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(54) **Automatic paper currency dispensing machine adapted for easy management of safes.**

(57) An automatic paper currency dispensing machine which dispenses the paper currency (40, 40a) in response to an operator's instruction. A mechanism (44, 45, 42, 43, 48, 109) to discharge the paper currency (40, 40a) stored in the storage (400) is encased in the casing (53, 54) to constitute the safe (31, 419, 702, 825), and the paper currency (40, 40a) is discharged from the opening (58) formed on the casing (53, 54). The paper currency dispensing machine removably encases this casing (53, 54), and is provided with the paper currency pick-up slot (22) formed to communicate with the opening (58). This may be structured to contain more than one such safes (31, 419, 702, 825). In the case of the latter, the safe control (460) is provided within

the casing (53, 54), to control the operations to dispense the paper currency (40, 40a) and to deliver them. This machine is also provided with the main control (434) which controls the safe control (460) in response to the operator's instruction, and those two controls are interconnected with detachable connector (426, 422, 423, 424). A blade (50) and a reject safe (51) may be provided within the safe (31, 419, 702, 825). The safe control (460) directs the blade (50) toward the reject safe (51), to guide the paper currency (40a), which has encountered a delivery error, toward the reject safe (51). With the above arrangement, there is provided an automatic paper currency dispensing machine, the safe of which can be handled in the most appropriate manner.

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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a machine for handling a negotiable instrument, in particular, a negotiable-instrument handling machine such as a paper currency dispensing machine which automatically dispenses negotiable instruments such as paper currency, check or currency, and contains a first storage section for storing the negotiable instrument, discharging means for discharging the negotiable instrument from the first storage section, conveying means for conveying the discharged negotiable instrument, and first casing which encloses the above mentioned storage section, dispensing means, and conveying means, and has a first opening formed through which the negotiable instrument delivered by the above-mentioned conveying means is guided outward.

Description of the Related Art

A paper currency dispensing machine is a machine which is installed in financial institutions such as banks, and automatically dispenses a specified amount of paper currency in response to the operation of a user. In the past, the automatic paper currency dispensing machine was of a type in which multiple safes were contained to accommodate various types of paper currency. Those various types of paper currency were discharged from those safes in response to the signal representing the user's request, and conveyed through a common conveyance passage, to be discharged through a single exit opening. Therefore, this type of machine could dispense more than one types of paper currency.

A display screen is provided on the front panel of the machine casing, and visually displays the key pad functions to be used by an operator, that is the user, to input data such as password and amount; instructions for input operation; and the data to show the machine status or to be used for confirming the inputted data. Also, there is provided within the machine, a voice synthesizing device to output the voice which corresponds to the data displayed on the display screen; a card reader/writer to accept the card associated with the operator's account through the slot, read the data stored in it, and also, write data in it; a printer to print the data pertaining to the operator and its transactions, in the form of a statement and journal; a control system to coordinate with each of the above-mentioned sections and control them; and a power supplying device and the like. The control unit comprises a processing system and is provided with memories to store the common control

information for all safes.

Also, there is an outlet through which the paper currency is discharged, that is, a pick-up opening, on the front panel of the machine casing, and in the normal condition, this opening is blocked by a shutter which can be opened or closed. A retractable stage where the paper currency is deposited is provided directly below the pick-up tray, and a reject safe is provided below this stage. The reject safe is a safe which is removably mounted within this machine casing, and stores the paper currency in abnormal conditions, such as the paper currency which will have encountered the situation in which identification or counting fails.

The above-mentioned type of machine contains removable safes, that is, payment safes, to store the paper currency prepared for the service. Each of such removable safes contains a conveyance passage to convey the paper currency discharged from its storage. In other words, this individual conveyance passage is provided for each of the respective safes. These individual conveyance passages are connected to a single common conveyance passage which communicates with the holding stage near the pick-up tray and delivers the paper currency towards the pick-up tray from the individual conveyance passages. These individual and common conveyance passages are provided with rollers which rotate in contact with the paper currency, or belts which run in contact with the paper currency, and these rollers and belts are driven by a single delivery motor. Also, an exit for the print strip from the printer, which prints the statement, opens toward this holding stage.

