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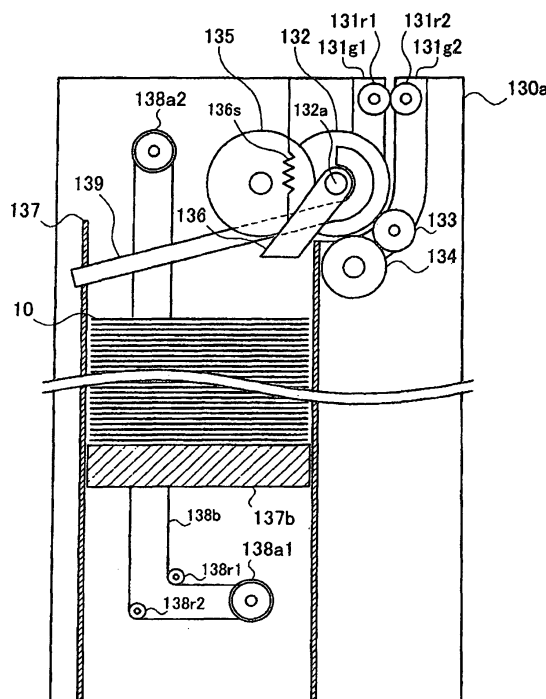
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(54) **Paper sheet storing apparatus, paper sheet handling system, and automatic teller machine**

(57) A cash circulation cartridge 130a included in an automatic teller machine 100 has a storage cartridge 137, a feed-in mechanism configured to convey bills 10 into the storage cartridge 137, and a hitting member 136. The feed-in mechanism includes a pair of conveyor guides 131g1 and 131g2, a pair of conveyor rollers 131r1 and 131r2, feed rollers 132, pinch rollers 133, and gate rollers 134. When each of the bills 10 is conveyed to the storage cartridge 137 by the feed-in mechanism, the hitting member 136 comes into contact with a front end of the bill 10 to be lifted up. When a rear end of the bill 10 enters a space for accumulation of the bills 10, the hitting member 136 hits the rear end of the bill 10 and thereby drops the bill 10 down in the storage cartridge 137. The hitting member 136 is arranged to come into contact with substantially the whole length of the conveyed bill 10 in its longitudinal direction, while hitting the rear end of the bill 10 and dropping the bill 10 down in the storage cartridge 137. This arrangement effectively reduces the potential for paper jams of the bills 10 and relevant troubles and ensures stable accumulation of the bills 10 in the cash circulation cartridge 130a.

Fig.3



Description

1. Field of the Invention

[0001] The present invention relates to a paper sheet storing apparatus, a paper sheet handling system, and an automatic teller machine.

2. Description of the Related Art

[0002] Automatic teller machines are generally used for the users' financial transactions including cash deposits and withdrawals in financial facilities and organizations. The automatic teller machine is equipped with a paper sheet handling system designed to handle diversity of paper sheets including banknotes or bills and forms and slips. The paper sheet handling system includes a paper sheet storing apparatus configured to collect and accumulate externally fed paper sheets. The paper sheet storing apparatus has a paper sheet cartridge to accumulate and keep the paper sheets therein.

[0003] In the paper sheet storing apparatus, paper sheets newly and subsequently conveyed into the paper sheet cartridge may collide with paper sheets conveyed and accumulated in advance in the paper sheet cartridge. The collision may bend or fold the paper sheets and may even cause paper jams and other relevant troubles. Such troubles are especially noticeable in accumulation of folded or curled paper sheets into the paper sheet cartridge.

[0004] Various techniques have been proposed to eliminate such troubles. For example, a paper sheet handling system disclosed in Japanese Patent Laid-Open No. H06-92553 hits the rear ends of paper sheets fed into a paper sheet accumulator (paper sheet cartridge) by means of blades provided around an impeller and thereby drops the paper sheets down in the paper sheet accumulator. In another example, a paper sheet storing apparatus disclosed in Japanese Patent Laid-Open No. 2001-316014 has a mechanism of holding the rear ends of paper sheets fed into a paper sheet accumulator (paper sheet cartridge) by a cam structure. These techniques of hitting or holding the rear ends of the paper sheets fed into the paper sheet cartridge aim to prevent paper sheets newly and subsequently conveyed into the paper sheet cartridge from colliding with paper sheets conveyed and accumulated in advance in the paper sheet cartridge.

SUMMARY OF THE INVENTION

[0005] The techniques of the above cited references, however, have no consideration on the exact hitting or holding position of each paper sheet in a lateral direction relative to a conveying direction of the paper sheets by the blades or by the cam structure. In the case of accumulation of folded or curled paper sheets in the paper sheet cartridge, these techniques may not effectively prevent the above troubles, such as folding or bending of

the paper sheets and paper jams. For example, when the fed paper sheet is inclined in the lateral direction relative to the conveying direction, the paper sheet may not be accurately hit by the blades or held by the cam structure.

[0006] In a paper sheet storing apparatus, there would thus be a demand for reducing the potential for paper jams and relevant troubles and ensures stable accumulation of paper sheets.

[0007] The present invention accomplishes at least part of the demands mentioned above by the following configurations applied to the paper sheet storing apparatus, the paper sheet handling system, and the automatic teller machine.

[0008] According to one aspect, the present invention is directed to a paper sheet storing apparatus configured to collect and accumulate paper sheets. The paper sheet storing apparatus includes: a paper sheet cartridge arranged to accumulate and keep the paper sheets therein; a feed-in mechanism configured to convey each of the paper sheets to the paper sheet cartridge in a perpendicular direction to an accumulating direction of the paper sheets in the paper sheet cartridge; and a hitting member provided above a paper sheet accumulation space for accumulation of the paper sheets in the paper sheet cartridge and configured to be set in a first state of allowing entrance of each conveyed paper sheet into the paper sheet accumulation space when the paper sheet is conveyed to the paper sheet cartridge by the feed-in mechanism and to be changed from the first state to a second state of hitting the conveyed paper sheet and thereby dropping the conveyed paper sheet down in the paper sheet cartridge when a rear end of the conveyed paper sheet enters the paper sheet accumulation space. The hitting member is arranged to be in contact with left and right ends of each conveyed paper sheet and at least part of a middle area of the paper sheet between the left and the right ends in the course of hitting the paper sheet and dropping the paper sheet down in the paper sheet cartridge.

[0009] In the paper sheet storing apparatus according to the above aspect of the invention, the hitting member comes into contact with the left and the right ends of each paper sheet conveyed to the paper sheet cartridge and at least part of the middle area of the paper sheet between the left and the right ends in the course of hitting the paper sheet and dropping the paper sheet down into the paper sheet accumulation space in the paper sheet cartridge. The structure of the hitting member enables each paper sheet conveyed to the paper sheet cartridge to be adequately hit and dropped down in the paper sheet cartridge, even when the conveyed paper sheet has a fold or a curl and when the conveyed paper sheet is slightly inclined in a lateral direction relative to the conveying direction. This arrangement effectively reduces the potential for paper jams of the paper sheets and relevant troubles and ensures stable accumulation of the paper sheets in the paper sheet cartridge. Typical examples of

the paper sheets are banknotes or bills and forms and slips. The conveying direction of the paper sheets by the feed-in mechanism may be a widthwise direction or a longitudinal direction of the paper sheets.

[0010] In one preferable application of the paper sheet storing apparatus according to the above aspect of the invention, the hitting member is arranged to be in contact with substantially a whole length of each conveyed paper sheet including the left and the right ends in the course of hitting the paper sheet and dropping the paper sheet down in the paper sheet cartridge.

[0011] The paper sheet storing apparatus of this application effectively hits each paper sheet conveyed to the paper sheet cartridge by the feed-in mechanism and thereby drops the paper sheet down into the paper sheet accumulation space in the paper sheet cartridge.

[0012] In one preferable embodiment of the paper sheet storing apparatus, the hitting member has multiple hitting elements.

[0013] In the paper sheet storing apparatus of this embodiment, another member may be located in a space between the multiple hitting elements. This enables the effective use of the space between the multiple hitting elements.

[0014] In the paper sheet storing apparatus of this embodiment, the multiple hitting elements may be arranged to be movable independently.

[0015] The paper sheet storing apparatus of this arrangement is especially preferable for the paper sheets conveyed to the paper sheet cartridge in the slightly inclined orientation relative to the conveying direction.

[0016] In another preferable application of the paper sheet storing apparatus according to the above aspect of the invention, the hitting member is arranged to be swung in a vertical direction about a preset pivot shaft located above the paper sheet accumulation space.

[0017] In one preferable embodiment of the paper sheet storing apparatus of this application, the hitting member comes into contact with a front end of each paper sheet conveyed to the paper sheet cartridge by the feed-in mechanism and is set to the first state by a force of the contact.

[0018] In the paper sheet storing apparatus of this embodiment, the hitting member may be changed from the first state to the second state by a dead weight of the hitting member to hit the paper sheet and drop the paper sheet down in the paper sheet cartridge.

[0019] The paper sheet storing apparatus of this arrangement does not require any actuator to drive the hitting member.

[0020] In another preferable embodiment of the paper sheet storing apparatus of the above application, the hitting member has: a guide element arranged to come into contact with each conveyed paper sheet and guide the conveyed paper sheet downward into the paper sheet accumulation space in the paper sheet cartridge when the paper sheet is conveyed to the paper sheet cartridge by the feed-in mechanism; and a pressure element ar-

ranged to press down surface of a topmost paper sheet located on a top of the paper sheets accumulated in the paper sheet cartridge.

[0021] In the paper sheet storing apparatus of this embodiment, the guide element works to accurately guide the paper sheet conveyed to the paper sheet cartridge by the feed-in mechanism downward in the paper sheet cartridge. The pressure element presses down the topmost paper sheet located on the top of the existing paper sheets accumulated in advance in the paper sheet cartridge. This arrangement effectively prevents paper sheets newly and subsequently conveyed into the paper sheet cartridge from colliding with the existing paper sheets conveyed and accumulated in advance in the paper sheet cartridge.

