reserve unit 21, it becomes possible to take out three
25 types of bills (in the example above, the face-up and upright ten-thousand yen bill, ten-thousand yen bills with orientations other than the Face up and upright orientation, and five- and one-thousand yen bills) even

when there are only two takeout ports (money output port 6 and return port 7) through which bills are taken out.

Furthermore, using this temporary reserve
5 unit 21 makes it possible, even when there is only one bill takeout port, to achieve a continuous sort mode which gathers several types of banknotes at a banknote takeout port, such as the money output port 6 or else, in an order of sequence designated by the teller with
10 sorted postures or orientations of banknote.

For example, in case the continuous sort mode is utilized, the teller specifies, by means of a display screen not shown, the money type(s) and posture or orientation of those bills to be collected at the
15 money output port 6 that is designated as a money takeout port in his or her preferred order of sequence. The data storage unit 121 stores therein the teller's designated money type(s) and posture or orientation of banknotes to be collected while letting them be queued
20 in the order required. Additionally, the transport-processing main control unit 110 empties any one of the bill accumulation units 23a-23d.

Subsequently, the transport-processing main control unit 110 determines whether a banknote being
25 tested is with its money type and posture or orientation equal to those of the first one being stored in the storage unit 121 and, if it is the first one then send it to the money output port 6 for

collection. Bills with their money types and postures or orientations being other than those of the first one are gathered and accumulated in the temporary reserve unit 21. Thereafter, from the temporary reserve unit
5 21, banknotes with their money types and postures or orientations other than the first one are judged by the transport-processing main control unit 110: if they include banknotes with a money type and posture or orientation identical to those of the second one being
10 stored in the storage unit 121, then collect them in the money output port 6; if they are banknotes with money types and postures or orientations except those of the second one being stored in the storage unit 121 then send them to the emptied one of bill accumulation
15 units 23a-23d. When the banknotes in the temporary reserve unit 21 (i.e., banknotes with money types and postures or orientations other than those of the first one) are gone away, the banknotes that are gathered in the emptied one of bill accumulation units 23a-23d
20 (i.e., banknotes with money types and postures or orientations except those of the second one) are sent to the temporary reserve unit 21.

Subsequently, the banknotes that are with money types and postures or orientations other than
25 those of the second one and that are gathered from the temporary reserve unit 21 are judged by the transport-processing main control unit 110: if these include banknotes with a money type and posture or orientation

identical to those of the third one being stored in the storage unit 121, then gather them at the money output port 6; if they are banknotes with money types and postures or orientations except those of the third one
5 then send them to the emptied one of bill accumulation units 23a-23d. When the banknotes of temporary reserve unit 21 (banknotes with money types and postures or orientations other than those of the third one) become absent, the banknotes that are gathered and accumulated
10 in the emptied one of the bill accumulation units 23a-23d (banknotes with money types and postures or orientations except those of the third one) are sent to the temporary reserve unit 21.

In this way, by repeated execution of the
15 above-stated processing, it becomes possible to gather and accumulate a required set of banknotes at the money output port 6 in accordance with any desired order of sequence, such as the teller's designated money type(s) and posture or orientation. Although the money type
20 and postures or orientations are used here, the banknotes may alternatively be sorted and collected based on dirtiness degrees and/or shape-related damage degrees.

By sorting banknotes in this way, it becomes
25 possible to distinctly sort banknotes using a small number of takeout ports and a small number of transport paths. This makes it possible to reduce manufacturing costs and, at the same time, lighten the bank teller's

workload by gathering sorted banknotes at a single
takeout port.

Fig. 14 is a diagram showing a banknote sort
result when the first banknote of a bundle is rejected.
5 As shown in Fig. 14, if the discrimination unit 22
fails to discriminate its money type due to the
presence of a certain factor, such as in the case of
the first bill having a large skew, the detection
result of the discrimination processing unit 116
10 becomes "Reject", resulting in the transport
destination of the first bill becoming the return port
7 undesirably.