A sensor to detect the paper currency while being conveyed is provided along the conveyance passage. In one of the prior art examples, a pair of sensors are provided along a single conveyance passage, wherein one of the sensors is adapted to detect the paper currencies being conveyed in double layers, and the other is adapted to detect the length and the degree of skewing of the paper currency being conveyed; thereby, it is assured that only the paper currency which is correctly delivered in the permissible condition is presented to the operator.

In operation, when the operator wants to withdraw the paper currency from the automatic paper currency dispensing machine, the operator inserts his or her card into the slot, and inputs the password and the desired amount one after another, using the key pad. In response to the above operation, the control unit of the machine computes the denominations and the necessary number of paper currency, and controls the dispensing mechanism to separate the paper currency piece by piece from the corresponding safe and discharge it. The paper currency guided out of the

safe is delivered through the corresponding individual conveyance passage to the common conveyance passage through which it is delivered toward the holding stage. The control unit detects, through the sensor provided along the conveyance passages, whether or not the paper currency is being properly conveyed; thereby, only the paper currency which will have been properly delivered to and deposited on the holding stage is presented to the operator.

After the control unit completes a proper delivery of the specified amount of paper currency to the holding stage, it controls the printer to print the detail of the transaction in a form of a print strip or journal. The print strip is discharged from the printer and is placed on the paper currency deposited on the holding stage. Then, the control unit opens the shutter of the pick-up tray, thereby allowing the operator to take out the paper currency and the statement.

If the control unit detects an anomaly in the conveyance passages, such as skewing, jam, separation failure, multiple layer conveyance, chain conveyance, denomination identification failure, or counting failure, it retracts the stage; thereby retrieving all the pieces of paper currency, which have been deposited on the stage up to that point of time, into the reject safe. Then, it returns the stage to the normal position to retry the paper currency dispensing operation from the beginning. Further, even if a single piece of paper currency or statement strip remains after a predetermined length of time from the opening of the shutter, it also retracts the stage and takes in the remnants into the reject safe.

The above-mentioned type of machine contains removal safes within the machine casing, and each of these safes is specifically designed in measurement and shape to accommodate only the single denomination it handles. For example, the Japanese one-thousand yen note is stored in a safe designed to correspond to its dimensions, and the Japanese ten-thousand yen note is stored in a safe designed to correspond to its dimensions. Since the Japanese one-thousand yen note and ten-thousand yen note are different in measurements, there is no exchangeability between these two safes. This lack of exchangeability constrains the adaptability of the machine to the condition of the environment in which this automatic paper currency dispensing machine is placed. For example, if there is a bias in the number of paper currency in different denominations depending on each of the stores where the machine is installed, or each of specific operating periods of day, the safe dedicated to a certain denomination is left unused because of little demand, lowering the overall efficiency of the machine. In other words,

the paper currency denominations in high demand must be frequently refilled, which leads to a deterioration of customer service.

As is described above, the paper currency discharged from the safe is conveyed through the corresponding individual conveyance passages, and then further delivered through the common conveyance passage toward a single pick-up tray. These individual conveyance passages and the common conveyance passage have rollers which rotate in contact with the paper currency or belts which run in contact with the paper currency, and these rollers or belts are driven by a single source of a driving force, such as conveyer motor. If a problem occurs in this conveyer motor because of some reason or other, or if the paper currency is jammed either in the common or individual passage, the operation of the entire machine stops. Even if the jam occurs in only one of the individual conveyance passages, it results in the entire machine stopping, regardless of the fact that nothing is wrong with the common conveyance passage and the remaining individual conveyance passages of the other safes.

For example, there is provided at the exit of the paper currency storage of the machine, a pick-up roller to take out the paper currency from the storage and a reverse roller to prevent the second or subsequent paper currency from being conveyed when more than one note happens to be simultaneously discharged. The jam tends to occur in this discharging mechanism. The discharging mechanism is mounted within the dispensing mechanism; therefore, a maintenance person must stop the operation of the entire machine to pull out the discharging mechanism, and then take out the jammed paper currency, so as to eliminate the cause of the jam and restore normal operations. Consequently, the customer service deteriorates due to the suspension of the entire operation of the machine, and the maintenance person has to stop the entire operation of the machine in order to carry out the maintenance operation, though the remainder of the safes may be operable.