[0022] In one preferable embodiment of the invention, the paper sheet storing apparatus further has: an actuator configured to change over a working state of the hitting member between the first state and the second state; and a drive controller configured to drive and control the actuator.

[0023] The paper sheet storing apparatus of this embodiment enables the hitting member to be driven at any desired timing.

[0024] In another preferable embodiment of the invention, the paper sheet storing apparatus further has a guide member assembly provided above the paper sheet accumulation space and configured to come into contact with each conveyed paper sheet and guide the conveyed paper sheet downward into the paper sheet accumulation space in the paper sheet cartridge when the paper sheet is conveyed to the paper sheet cartridge by the feed-in mechanism.

[0025] In the paper sheet storing apparatus of this embodiment, the guide member assembly works to accurately guide the paper sheet conveyed to the paper sheet cartridge by the feed-in mechanism downward in the paper sheet cartridge.

[0026] In another preferable embodiment of the invention, a vertically movable bottom plate member forms a bottom plate of the paper sheet cartridge. The paper sheet storing apparatus further has a lift mechanism to move up and down the bottom plate member.

[0027] In the paper sheet storing apparatus of this embodiment, the bottom plate member of the paper sheet cartridge is moved up and down by the lift mechanism. This arrangement allows the paper sheet accumulation space to be arbitrarily set in the paper sheet cartridge.

[0028] The paper sheet storing apparatus of this embodiment may further has a feed-out mechanism configured to take the paper sheets accumulated in the paper sheet cartridge out of the paper sheet cartridge.

[0029] In the paper sheet storing apparatus of this embodiment, the paper sheets accumulated and kept in the paper sheet cartridge are taken out of the paper sheet cartridge. This structure is especially preferable for cash circulation cartridges provided in a cash handling system of a circulation type automatic teller machine. The cash

circulation cartridges are used to classify and accumulate normal banknotes or bills suitable for circulation by denominations and to release and deliver the accumulated normal bills.

[0030] According to another aspect, the present invention is directed to a paper sheet handling system equipped with the paper sheet storing apparatus having any of the arrangements described above.

[0031] According to still another aspect, the present invention is directed to an automatic teller machine equipped with the paper sheet handling system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

Fig. 1 shows the appearance of an automatic teller machine in one embodiment of the invention;

Fig. 2 shows the schematic structure of a cash handling system included in the automatic teller machine in the embodiment of the invention;

Fig. 3 shows the schematic structure of a cash circulation cartridge included in the cash handling system;

Fig. 4 shows the schematic structure of a hitting member provided in the cash circulation cartridge;

Figs. 5(a) and (b) are explanatory views showing operations of the cash circulation cartridge in accumulation of bills;

Figs. 6(a) and (b) are explanatory views showing operations of the cash circulation cartridge in accumulation of bills;

Fig. 7 is an explanatory view showing operations of the cash circulation cartridge in withdrawal of bills;

Fig. 8 shows the schematic structure of another hitting member in Modified Example 1;

Fig. 9 shows the schematic structure of still another hitting member in Modified Example 2;

Fig. 10 shows the schematic structure of another hitting member in Modified Example 3; and

Fig. 11 shows the schematic structure of another cash circulation cartridge in one modified example.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] One mode of carrying out the invention is described below as a preferred embodiment with reference to the accompanied drawings:

A. Configuration of Automatic Teller Machine

B. Structure of Cash Handling System

C. Cash Circulation Cartridge

C1. Structure of Cash Circulation Cartridge

C2. Operations of Cash Circulation Cartridge

C2.1. Operations in Bill Accumulation

C2.2. Operations in Bill Withdrawal

D. Reject Cartridge

E. Other Aspects

[0034] A. Configuration of Automatic Teller Machine
Fig. 1 shows the appearance of an automatic teller machine 100 in one embodiment of the invention. The automatic teller machine 100 is installed, for example, in a bank or in a convenience store and is used for various financial transactions including deposit and withdrawal transactions in response to the users' operations. As illustrated, the automatic teller machine 100 includes a cash handling system 101, a card/statement processor 102, a passbook processor 103, a user operation unit 104, and a main controller 105.

[0035] The cash handling system 101 is configured to keep banknotes or bills deposited by the users and to withdraw the bills kept therein in response to the users' requests. The cash handling system 101 has a cash slot for deposit and withdrawal of bills. In deposit transactions, the bills inserted by the user are checked for the authenticity and significant damage, are classified by the denominations, and are collected and accumulated in cash circulation cartridges and a reject cartridge (described later). In withdrawal transactions, required numbers of respective denomination bills corresponding to the user's specified amount of money are taken out of the cash circulation cartridges to the user via the cash slot. The cash handling system 101 is one embodiment of the paper sheet handling system of the invention and will be described in detail later.

[0036] The card/statement processor 102 is configured to read information recorded on a magnetic stripe card (cash card) and issue a transaction statement as a record of the details of each financial transaction. The information recorded on the magnetic stripe card includes, for example, a number allocated to each financial facility, a transaction item, and each user's bank account number.

[0037] The passbook processor 103 is configured to read printed marks and other data from each user's passbook and to print required data on the passbook in response to each financial transaction.

[0038] The user operation unit 104 is a user interface configured to give the user a guidance display for deposit, withdrawal, and other financial transactions and to receive the user's entries for the deposit, withdrawal, and other financial transactions. A touch panel is used for the user operation unit 104 in this embodiment, but may be replaced with another equivalent device, for example, the combination of a display and some press button switches.

[0039] The main controller 105 is constructed as a microcomputer including a CPU and memories. The main controller 105 transmits information to and from the cash handling system 101, the card/statement processor 102, the passbook processor 103, and the user operation unit 104 and controls the operations of the whole automatic teller machine 100.

[0040] B. Structure of Cash Handling System Fig. 2 is a side sectional view showing the schematic structure of the cash handling system 101 in the embodiment of the invention. The cash handling system 101 of this embodiment is designed as a circulation type structure to circulate and reuse deposited and accumulated bills for subsequent withdrawal transactions. This structure is, however, not restrictive, but the cash handling system 101 may be designed as a non-circulation type structure not to circulate or reuse the deposited and accumulated bills for the subsequent withdrawal transactions. As illustrated, the cash handling system 101 includes an upper unit 110 and a vault 120.

[0041] The upper unit 110 includes a cash delivery assembly 111 with a shutter 112, a bill conveying line 113, a bill detector 114, a temporary cabinet 116, and a control unit 118.

[0042] The cash delivery assembly 111 includes a cash slot designed to be accessible for the user's insertion and withdrawal of bills and various rollers. The shutter 112 is opened and closed, in response to the user's operation of the user operation unit 104 provided on the automatic teller machine 100. The cash delivery assembly 111 is also equipped with a sensor for sensing insertion of bills or detecting the presence of bills.

[0043] The bill conveying line 113 is arranged to convey the bills in the cash handling system 101. The bill conveying line 113 has conveyor belts and multiple rollers provided to hold the bills and drive motors used to drive the multiple rollers, although not being specifically illustrated. The bill conveying line 113 is also equipped with multiple sensors provided at adequate positions for detecting the passage of bills. The bill conveying line 113 has gates provided at its respective branches and driven by, for example, electromagnetic solenoids to switch over the conveyance destination of each bill. In this embodiment, the conveying direction of the bills is a widthwise direction of the bills.

[0044] The bill detector 114 is located on the bill conveying line 113. The bill detector 114 has various sensors provided to check each of the bills conveyed on the bill conveying line 113 from the cash delivery assembly 111 for its denomination and its suitability or unsuitability for circulation (authenticity and damage condition of the bill) and output the check results.

[0045] The temporary cabinet 116 is used to temporarily store the conveyed bills in the course of each deposit or withdrawal transaction. The temporary cabinet 116 is designed to accumulate the bills in a conveying order and to deliver the bills in its reverse order. The temporary cabinet 116 of this embodiment adopts a mechanism of holding the bills by means of a belt wound on the circumference of a rotary drum.

[0046] The control unit 118 is constructed as a micro-computer including a CPU and memories and controls the operations of the respective constituents in the cash handling system 101 including the cash circulation cartridges and the reject cartridge (described later) accord-

ing to preset programs. The control unit 118 transmits information to and from the main controller 105 provided in the automatic teller machine 100.

[0047] The vault 120 is covered with a thick metal plate and is designed to be tough and rigid for safety. The vault 120 has three cash circulation cartridges 130a, 130b, and 130c configured to collect and accumulate normal bills suitable for circulation (hereafter referred to as circulation bills), that is, bills usable for subsequent withdrawal transactions, and one reject cartridge 140 configured to collect and accumulate bills unsuitable for circulation and subsequent financial transactions, for example, significantly damaged bills and counterfeit bills (hereafter referred to as rejected bills).

[0048] In the structure of this embodiment, the cash circulation cartridge 130a, the cash circulation cartridge 143b, and the cash circulation cartridge 130c are respectively allocated to accumulate and store 10000 yen bills, 5000 yen bills, and 1000 yen bills. The cash handling system 101 may further have an additional cash circulation cartridge for accumulation and storage of 2000 yen bills. The respective cash circulation cartridges provided in the cash handling system 101 may be allocated to accumulate and store bills of another currency, for example, US dollar bills or UK pound bills, instead of the Japanese currency.

[0049] The reject cartridge 140 is designed to simultaneously collect and accumulate multiple different types of rejected bills in different sizes, that is, rejected bills of different denominations. In the structure of this embodiment, the cash handling system 101 includes only one reject cartridge 140. This is, however, not restrictive, but the cash handling system 101 may include multiple reject cartridges 140 for accumulation and storage of a greater mass of rejected bills. The cash circulation cartridges 130a, 130b, and 130c and the reject cartridge 140 are examples of the paper sheet storing apparatus of the invention.

[0050] C. Cash Circulation Cartridge The three cash circulation cartridges 130a, 130b, and 130c are used for storage and delivery of different denominations of circulation bills but have identical structures and operations. The description accordingly regards only the structure and the operations of the cash circulation cartridge 130a. As mentioned previously, the cash circulation cartridge 130a is used to store and accumulate 10000 yen bills in this embodiment. In the following description, however, banknotes accumulated in and withdrawn from the cash circulation cartridge 130a are simply referred to as bills 10.