In this embodiment, even when the first
banknote is rejected, banknotes are continued to be
15 advanced from the money entry port 5; so, a bundle of
banknotes is gathered in a sorted manner in accordance
with a discrimination result of the bill that was able
to be first recognized by the discrimination unit 22
among the second bill and its following ones. In
20 Fig. 14, a banknote sort result is shown in case the
money type of the second banknote was able to be first
discriminated by the discrimination unit 22.

The processing flow diagram of the
destination-controllable transport-processing main
25 control unit 110 shown in Fig. 9 is directed to a
processing flowchart in the embodiment which is able to
select whether or not banknotes are to be gathered at
the money output port 6 in accordance with the banknote

orientation, dirtiness degree and/or shape-related damage degree as first detected by the discrimination unit 22 and which has the means for selecting whether to collect, for accumulation at the temporary reserve
5 unit 21, or not a certain kind of banknote which is of the money type to be collected at the money output port 6 but whose orientation or dirtiness/shape-related damage degree that is short of the level of the target banknote to be collected at the money output port 6.

10 However, respective parts (a) to (d) of Fig. 9 at (A) can be also implemented in a combined manner while permitting alternative designing of various embodiments, including but not limited to an embodiment using the part (a) only, an embodiment using the part
15 (c) only, an embodiment with a combination of the parts (a) and (b), an embodiment with co-use of the parts (a) and (c), and an embodiment employing the parts (a), (b) and (C) in combination.

It is noted that although the illustrative
20 embodiment above is arranged to sort banknotes into dirty banknotes and clean banknotes in comparison with the stored dirtiness level as a reference level, it is also possible to sort them into banknotes with their dirtiness levels equal to the dirtiness level stored
25 and the other banknotes. As for the shape-related damage level also, similar arrangements are applicable.

Additionally, as another embodiment, it is possible to employ a method having the steps of

stopping the advancing of banknotes from the money
entry port 5 upon rejection of the first banknote,
permitting the teller to select whether the bill
discrimination is to be continued or not, and then
5 restarting the above-noted operation after the
continuation of discrimination is selected.

In the way stated supra, by providing the
paper sheet handling machine capable of performing, in
the process of banknote organizing works, the screening
10 and collection of banknotes in a way pursuant to the
banknote's orientation, dirtiness and/or shape-related
damage degree in addition to denomination values
thereof while at the same time simplifying manual
operations required, it is possible to lighten the
15 teller's workload and also improve the efficiency of
service counter works.

It should be further understood by those
skilled in the art that although the foregoing
description has been made on embodiments of the
20 invention, the invention is not limited thereto and
various changes and modifications may be made without
departing from the spirit of the invention and the
scope of the appended claims.

Claim

1. A paper sheet handling machine comprising:
 - a money entry port for receiving paper sheets;
 - a plurality of take-out ports for output of paper sheets;
 - a discrimination unit for detecting types and significances of damages of the paper sheets;
 - a storage unit for storing the types of the paper sheets and the significances of damages of the paper sheets as damage levels in a ranked manner; and
 - a temporary reserve unit for permitting temporary accumulation of paper sheets,
 - wherein said plurality of take-out ports include a money output port for payout of paper sheets and a return port for returning paper sheets;
 - wherein type and damage significance of a specific paper sheet received from said money entry port are distinctly detected by said discrimination unit;
 - wherein the detected type and damage significance of the specific paper sheet are stored; and
 - wherein paper sheets which are the same in type as the specific paper sheet stored and which have damage levels equivalent to a damage significance equal to or less than the damage level of the stored specific paper sheet are sent to said money output port, and
 - paper sheets which are the same in type as the specific paper sheet stored and which have damage levels equivalent to a damage significance greater than the damage level of the specific paper sheet are sent to said temporary reserve unit, while causing remaining paper sheets to be gathered at said return port in a sorted manner.