The control unit has a memory to store control information such as operational histories of the safe and problem statuses. The operational history information includes the transaction counts and their amounts, and the problem information includes the occurrence counts of problems, such as jams. This control information stored in the memory is renewed by additional information each time a new transaction occurs, and then, is submitted as reference for the management of the number of the handled paper currency, maintenance, and inspection, after the end of the service offered by this machine. However, in the prior machine, the control information is stored without any corre-

spondence to each of the safes; therefore, it is impossible to grasp the operational condition for each safe. For example, it is impossible to grasp from this control information, in which one of the safes, more troubles have occurred.

If a jam occurs in one of the conveyance passages, all pieces of the paper currency involved in this process are retrieved into the reject safe. In other words, these pieces of paper currency are taken into the reject safe together with other notes which have been normally delivered during this transaction. Therefore, even if the maintenance person examines the reject safe, it is difficult to identify in which safe the problem has occurred. This also leads to the deterioration of the efficiency in administering the paper currency.

If a person in charge of the machine wishes to administer a detailed examination of the paper currency in the machine, the person takes out the discharging safe and the reject safe from the machine. Since the safes are locked, the person releases the lock, counts the paper currency in the safe, and compares the results with the journal printed by the printer. The prior safe of the removable type is large and heavy, since it contains the paper currency discharging mechanism and the conveyance passage. However, the recent trend shows that the automatic paper currency dispensing machine has come to be installed in a booth which is placed away from the office of a financial institution. It is inconvenient, and also often involves danger, if such a large and heavy safe, along with the journal, must be carried to the business office.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a negotiable-instrument handling machine, the safes of which can be handled in the most appropriate manner.

In accordance with the present invention, there is provided an automatic paper currency dispensing machine which dispenses the paper currency in response to an operator's instruction. A mechanism to discharge the paper currency stored in the storage is encased in the casing which constitutes the safe, and the paper currency is discharged from the opening formed in the casing. The automatic paper currency dispensing machine removably encases this casing, and also, it is provided with the paper currency pick-up slot formed to communicate with the opening. This machine may be structured to contain more than one such a safe. In the case of the latter, a safe control is provided within the casing, to control operations such as dispensing or delivering the paper currency. This machine is also provided with a main

control which controls the safe control in response to the operator's instructions, and those two controls are interconnected with detachable connectors. A blade and a reject safe may be provided within the safe. The safe control directs the blade toward the reject safe, to guide the paper currency which has encountered a delivery error toward the reject safe. With the above-mentioned arrangement, there is provided an automatic paper currency dispensing machine, the safe of which can be handled in the most appropriate and efficient manner.

In accordance with an aspect of the present invention, there is provided a negotiable-instrument handling machine which comprises: a second casing having a plurality of installation slots for storing detachably said first casing, and a plurality of second opening formed corresponding to said plurality of installation slots, said second opening being positioned to communicate with said first opening when said first casing is in the installation slot; a first control circuit provided within said first casing for controlling said discharging means and conveying means; a second control circuit provided within said second casing for controlling said first control circuit; and connecting means comprising a first connector provided on said first casing, and a second connector provided on said second casing for interconnecting said first control circuit to said second control circuit when said first casing is stored in the installation slot.

In accordance with a further aspect of the present invention, there is provided a negotiable-instrument handling machine which comprises: a second casing of a portable size having an installation slot to store removably said first casing, and having a second opening formed to be positioned to communicate with the first opening when said first casing is in the installation slot; operating means provided on said second casing for manually entering instructions and data including a request for dispensing the negotiable instrument; displaying means provided on said second casing for visually displaying the condition of said machine and data; a first control circuit provided within said first casing for controlling said discharging means and conveying means; a second control circuit provided within said second casing for controlling said first control circuit and displaying means, in response to said operating means.