[0051] C1. Structure of Cash Circulation Cartridge Fig. 3 is a side sectional view showing the schematic structure of the cash circulation cartridge 130a. As illustrated, the cash circulation cartridge 130a includes a pair of conveyor guides 131g1 and 131g2, a pair of conveyor rollers 131r1 and 131r2 provided corresponding to the conveyor guides 131g1 and 131g2, feed rollers 132, pinch rollers 133, gate rollers 134, a pickup roller 135, a hitting mem-

ber 136, a stack guide 139, and a storage cartridge 137 for accumulating and storing the bills 10.

[0052] The storage cartridge 137 has a vertically movable plate 137b as a bottom plate for accumulation of the bills 10 thereon. The vertically movable plate 137b is lifted up and down in a vertical direction by means of a lift mechanism. As the lift mechanism, the cash circulation cartridge 130a has a drive belt 138b, drive rollers 138a1 and 138a2, rollers 138r1 and 138r2, and drive motors (not shown) for actuating the drive rollers 138a1 and 138a2.

[0053] The conveyor guides 131g1 and 131g2 constitute a conveyance pathway to receive and accumulate the bills 10 into the storage cartridge 137 and to take out and deliver the bills 10 from the storage cartridge 137. The conveyor rollers 131r1 and 131r2 are arranged to hold the bills 10 and are rotatable by a motor (not shown). There is one pair of conveyor rollers in the structure of this embodiment, but there may be multiple pair of conveyor rollers provided in the cash circulation cartridge. The feed rollers 132, the gate rollers 134, and the pickup roller 135 are also rotatable by motors (not shown). The pinch rollers 133 are in contact with the feed rollers 132 to be rotatable with rotation of the feed rollers 132. As explained later, the respective motors are driven to receive and accumulate the bills 10 into the storage cartridge 137 and to take out and deliver the bills 10 from the storage cartridge 137. The conveyor guides 131g1 and 131g2, the conveyor rollers 131r1 and 131r2, the feed rollers 132, the pinch rollers 133, and the gate rollers 134 correspond to the feed-in mechanism of the invention. The conveyor guides 131g1 and 131g2, the conveyor rollers 131r1 and 131r2, the feed rollers 132, the pinch rollers 133, the gate rollers 134, and the pickup roller 135 correspond to the feed-out mechanism of the invention.

[0054] The hitting member 136 is provided to hit the bill 10, which is fed into the storage cartridge 137 by the feed-in mechanism (explained above), and thereby drop the bill 10 down in the storage cartridge 137. The hitting member 136 is arranged to be swung in the vertical direction about a pivot shaft located above the storage cartridge 137. As illustrated, in the structure of this embodiment, a rotating shaft 132a of the feed rollers 132 works as the pivot shaft of the hitting member 136. This is, however, not restrictive and the pivot shaft of the hitting member 136 may be provided separately from the rotating shaft 132a of the feed rollers 132. The hitting member 136 is supported by a spring 136s. The spring 136s sets a free end of the hitting member 136 at a preset height (lowermost position) when the hitting member 136 does not come into contact with the bill 10 fed into the storage cartridge 137 by the feed-in mechanism. The spring 136s also sets an angle of the hitting member 136 and the bill 10 to an acute angle when the hitting member 136 comes into contact with the bill 10 fed into the storage cartridge 137 by the feed-in mechanism. This acute angle is preferably a smallest possible angle to reduce the force ap-

plied to the bill 10 fed by the feed-in mechanism and brought into contact with the hitting member 136. This prevents the bill 10 from being folded or damaged by collision with the hitting member 136. Weight reduction of the hitting member 136 is preferable to decrease the inertial force. The hitting member 136 may be lifted up by means of an actuator (not shown) as explained later.

[0055] The stack guide 139 is provided to come into contact with the bill 10, which is fed into the storage cartridge 137 by the feed-in mechanism, and guide the bill 10 downward in the storage cartridge 137. The stack guide 139 is arranged to be swung in the vertical direction about a pivot shaft located above the storage cartridge 137. As illustrated, in the structure of this embodiment, the rotating shaft 132a of the feed rollers 132 works as the pivot shaft of the stack guide 139, in addition to as the pivot shaft of the hitting member 136. This is, however, not restrictive and the pivot shaft of the stack guide 139 may be provided separately from the rotating shaft 132a of the feed rollers 132. The stack guide 139 may be lifted up by means of an actuator (not shown). The stack guide 139 is a rod-like member in this embodiment, but may alternatively be a plate-like member. The number of the stack guides 139 may be set arbitrarily according to the requirements.

[0056] Fig. 4 is a perspective view showing the schematic structure of the hitting member 136 provided in the cash circulation cartridge 130a. For the better understanding, only the storage cartridge 137, the feed rollers 132 and their rotating shaft 132a, and the hitting member 136 are illustrated, and all the other constituents are omitted from the illustration.

[0057] The conveying direction of the bills 10 is the widthwise direction of the bills 10 as mentioned previously. The hitting member 136 has a width L set to be longer than the length of the bills 10 in a longitudinal direction. This arrangement effectively hits the whole length of the bill 10 in the longitudinal direction to drop down the bill 10 in the storage cartridge 137, even when the fed bill 10 has a fold or a curl and when the fed bill 10 is slightly inclined in the lateral direction relative to the conveying direction into the storage cartridge 137.

[0058] In the illustrated example, the two feed rollers 132 are located on the center of the hitting member 136. This is, however, not restrictive. The number and the positions of the feed rollers 132 may be set arbitrarily to enable stable conveyance of the bills 10.

[0059] C2. Operations of Cash Circulation Cartridge The cash circulation cartridge 130a is controlled by the control unit 118 provided in the cash handling system 101 as mentioned above. The description sequentially regards operations of the cash circulation cartridge 130a in accumulation of the bills 10 into the storage cartridge 137 and operations of the cash circulation cartridge 130a in withdrawal of the bills 10 out of the storage cartridge 137.

[0060] C2.1. Operations in Bill Accumulation Figs. 5 and 6 are explanatory views showing operations of the

cash circulation cartridge 130a in accumulation of the bills 10.

[0061] As shown in Fig. 5(a), each of the bills 10 inserted via a bill slot at an upper end of the conveyor guides 131g1 and 131g2 is successively held between the conveyor rollers 131r1 and 131r2, between the feed roller 132 and the pinch roller 133, and between the feed roller 132 and the gate roller 134 and is conveyed with rotations of these rollers in the directions shown by the arrows.

[0062] As shown in Fig. 5(b), when the front end of the bill 10 comes into contact with the hitting member 136, the hitting member 136 is lifted up by the rigidity of the bill 10 and the conveying force applied to the hitting member 136. In this state, the spring 136s is contracted. This state of the hitting member 136 corresponds to the first state of the invention.

[0063] The bill 10 is further conveyed by the feed-in mechanism while lifting up the hitting member 136. As shown in Fig. 6(a), the bill 10 then comes into contact with a lower face of the stack guide 139 and is guided along the lower face of the stack guide 139 downward in the storage cartridge 137.

[0064] When the rear end of the bill 10 enters the storage cartridge 137, the bill 10 is hit by the dead weight of the hitting member 136 and the reactive force of the spring 136s and is dropped down in the storage cartridge 137 as shown in Fig. 6(b). This state of the hitting member 136 corresponds to the second state of the invention. The bill 10 hit by the hitting member 136 is then accumulated in the storage cartridge 137.

[0065] In the illustrated example, there is still a sufficient space for accumulation of the bills 10 in the storage cartridge 137. The newly and subsequently conveyed bill 10 accordingly does not collide with the existing bill 10 conveyed and accumulated in advance in the storage cartridge 137. Even when there is a relatively narrow space remaining for accumulation of the bills 10 or when the existing bills 10 conveyed and accumulated in the storage cartridge 137 have some folds or curls, the hitting member 136 presses down the existing bills 10. This arrangement thus effectively prevents the newly and subsequently conveyed bills 10 from colliding with the existing bills 10 conveyed and accumulated in advance in the storage cartridge 137.

[0066] C2.2. Operations in Bill Withdrawal Fig. 7 is an explanatory view showing operations of the cash circulation cartridge 130a in withdrawal of the bills 10.

[0067] As illustrated, in withdrawal of the bills 10 out of the storage cartridge 137, the hitting member 136 and the stack guide 139 are respectively lifted up by the actuators (not shown) above the lowest ends of the feed rollers 132 and above the lowest end of the pickup roller 135. The vertically movable plate 137b of the storage cartridge 137 is lifted up by the lift mechanism until the topmost bill 10 accumulated on the top of the storage cartridge 137 is brought into contact with the pickup roller 135 with a predetermined load. The load at the contact

of the pickup roller 135 with the topmost bill 10 accumulated on the top of the storage cartridge 137 may be detected, for example, by a load sensor located on a rotating shaft of the pickup roller 135.

[0068] The pickup roller 135 is rotated in the direction of the arrow, while the feed rollers 132 and the conveyor rollers 131r1 and 131r2 are rotated in the directions of the arrows. Each of the bills 10 is accordingly taken out via the bill slot at the upper end of the conveyor guides 131g1 and 131g2.

[0069] After the withdrawal of the topmost bill 10 accumulated on the top of the storage cartridge 137, there is a smaller contact load between the pickup roller 135 and a second topmost bill 10 to be taken out next. With the decrease in contact load, the vertically movable plate 137b of the storage cartridge 137 is sequentially lifted up by the lift mechanism.

[0070] D. Reject Cartridge The structure and the operations of the reject cartridge 140 are basically similar to the structure of the cash circulation cartridge 130a and the operations of the cash circulation cartridge 130a in accumulation of the bills 10 described above. The reject cartridge 140 of this embodiment is not designed to enable withdrawal of the rejected bills accumulated in a storage cartridge. The reject cartridge 140 accordingly does not have constituents corresponding to the pickup roller 135, the vertically movable plate 137b, and the lift mechanism (the drive belt 138b, the drive rollers 138a1 and 138a2, the rollers 138r1 and 138r2, and the drive motors for actuating the drive rollers 138a1 and 138a2) of the vertically movable plate 137b provided in the cash circulation cartridge 130a. The reject cartridge 130 may alternatively be designed to have the identical structure with the structure of the cash circulation cartridge 130a.

[0071] In the cash circulation cartridge 130a of the embodiment described above, the hitting member 136 is located above the space for accumulation of the bills 10 in the storage cartridge 137. When the bill 10 is fed into the storage cartridge 137 by the feed-in mechanism, the hitting member 136 allows entrance of the fed bill 10 into the space for bill accumulation (first state). When the rear end of the fed bill 10 in the conveying direction enters the space for bill accumulation in the storage cartridge 137, the hitting member 136 hits the rear end of the bill 10 and thereby drops down the bill 10 in the storage cartridge 137 (second state). The hitting member 136 is designed to be in contact with the whole length of the fed bill 10 in the longitudinal direction while hitting the bill 10 to be dropped down in the storage cartridge 137. The structure of the hitting member 137 enables the bill 10 fed into the storage cartridge 137 to be adequately hit and dropped down in the storage cartridge 137, even when the fed bill 10 has a fold or a curl and when the fed bill 10 is slightly inclined in the lateral direction relative to the conveying direction. This arrangement effectively reduces the potential for paper jams of the bills 10 and relevant troubles and ensures stable accumulation of the bills 10 in the storage cartridge 137.

[0072] E. Other Aspects The embodiment discussed above is to be considered in all aspects as illustrative and not restrictive. There may be many modifications, changes, and alterations without departing from the scope or spirit of the main characteristics of the present invention. Some examples of possible modification are given below.

[0073] E1. Modified Example 1 In the above embodiment, the cash circulation cartridge 130a has one hitting member 136. This is, however, neither restrictive nor essential. The hitting member is generally required to be in contact with left and right ends of the bill 10 (both ends of the bill 10 in the longitudinal direction perpendicular to the conveying direction) and at least part of a middle area of the bill 10 between the left and the right ends in the process of hitting the rear end of the bill 10 and dropping down the bill 10 in the storage cartridge 137.

[0074] Fig. 8 is a perspective view showing the schematic structure of another hitting member 136A in Modified Example 1. This illustration corresponds to the perspective view of Fig. 4. As illustrated, the hitting member 136A has three hitting elements 136Aa, 136Ab, and 136Ac, which are independently movable. The width of the hitting member 136A, that is the distance between an outside edge of the hitting element 136Aa and an outside edge of the hitting element 136Ac, is equal to the width L of the hitting member 136 in the cash circulation cartridge 130a of the embodiment.

[0075] Like the hitting member 136 of the embodiment, the arrangement of the hitting member 136A of this modified example effectively reduces the potential for paper jams of the bills 10 and relevant troubles and ensures stable accumulation of the bills 10 in the storage cartridge 137. The hitting member 136A has the three hitting elements 136Aa, 136Ab, and 136Ac in this modified example. This number is, however, not restrictive, but the hitting member may have a greater number of hitting elements.

[0076] E2. Modified Example 2 Fig. 9 is a perspective view showing the schematic structure of still another hitting member 136B in Modified Example 2. This illustration corresponds to the perspective view of Fig. 4. As illustrated, the hitting member 136B has a guide element 136Bg arranged to come into contact with the front end of the bill 10 fed by the feed-in mechanism and to guide the bill 10 down in the storage cartridge 137 and a pressure element 136Bp arranged to press down the surface of the topmost bill 10 located on the top of the bills 10 accumulated in the storage cartridge 137. The width of the hitting member 136B is equal to the width L of the hitting member 136 in the cash circulation cartridge 130a of the embodiment.

[0077] Like the hitting member 136 of the embodiment, the arrangement of the hitting member 136B of this modified example effectively reduces the potential for paper jams of the bills 10 and relevant troubles and ensures stable accumulation of the bills 10 in the storage cartridge 137. The pressure element 136Bp of the hitting member

136B presses down the existing bills 10 conveyed and accumulated in advance in the storage cartridge 137. This arrangement thus effectively prevents the bills 10 newly and subsequently conveyed into the storage cartridge 137 from colliding with the existing bills 10 conveyed and accumulated in advance in the storage cartridge 137.

[0078] E3. Modified Example 3 Fig. 10 is a side sectional view showing the schematic structure of another hitting member 136C in the cash circulation cartridge 130a in Modified Example 3. As illustrated, the hitting member 136C has an upward bent element 136Cb arranged to locate its free end above the lower face of the stack guide 139. The width of the hitting member 136C is equal to the width L of the hitting member 136 in the cash circulation cartridge 130c of the embodiment, although not being specifically illustrated.

[0079] Like the hitting member 136 of the embodiment, the arrangement of the hitting member 136C of this modified example effectively reduces the potential for paper jams of the bills 10 and relevant troubles and ensures stable accumulation of the bills 10 in the storage cartridge 137. The upward bent element 136Cb of the hitting member 136 prevents the bill 10 from being stuck between the hitting member 136C and the stack guide 139.

[0080] E4. Modified Example 4

In the cash circulation cartridge 130a of the embodiment, the hitting member 136 is moved up and down by the conveying force of the bill 10 applied to the hitting member 136 and by the dead weight of the hitting member 136.

[0081] Fig. 11 shows the schematic structure of a cash circulation cartridge 130Aa in one modified example. The structure of the cash circulation cartridge 130Aa is similar to the structure of the cash circulation cartridge 130a of the embodiment. The cash circulation cartridge 130Aa of this modified example has an actuator 136ac driven to swing the hitting member 136 up and down and passage sensors 131s1 and 131s2 provided on the conveyance pathway (the conveyor guides 131g1 and 131g2) to detect passage of the bill 10, instead of the spring 136s. The control unit 118 controls the actuator 136ac according to the outputs of the passage sensors 131s1 and 131s2 to swing the hitting member 136 at preset timings. The actuator 136ac may be driven electromagnetic means or by rotation of a motor. An optical sensor including a light emitting element and a light receiving element is a typical example of the passage sensors 131s1 and 131s2.

[0082] Like the cash circulation cartridge 130a of the embodiment, the arrangement of the cash circulation cartridge 130Aa of the modified example effectively reduces the potential for paper jams of the bills 10 and relevant troubles and ensures stable accumulation of the bills 10 in the storage cartridge 137.

[0083] E5. Modified Example 5

The cash circulation cartridge 130a of the embodiment has the stack guide 139. The stack guide 139 may, however, be omitted when not required.

[0084] E6. Modified Example 6 In the cash circulation cartridge 130a of the embodiment, the spring 136s supports the hitting member 136 and determines the height or the lowermost position of the hitting member 136 when the hitting member 136 does not come into contact with the bill 10 fed into the storage cartridge 137 by the feed-in mechanism. This structure is, however, neither restrictive nor essential. One modified structure may use a stopper to determine the height or the lowermost position of the hitting member 136, instead of the spring 136s.

[0085] E7. Modified Example 7 In the cash circulation cartridge 130a of the embodiment, the hitting member 136 is arranged to be swung about the rotating shaft 132a as the pivot shaft. This structure is, however, neither restrictive nor essential. In one modified example, a hitting member may be provided at a predetermined location above the space for accumulation of the bills 10 in the storage cartridge 137 and moved up and down in the vertical axis by an actuator to guide the bill 10 into the space for bill accumulation and hit the bill 10 to be dropped down in the storage cartridge 137.

[0086] E8. Modified Example 8

The above embodiment regards the paper sheet storing apparatus of the invention applied to the cash circulation cartridges 130a, 130b, and 130c or to the reject cartridge 140 to accumulate the circulation bills or the rejected bills therein. The paper sheet storing apparatus of the invention is, however, not restricted to this application but is also applicable to accumulate diversity of other paper sheets, for example, forms and slips.

Claims

1. A paper sheet storing apparatus configured to collect and accumulate paper sheets, the paper sheet storing apparatus comprising:

a paper sheet cartridge arranged to accumulate and keep the paper sheets therein;
 a feed-in mechanism configured to convey each of the paper sheets to the paper sheet cartridge in a perpendicular direction to an accumulating direction of the paper sheets in the paper sheet cartridge; and
 a hitting member provided above a paper sheet accumulation space for accumulation of the paper sheets in the paper sheet cartridge and configured to be set in a first state of allowing entrance of each conveyed paper sheet into the paper sheet accumulation space when the paper sheet is conveyed to the paper sheet cartridge by the feed-in mechanism and to be changed from the first state to a second state of hitting the conveyed paper sheet and thereby dropping the conveyed paper sheet down in the paper sheet cartridge when a rear end of the conveyed paper sheet enters the paper sheet

accumulation space,

wherein the hitting member is arranged to be in contact with left and right ends of each conveyed paper sheet and at least part of a middle area of the paper sheet between the left and the right ends in the course of hitting the paper sheet and dropping the paper sheet down in the paper sheet cartridge.

2. The paper sheet storing apparatus in accordance with claim 1,
 wherein the hitting member is arranged to be in contact with substantially a whole length of each conveyed paper sheet including the left and the right ends in the course of hitting the paper sheet and dropping the paper sheet down in the paper sheet cartridge.

3. The paper sheet storing apparatus in accordance with either one of claims 1 and 2, wherein the hitting member has multiple hitting elements.

4. The paper sheet storing apparatus in accordance with claim 3,
 wherein the multiple hitting elements are movable independently.

5. The paper sheet storing apparatus in accordance with claim 1,
 wherein the hitting member is arranged to be swung in a vertical direction about a preset pivot shaft located above the paper sheet accumulation space.

6. The paper sheet storing apparatus in accordance with claim 5,
 wherein the hitting member comes into contact with a front end of each paper sheet conveyed to the paper sheet cartridge by the feed-in mechanism and is set to the first state by a force of the contact.

7. The paper sheet storing apparatus in accordance with claim 6,
 wherein the hitting member is changed from the first state to the second state by a dead weight of the hitting member to hit the paper sheet and drop the paper sheet down in the paper sheet cartridge.