In accordance with a further aspect of the present invention, there is provided a negotiable-instrument handling machine comprises: a first storage for storing the negotiable instrument; first discharging means for discharging the negotiable instrument from said first storage; first conveying means for conveying the discharged negotiable instrument; a second casing for encasing said

storage, discharging means, and conveying means, and having a second opening formed to discharge the negotiable instrument delivered through said conveying means, from said second casing; a third casing capable of being stacked on top of each other within said mechanical discharging means for storing said second casing; second conveying means provided within said third casing for conveying the negotiable instrument discharged from said second opening to a first position directed to the outside of said third casing; third conveying means provided within said third casing for conveying the negotiable instrument, delivered to a second position directed to the outside of said third casing, to the first position; the second position meeting, when said third casings are stacked up on top of each other, with the first position of adjacent one of said third casings; first power transmission means provided within said third casing for receiving, through the third position, the power from outside said third casing, to transmit the power to said second and third conveying means; and second power transmission means provided within said third casing for transmitting the power out of said third conveying means at a fourth position; the fourth position meeting, when said third casings are stacked up on top of each other, with the third position of adjacent one of said third casings, said second power transmission means being mechanically connectable, when said third casings are stacked up on top of each other, with said second power transmission means of adjacent one of said third casings; said mechanical discharging means further comprising: fourth conveying means for conveying the negotiable instrument delivered to the first position to a first opening, and driving means mechanically connectable to said first power transmission means of said third casing positioned at an end, when said third casings are stacked up, for supplying the power to said first power transmission means.

In accordance with a still further aspect of the present invention, there is provided a safe which comprises: detecting means provided within said first casing for detecting whether or not the negotiable instrument is in a proper condition while being conveyed through said conveying means; a second storage provided within said first casing, storing the negotiable instruments; and selecting means provided within said first casing and positioned between said conveying means and said first opening for selectively directing the negotiable instrument delivered through said conveying means to either of the first and second storages; and a control circuit provided within said first casing for controlling said discharging means, conveying means, and selecting means, in response to said detecting means; said control circuit controlling, in

response to said detecting means detecting an improper condition of the negotiable instrument while being conveyed through said conveying means, said selecting means to guide the delivered negotiable instrument to said second storage.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention will become more apparent from the consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective external view of an embodiment of the automatic cash dispensing machine in accordance with the present invention;

FIG. 2 offers a sectional view of the machine at the line II-II indicated in FIG. 1;

FIG. 3 offers a sectional view of the safe at the line II-II indicated in FIG. 1;

FIG. 4 offers an exterior view of the safe of the embodiment shown in FIG. 1;

FIG. 5 shows the open safe in the embodiment;

FIG. 6 is a block diagram showing schematically the functions of the structural example of the control system of the embodiment;

FIG. 7 is a diagram showing an example of key pad which is displayed in the embodiment;

FIGS. 8 and 9 show specific examples of the structure of the paper currency discharging mechanism in the embodiment;

FIGS. 10 through 15 are schematic diagrams prepared to help to understand the operations of the mechanisms shown in FIGS. 8 and 9;

FIG. 16 shows, like to FIG. 8, a specific alternative example of the paper currency discharging mechanism in the embodiment;

FIG. 17 is a block diagram showing partially the control system to control the paper currency discharging mechanism of the embodiment;

FIG. 18 shows an example of the operational flow chart of the control system shown in FIG. 17;

FIGS. 19, 20 and 21 are, like to FIGS. 11 through 15, views which are useful for understanding the operation of the mechanism shown in FIG. 16;

FIG. 22 shows, as does FIG. 8, a further specific alternative of the paper currency discharging mechanism of the embodiment;

FIG. 23 is a block diagram showing partially the control system to control the paper currency discharging mechanism shown in FIG. 22;

FIGS. 24 through 27 show examples of the operational flow charts of the control system shown in FIG. 23;

FIGS. 28 and 29 are views which are useful for understanding the operation of the mechanism shown in FIG. 23;

FIG. 30 shows, as FIG. 8 does, a further specific alternative example of the paper currency discharging mechanism;