8. The paper sheet storing apparatus in accordance with claim 5,
 wherein the hitting member has:

a guide element arranged to come into contact with each conveyed paper sheet and guide the conveyed paper sheet downward into the paper sheet accumulation space in the paper sheet cartridge when the paper sheet is conveyed to the paper sheet cartridge by the feed-in mechanism; and

a pressure element arranged to press down surface of a topmost paper sheet located on a top of the paper sheets accumulated in the paper sheet cartridge.

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9. The paper sheet storing apparatus in accordance with claim 1, the paper sheet storing apparatus further having:

an actuator configured to change over a working state of the hitting member between the first state and the second state; and
a drive controller configured to drive and control the actuator.

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10. The paper sheet storing apparatus in accordance with claim 1, the paper sheet storing apparatus further having:

a guide member assembly provided above the paper sheet accumulation space and configured to come into contact with each conveyed paper sheet and guide the conveyed paper sheet downward into the paper sheet accumulation space in the paper sheet cartridge when the paper sheet is conveyed to the paper sheet cartridge by the feed-in mechanism.

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11. The paper sheet storing apparatus in accordance with claim 1,
wherein a vertically movable bottom plate member forms a bottom plate of the paper sheet cartridge, the paper sheet storing apparatus further having:

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a lift mechanism to move up and down the bottom plate member.

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12. The paper sheet storing apparatus in accordance with claim 11, the paper sheet storing apparatus further having:

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a feed-out mechanism configured to take the paper sheets accumulated in the paper sheet cartridge out of the paper sheet cartridge.

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13. A paper sheet handling system equipped with the paper sheet storing apparatus in accordance with claim 1.

14. An automatic teller machine equipped with the paper sheet handling system in accordance with claim 13.

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Fig.1

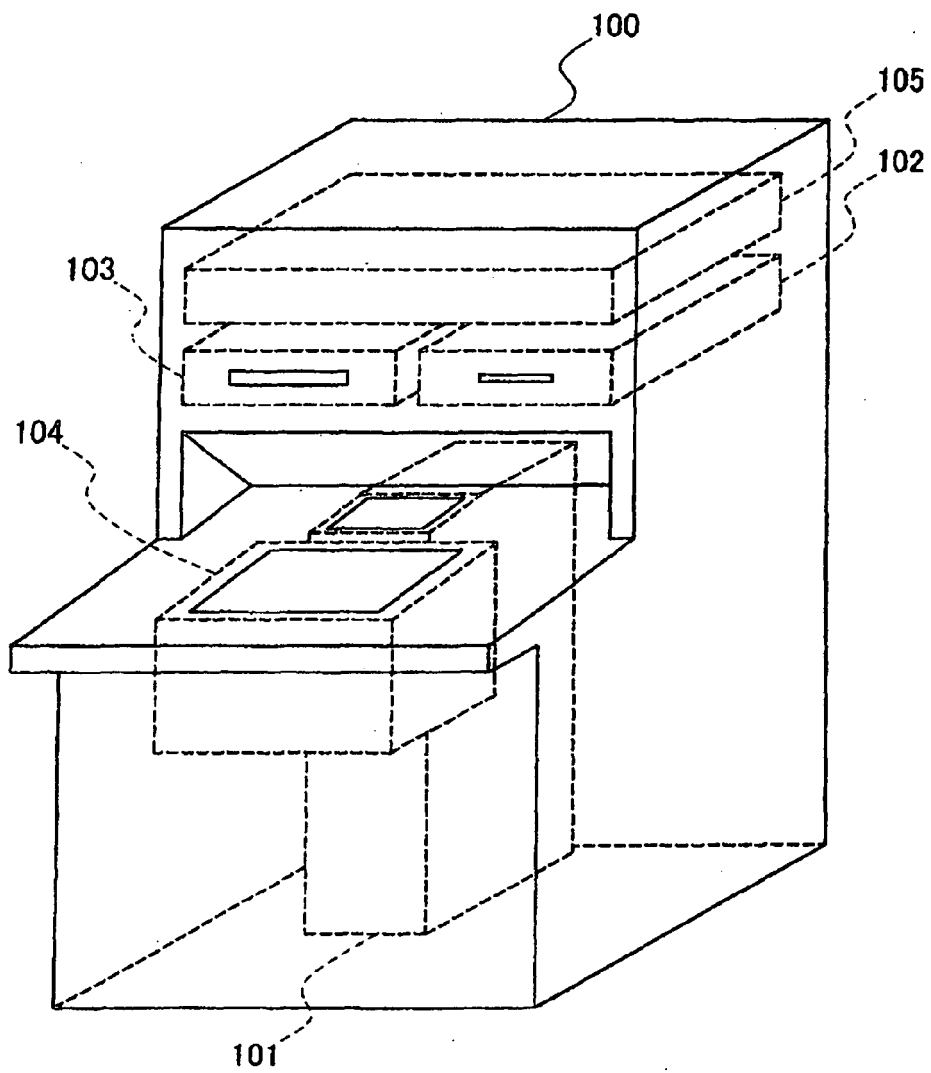


Fig.2

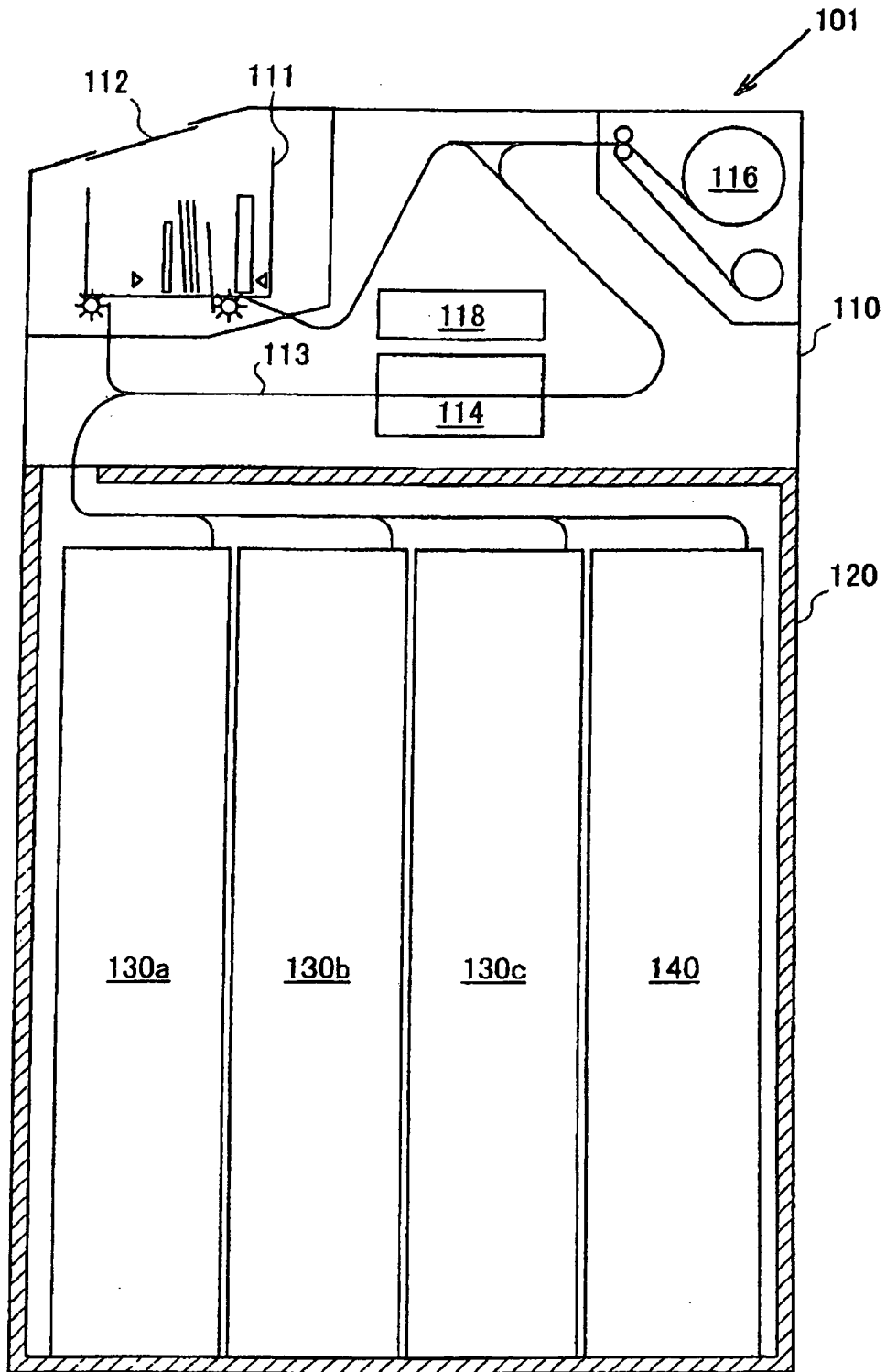


Fig.3

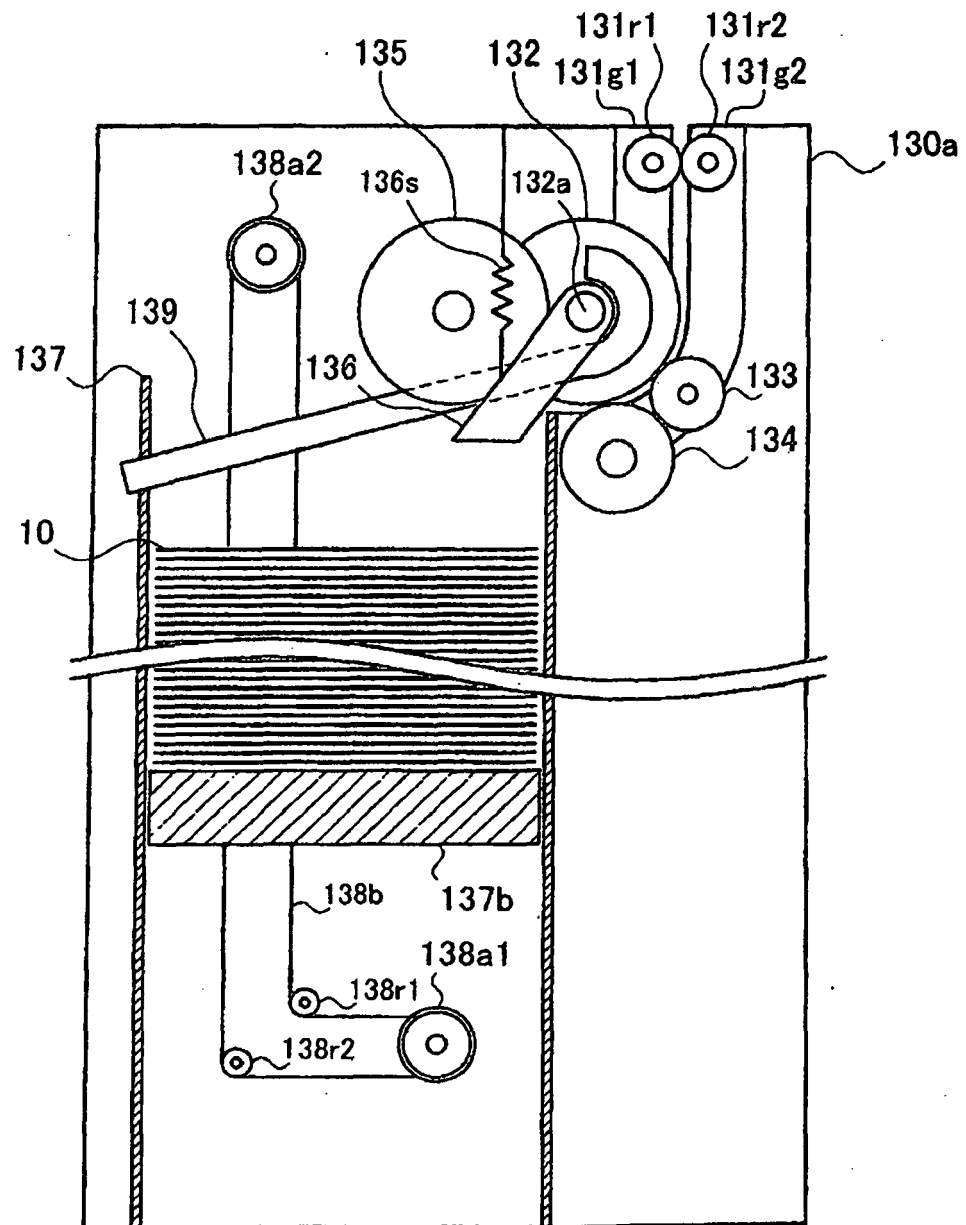


Fig.4

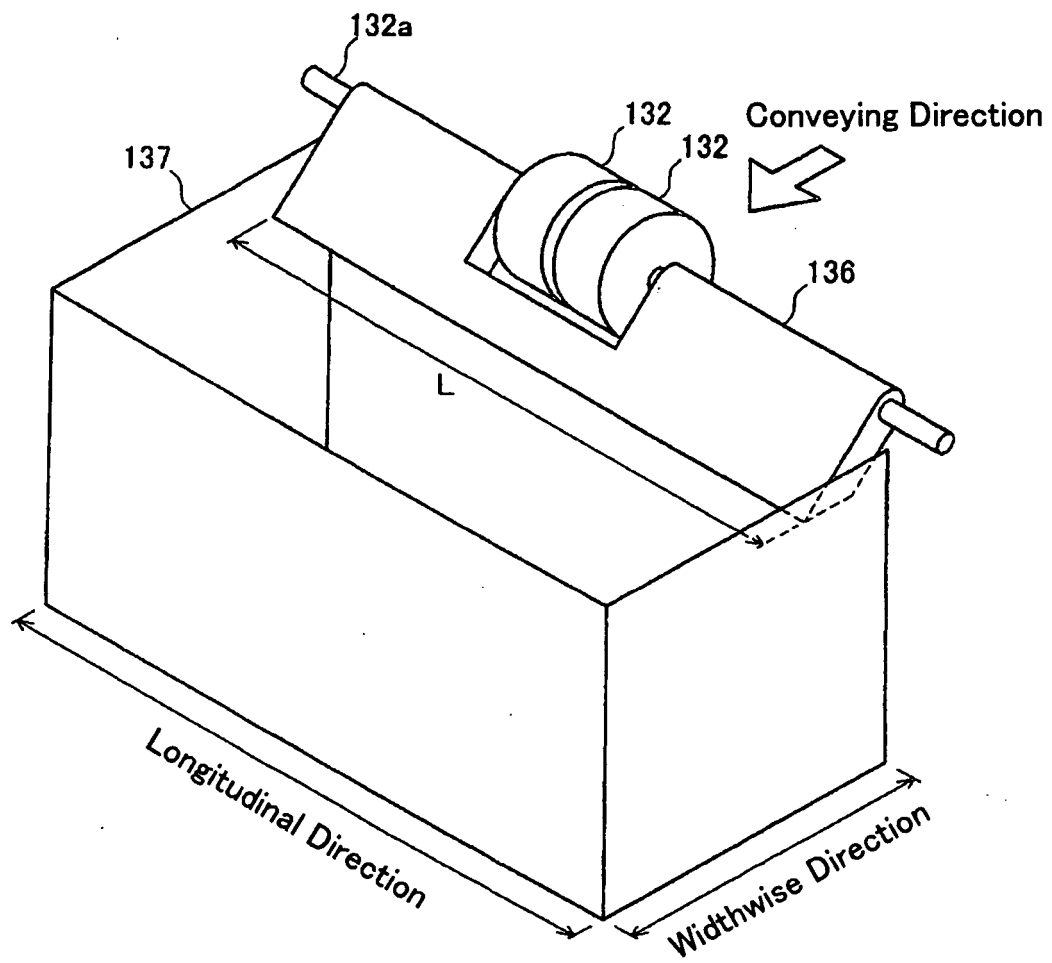


Fig.5(a)

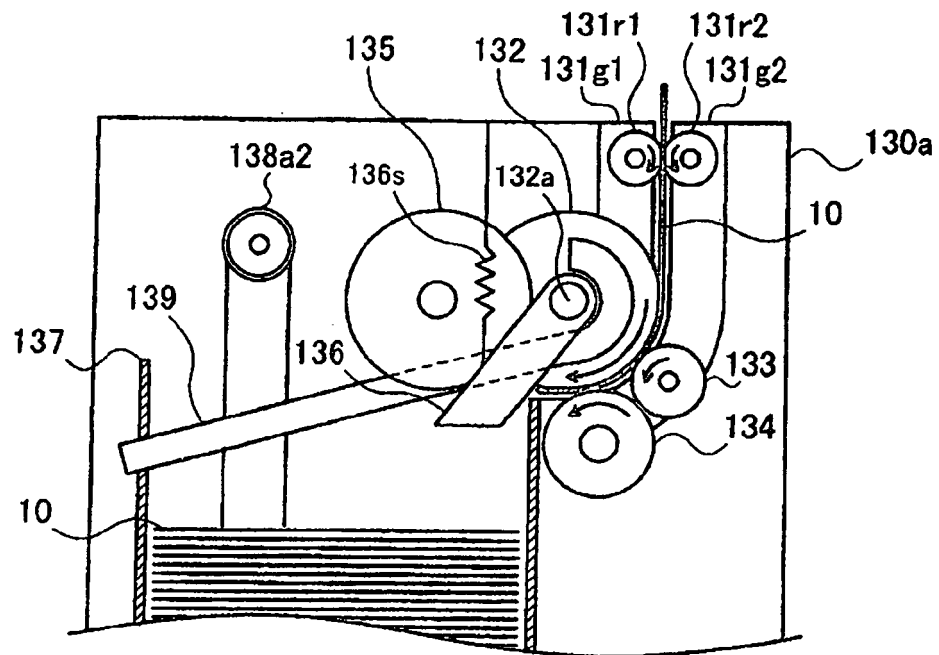


Fig.5(b)

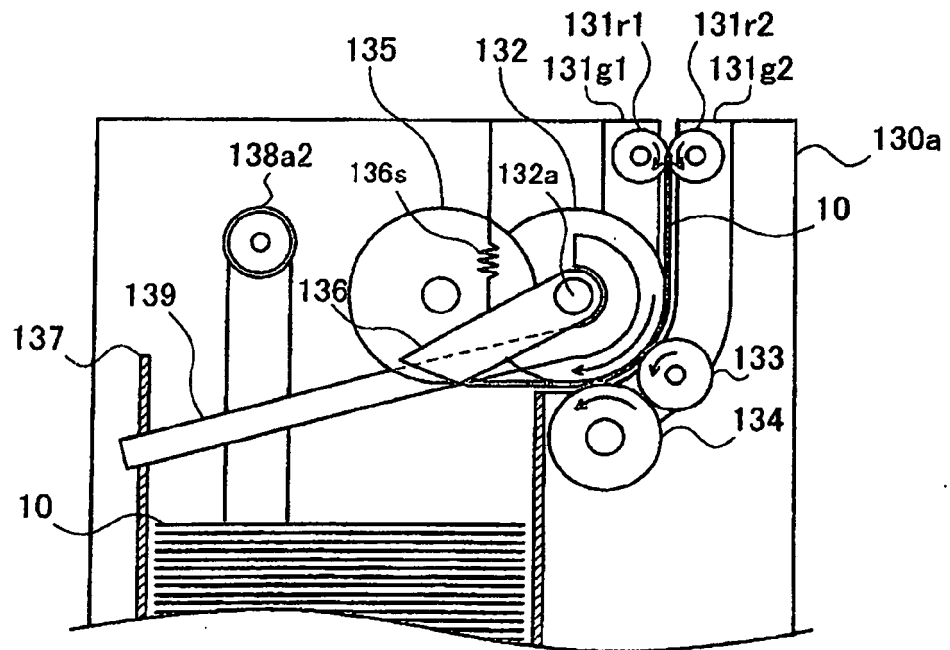


Fig.6(a)