FIG. 31 is, as FIG. 17 is, a block diagram showing partially the control system to control the paper currency discharging mechanism shown in FIG. 30;

FIGS. 32 and 33 show examples of the operational flow chart of the control system shown in FIG. 30;

FIGS. 34 to 37 are views which are useful for understanding the operations of the mechanism shown in FIG. 30;

FIG. 38 is an external front view of an alternative embodiment of the automatic paper currency dispensing machine in accordance with the present invention;

FIG. 39 offers a conceptual sectional view of the machine at the line XXXIX-XXXIX indicated in FIG. 38;

FIG. 40 offers, as FIG. 3 does, a sectional view of the safe shown in FIG. 38;

FIG. 41 shows the open safe of the embodiment, and the illustration of the interior of its upper base is omitted;

FIG. 42 offers the perspective external view of the safe of the embodiment;

FIG. 43 is a front view of the DIP switch of the safe shown in FIG. 42;

FIG. 44 is a functional block diagram showing schematically the structural example of the control system of the embodiment;

FIGS. 45 and 46 show formats for administrative data and trouble data, respectively, of the storage safe control memory of the embodiment;

FIGS. 47 and 48 show normal operational flow charts of the control system shown in FIG. 44;

FIG. 49 shows an example of the operational flow chart for the instance when a jam occurs in the control system of the embodiment;

FIG. 50 partially shows the open safe in a further alternative embodiment of the present invention;

FIG. 51 offers a sectional view of the machine at the line LI-LI indicated in FIG. 50;

FIG. 52 offers an enlarged partial perspective view of the projection in the embodiment shown in FIG. 52;

FIG. 53 offers an enlarged frontal view of the projection in the embodiment;

FIGS. 54 and 55 are enlarged partial sectional views of the safes in the embodiments shown in FIG. 3 or FIGS. 56 and 57, wherein FIG. 54 shows how the blade directs the paper currency to the paper currency discharge opening, and

FIG. 55 shows how the blade directs the paper currency to the reject safe;

FIG. 56 offers, as does FIG. 39, a conceptual sectional view of a further alternative embodiment of the paper currency discharging mechanism in accordance with the present invention;

FIG. 57 offers, as does FIG. 3, a sectional view of the safe shown in FIG. 56;

FIG. 58 is a perspective external view of a further alternative embodiment of the automatic paper currency dispensing machine in accordance with the present invention;

FIG. 59 is a side view showing conceptually the interior of the machine shown in FIG. 58;

FIG. 60 offers, as does FIG. 3, a conceptual sectional view of the discharging module shown in FIG. 58;

FIG. 61 is a drawing which is useful for understanding the driving power transmission mechanism of the discharging module of the embodiment;

FIG. 62 is a view of the driving power transmission mechanism shown in FIG. 61, being observed from the direction indicated by an arrow H in the figure; and

FIG. 63 offers, as does FIG. 3, a sectional view of the safe shown in FIG. 60.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, the embodiment of an automatic cash dispensing machine 21 in accordance with the present invention is a machine which may be installed in financial institutions such as banks, to be used for dispensing automatically the paper currency equivalent to the amount specified in response to the operation of an operator, that is, a customer. The machine 21, the embodiment in accordance with the present invention, is designed to handle cash, but the application of the present invention is not limited to this type of use, and instead, can be preferably applied to deal with other types of negotiable instruments, such as gift certificates issued by a retail store such as a department store, prepaid book certificates, or prepaid tickets issued by a travel agency.

This machine 21 has been designed as a movable type to be placed on a table, and contains casing 26a and lid 26. The latter is attached to the former with use of a hinge 26b so that it can be opened or closed in the direction indicated by an arrow A. The lid 26 is provided with a pick-up window 22 which opens toward the customer, that is, at the front of the machine, and through which the paper currency is picked up. The lid 26 has an

input display pad 23 provided on its front panel. The input display pad 23 is a display/input device of a touch panel type, and constitutes a display screen with a display function 23, which visually displays the data such as instructions for input operations, or information to indicate the machine condition or to confirm the inputted data; and an input function 23b which is carried out through a key pad 23c in FIG. 7, which may be touched by the operator or the customer, to input the data such as password and amount.