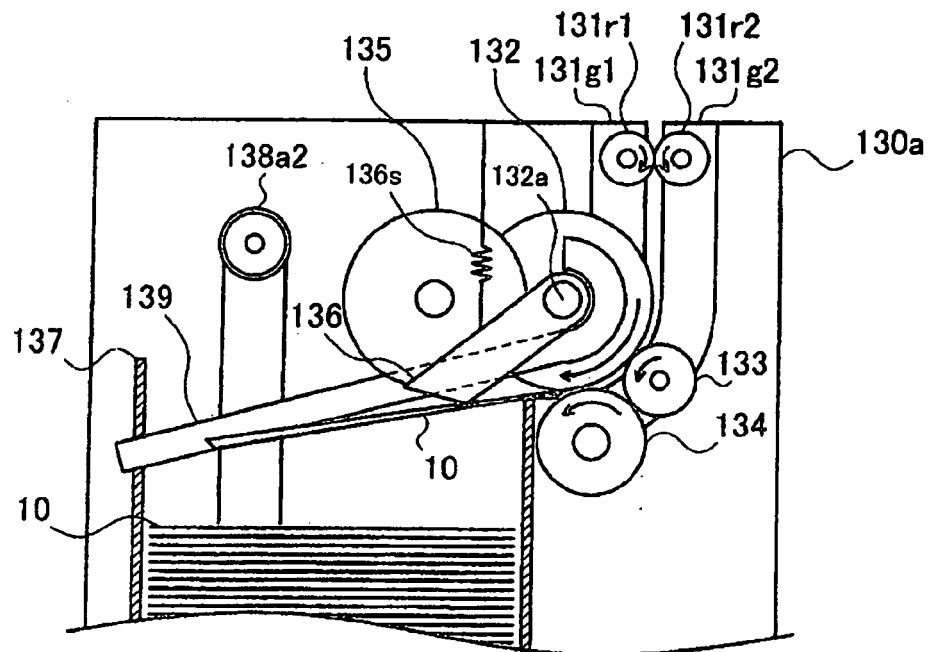


Fig.6(b)

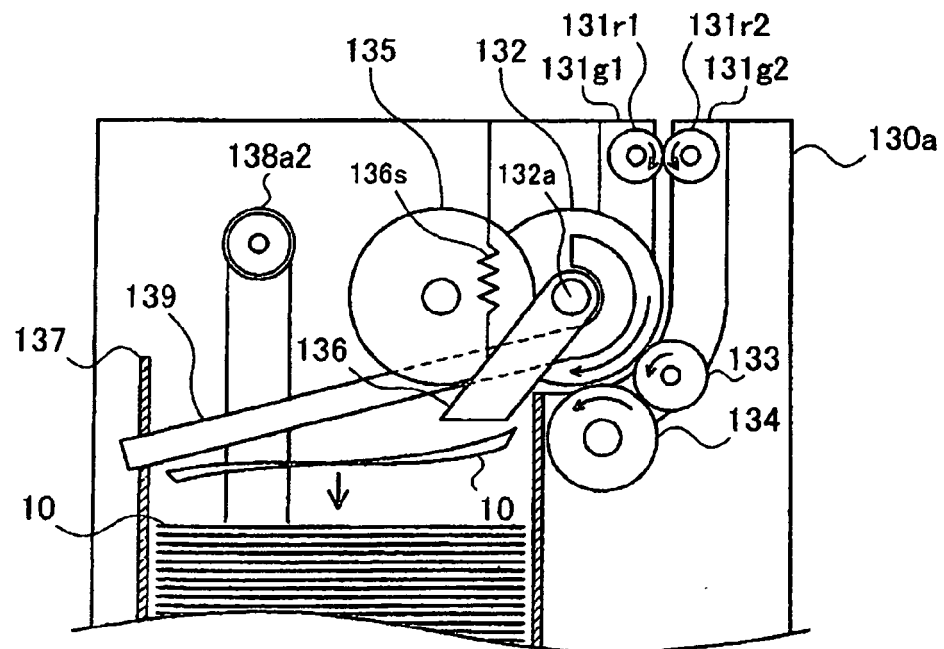


Fig.7

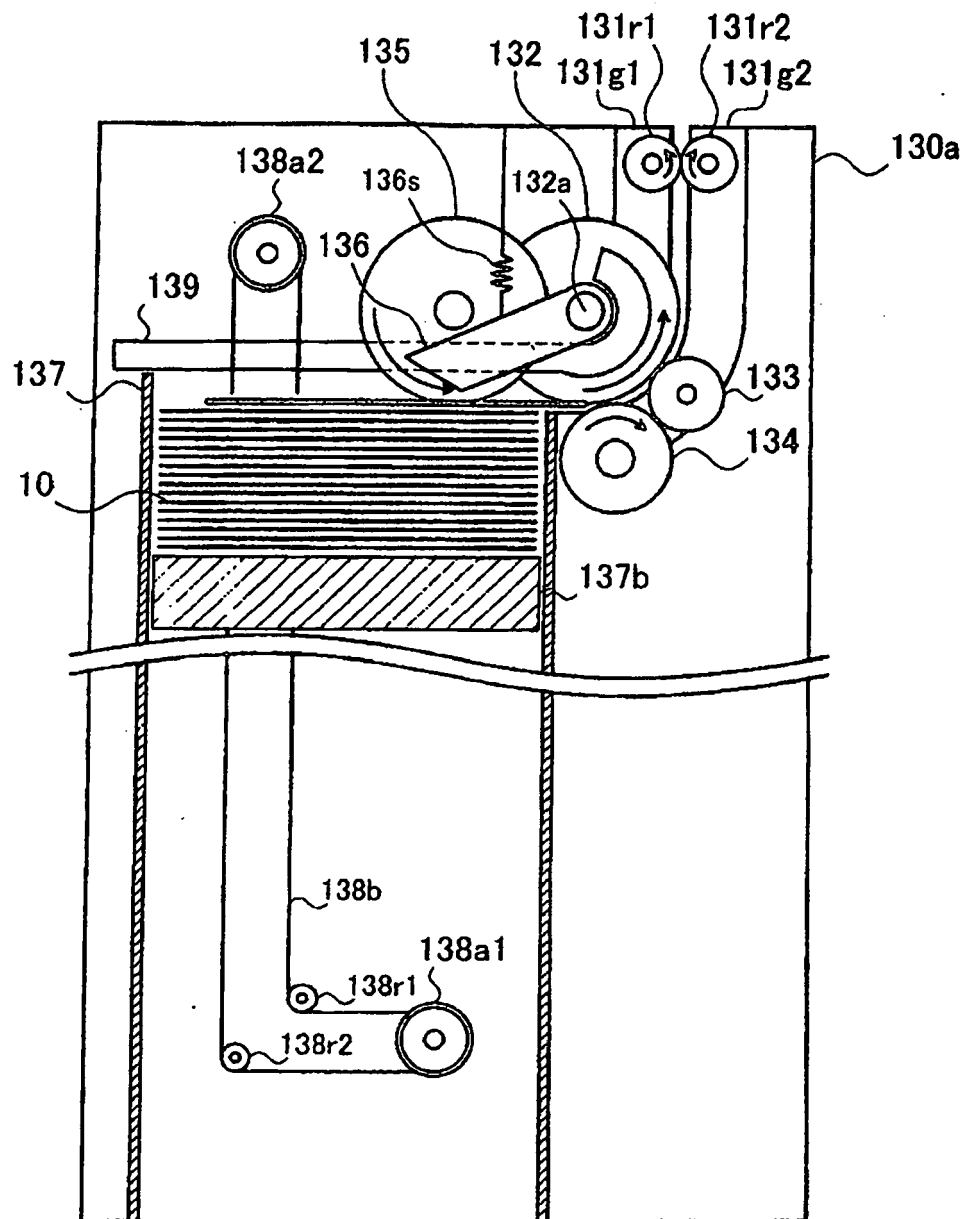


Fig.8

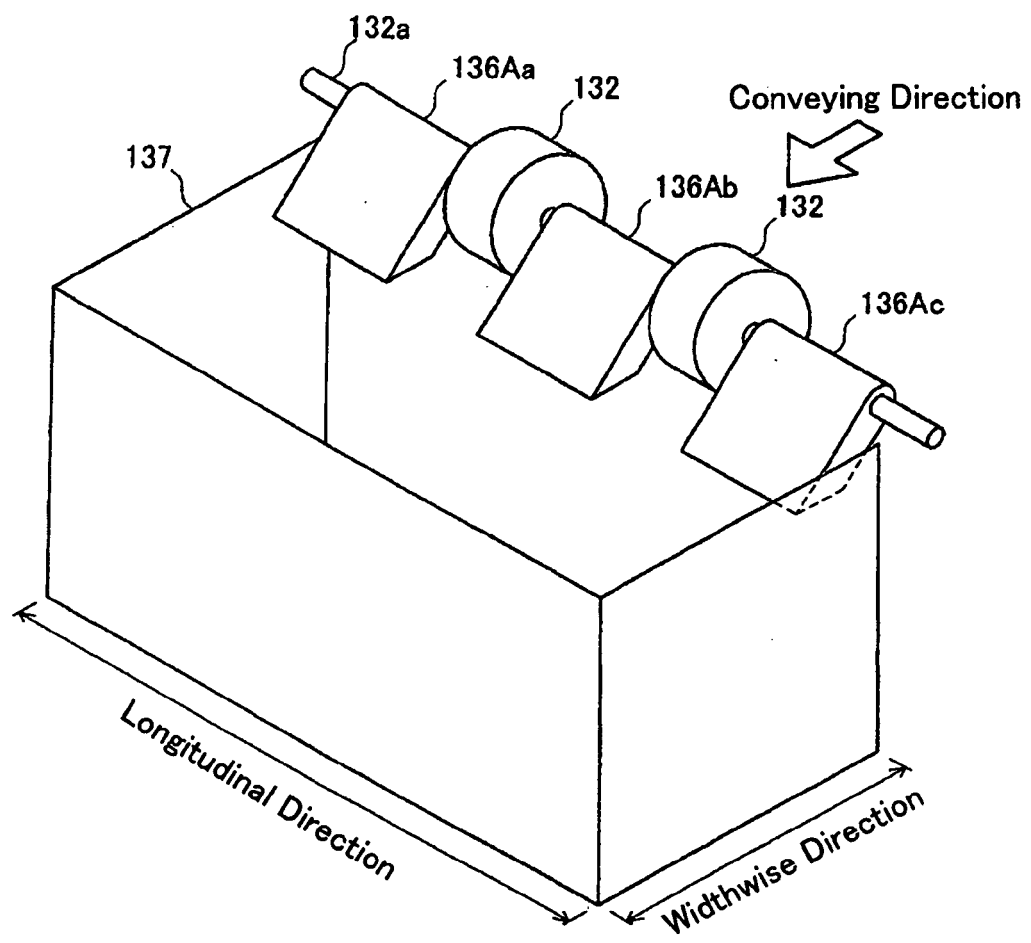


Fig.9

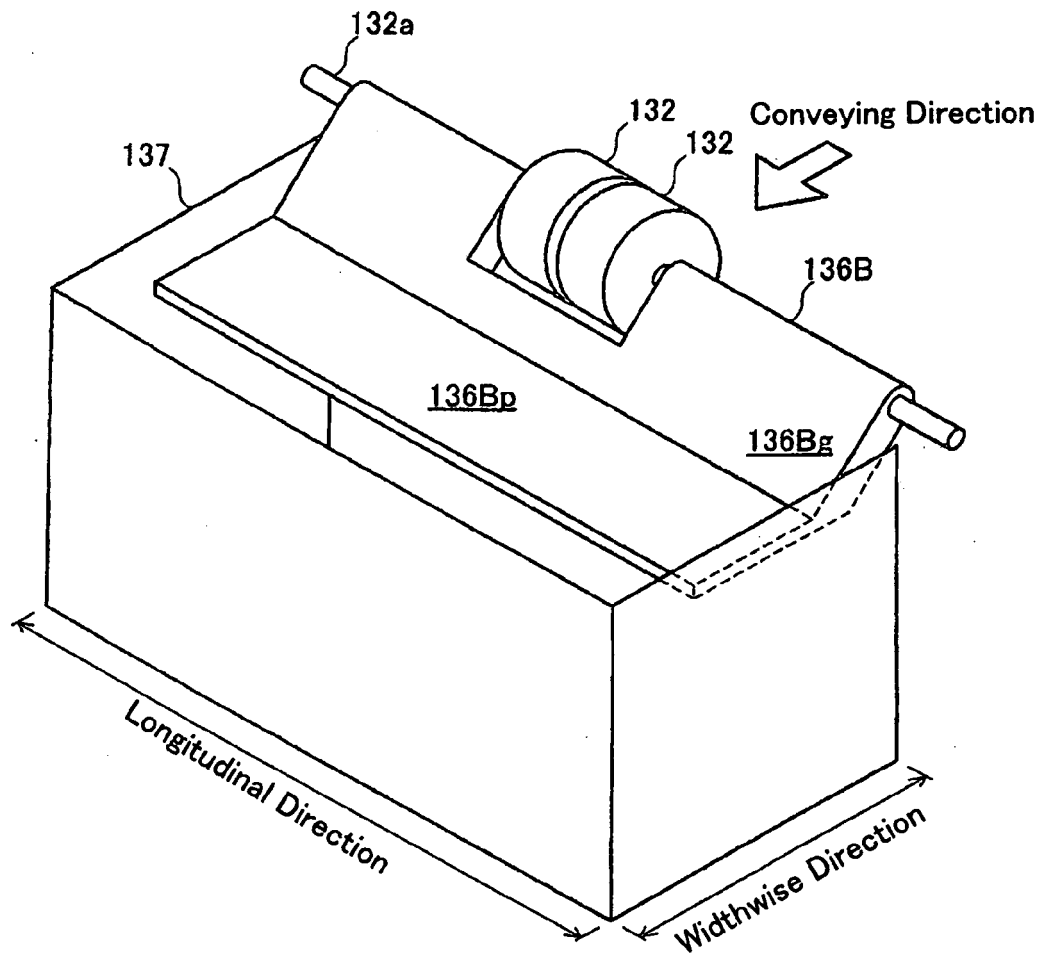


Fig.10

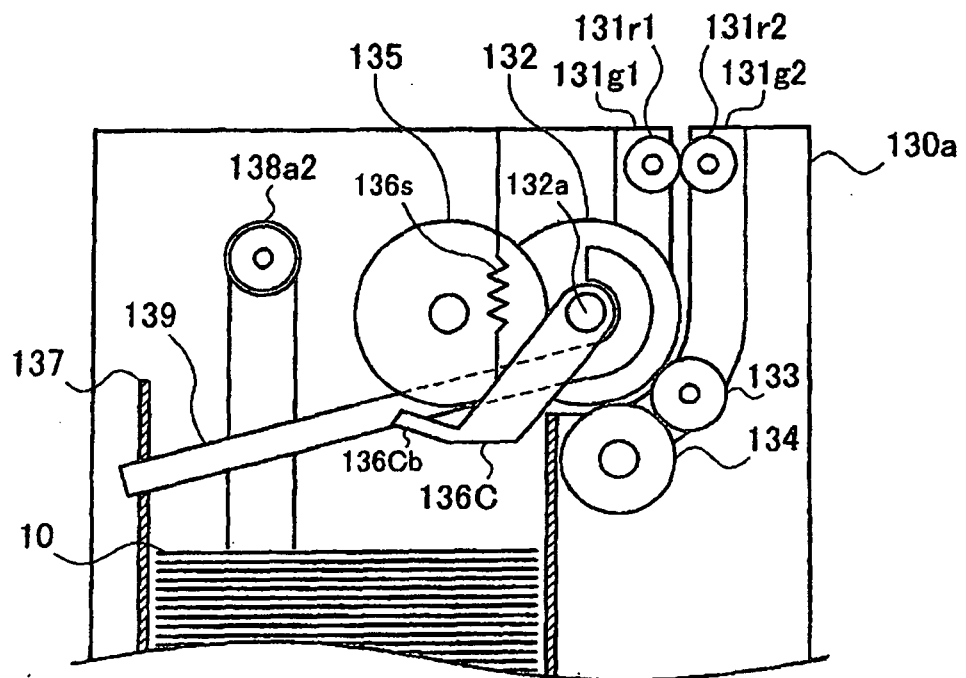
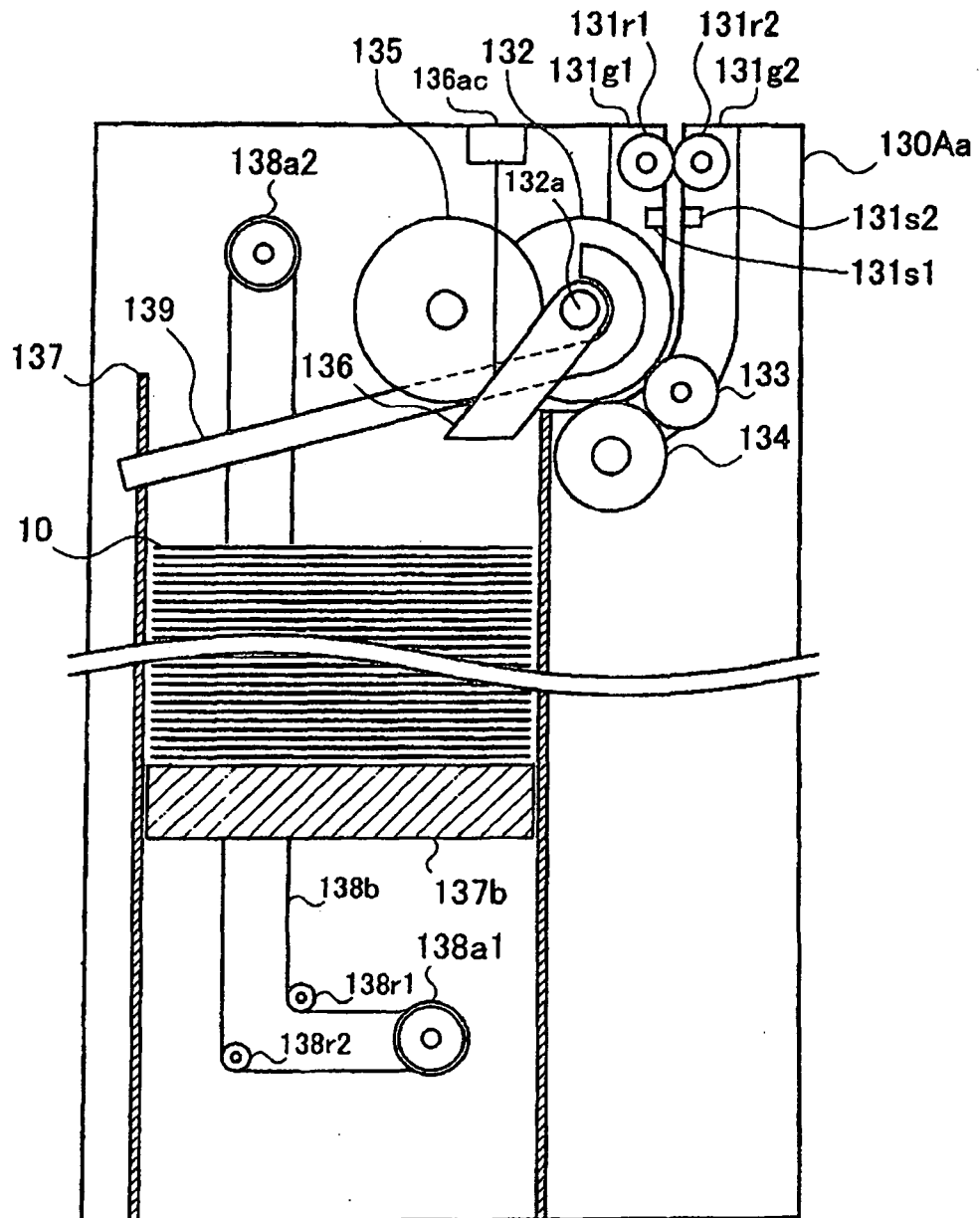


Fig.11



REFERENCES CITED IN THE DESCRIPTION

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