The lid 26 is further provided with a slot 24 which opens at its front, to be used for accepting or returning the customer card, not shown, pertaining to the user, or the ID card, not shown, pertaining to the maintenance personnel for the machine. These cards are preferably, for example, an account card, that is, the so-called "cash card," issued by the financial institution in connection with the savings account owned by the customer; the so-called "finance card" and credit card to be used by the financial institution to make a small amount of a cash loan; and the like. In this embodiment, they are preferably magnetic cards. There is also provided an opening below the card slot 24, a discharge slot 25 for the statement strip on which the transaction details are printed.

On the interior side of the lid 26, a card reader 24 is provided at the location corresponding to the card slot 24. Further, a printer 28 is provided at the location corresponding to the discharge slot 25 for the statement strip. The card reader 27 contains a sensor, not shown, to detect the insertion of the card, and a magnetic head 29 including circuitry associated therewith, which are used for reading data from the card, and also, for writing data on the card. Further, a control electronics to control the entire machine, that is, the main control 30, is provided on the interior side of the lid 26.

Within the machine casing 26a, a safe 31 is removably installed. The safe 31 stores paper currency 40 in the area generally indicated by reference numeral 400, and is also provided with a mechanism for discharging the paper currency. Further, a power source 32 to supply the sections and components of this machine with electric power, is provided. Also, there is a tray 20 on the front panel of the machine, flanking the pick up window 22, and the paper currency is deposited in this tray 20.

Referring to FIG. 3, the safe 31 stores a large number of paper currency 40 which is standing on its side end. The paper currency 40 is pressed by a stage 41 which remains urged to the right direction of the figure by an urging means such as a spring, not shown, and a piece of paper currency 40a, that is, the right most piece, remains in contact with a picker roller 44. The surface of the

picker roller 44 is covered with material having a high coefficient of friction. The picker roller 44 is linked with a discharge motor 45 in such a manner that it is driven by the motor (M) 45 to rotate intermittently; therefore, in the normal situation, the paper currencies are discharged upward of the figure, piece by piece, while holding a predetermined interval. There are provided above the discharge roller 44, a feed roller 42 which rotates in the paper currency delivery direction, and a reverse roller 43 which rotates in the reverse direction; therefore, the delivery of more than one piece of paper currency is prevented, in other words, only a single piece of paper currency is delivered upward.

The single piece of paper currency discharged from the safe 31 is conveyed to the left direction of the figure, being held between a pair of conveyer or transporting belts 46 and 47 which are suspended by pulleys 55. The pulleys 55 are linked with a conveyer motor 48, so that it rotates by being driven by the conveyer motor 48, which in turn makes the conveyer belts 46 and 47 move. The conveyer motor 48 is preferred to be a direct-current servo motor, which offers variable rotational speeds. The conveyer belts 46 and 47 run in tight contact with each other, forming a paper currency conveyance passage 109 for a predetermined distance, as shown in the figure. Along this conveyance passage 109, photosensor units 49 and 56 are provided. The sensor unit 49 is a transmission type photosensor and optically detects whether or not more than one piece of paper currency are simultaneously conveyed. The sensor unit 56 is a photosensor which is provided for measuring the degree of skewing when the paper currency is conveyed in the misaligned condition, and also, for measuring the length of a bank note. Both photosensor units 49 and 56 compose a sensor 71, FIG. 6, which checks the paper currency conveyance condition.

As shown in the figure, there is provided in the safe 31, a reject box 51, in which the more than one piece of paper currency which have been delivered while being stuck to each other, or the paper currency which has been delivered in a misaligned manner, are placed. In order to carry out this task, a rotatable blade 50 is provided above the box 51, adjacent to the pulleys 55. The side edge 50a of the blade 50 normally holds an attitude, as indicated by the solid line in the figure, slanted toward the pulley 55 which is supporting the conveyer belt 47, guiding thereby the conveyed paper currency toward the paper currency discharge slot 58. If the paper currency is detected in the above-mentioned abnormal condition, the blade 50 is rotated by a solenoid 39, under the control of a safe control 33, and takes the position

indicated by the dotted line in the figure, directing thereby the conveyed paper currency to the reject box 51. By this arrangement, the paper currency in the abnormal condition is prevented from being presented to the user. The paper currency discharge slot 58 faces the pick-up window 22 of the machine, as is evident in FIG. 2. Thus, only the paper currency which is normally delivered is allowed to be discharged into the pick-up window 22.

Referring back to FIG. 3, there is an additional photosensor unit 57 between the paper currency discharge slot 58 and the pulley 55 of the conveyer belt 46. This sensor unit 57 is a photosensitive device to detect the completion of the paper currency conveyance. If the safe control 30 fails to detect the completion of paper currency conveyance through this sensor unit 57 after an elapse of a predetermined length of time since the discharge of paper currency from the safe 31, it determines that the paper currency has been jammed in the conveyance passage 109. Then, the safe control 30 counts the number of paper currency detected by the sensor unit 57, and the number of paper currency discharged from the safe 31 is supervised on the basis of this count.

Referring to FIGS. 4 and 5, in addition to FIG. 3, the safe 31 has a lower base 53 and an upper base 54. The latter is attached to the former with a hinge 52 in such a manner that the latter can be opened or closed in the arrow B direction. As evident from FIG. 4, the safe 31 is shaped to be portable, and the upper base is provided with a handle 60. Further, a lock 61 is provided below the paper currency discharge opening 58, and it prevents both bases from being released from each other if it is locked when both bases 53 and 54 are in the closed condition. The lower base is provided with the discharge motor 45, conveyer motor 48, picker roller 44, feed roller 42, reverse roller 43, stage 41, and reject box 51. Further, the upper roller 54 is provided with pulleys 55, conveyer belts 46 and 47, blade 50, and sensor units 49 and 56.

Referring to FIG. 6, the control system of this machine contains the main control 30 which controls the entire machine, and the safe control 33 which is positioned within the safe 31 to control the safe. The safe control 33 comprises a microcomputer or logic electronics, and monitors and controls the operation of the sections included in the safe 31. To the safe control 33, a read-only memory (ROM) 34 where control sequences to be used for executing controls are stored, and a random access memory (RAM) 35 where control data and resultant data are temporarily stored, are connected. What is characteristic about this embodiment is that the data resulting from the transaction carried out by this machine following the operation

of the user are stored in the temporary memory 35. This process will be described later in detail. These data resulting from the completed transaction are stored in memory 35 which is supported by a backup battery 38, which will be described later, to retain its memory contents. Incidentally, as a storage medium for storing such data of the completed transaction, other storage mediums such as magnetic disk or electrically erasable, programmable read-only memory (EEPROM) may be preferably adopted in place of the temporary memory 35.

Further, a driver 36 and a sensor reading circuit 35 are connected to the safe control 33. The driver 36 drives motors 45 and 46 as well as the solenoid 39, in response to the control signal outputted by the control circuit, and the solenoid 39 moves the blade 50. The sensor reading circuit 37 receives the sensor signal obtained through the sensors 57 and 71 and transfers this to the safe control 33. The safe control 33 is also connected to the battery 38. The safe control 33 is detachably connected to the main control 30 with connecting lines 33a, and while in the connected state, is supplied with power by the electric power source 32 of the machine main assembly. The battery 38 is a direct-current backup power source to secure the power supply while the safe 31 is separated from the machine. The driver 36 is connected to discharge motor 45, conveyer motor 48, and solenoid 39 for rotating the blade 50.

The main control 30 of the machine also comprises a microcomputer or logic electronics, and supervises and controls the operations of the entire machine. The main control 30 and the other circuits within this machine are powered by the power source 32. The main control 30 is connected to a keyboard interface 72 which encodes the signal inputted through the input function 23b of the input display 23 and transfer this to the main control 30. Further, the main control 30 is connected to a display driver 73 which makes the display function 23a of the input display 23 display the data in response to the control signal from the main control 30. The above-mentioned card reader 27 is connected to the main control 30 through the medium of a magnetic card reading device 74. The magnetic card reading device 74 has a function to receive the signal from the card reader 27 and transfer this to the main control 30. Further, the statement printer 28 is connected to a printer control, and to the main control 30 through an interface 75. The printer control and interface 75 have functions to control and to drive the printer in response to the control signal developed by the main control 30.

In operation, the operator inserts the magnetic card into the card slot 24 as the first step. The insertion of card is detected by the sensor of the

card reader 27, and then, the card reader 27 reads the data stored in the card through a magnetic head 29. The read customer data are sent to the magnetic-card reading circuit 74, through which the data are taken in by the main control 30. The main control 30 checks the validity of the financial institution code, account number, and customer code, which are included in the received data. If the result of this checkup indicates that the data belong to a customer with whom transactions are possible, the main control 30 transfers those customer data to the safe control 31 over the connecting lines 33a. The safe control 33 also stores those data in the temporary memory 35. If the main control 30 determines that transactions are impossible, for example, due to anomalies found in the card data contents during the validity checkup of the received data, it takes such measures as controlling the input display 23 to display this matter, and also, controlling the card reader 27 to eject the card.

The main control 30 controls the display driver 73 to make the input display 23 display the key pad 23c, FIG. 7, whereby prompting the operator to input the desired amount. The operator touches the desired keys of this key pad 23c to select "withdraw" as the type of transaction, and then, inputs the amount of withdrawal. The signals representing the inputted transaction type and amount are converted into corresponding codes through the keyboard interface 72, and transferred to the main control 30. Then, the main control 30 sends the data associated with the transaction type and amount to the display driver 73, so that the data are displayed on the input display 23. The input display 23 also displays the key pad 23c. Then, the operator confirms the displayed data, and presses "CANCEL" key or "CONFIRM" key on the key pad 23c, FIG. 7. If the operator confirms the display data on the input display 23 and presses the "CONFIRM" key, the main control 30 makes the safe control 33 store the data pertaining to the withdrawal amount in the temporary memory 35, while displaying the withdrawal amount on the input display 23. On the other hand, if the "CANCEL" key is pressed, the main control 30 responds to this action by making the safe control 33 erase the transaction data, which includes this amount, from the temporary memory 35, and by controlling the display driver 73 to change the amount displayed on the input display 23 to "0." Then, the system waits for the next input operation.

If the "CONFIRM" key is pressed, the control is transferred to the safe control 33, and the paper currency discharging operation is initiated. The main control 33 controls the driver 36 to drive the conveyer motor 48, and next, drives the discharge motor 45. In response to these actions, the dis-

charge roller 42 begins to rotate. The discharge roller 42 takes up the paper currency 40a which is in contact with the picker roller 44 at this time, and coordinates with the function of the reverse roller 43 to deliver only a single piece of paper currency 40a between the conveyer belts 46 and 47.

At this time, the conveyer belts 46 and 47 have already begun to travel due to the rotation of the motor 48. A single piece of paper currency 40a discharged from the safe 31 is conveyed to the left direction in the figure while being held between the pair of conveyer belts 46 and 47. During this conveyance, the conveyance condition monitoring sensor 71 outputs the signal representative of the paper currency condition, and this signal is sent to the safe control 33 through the sensor reading circuit 37. The safe control 33 uses this monitoring signal from the conveyance condition monitoring sensor 71 to determine whether or not more than one piece of paper currency are being conveyed, and also, to measure the degree of misalignment of the paper currency in order to check the running condition of the paper currency. If there is no anomaly in the paper currency conveyance, the safe control 33 holds the blade 50 at the position indicated by the solid line in FIG. 3 or 54, discharging thereby the conveyed paper currency into a collection tray 20. In this embodiment, the operations to discharge the paper currency from the safe 31 and to convey it to the collection tray 20 are executed within the safe 31, as described above. Therefore, even if the paper currency gets jammed while being conveyed, only the safe 31 in question may be removed from the machine 21, and then, the lock 61 can be unlocked to restore the safe 31 from the jam. Further, after the jammed safe 31 is removed, a different safe 31 may be installed in the machine 21. In this way, the operational efficiency of the machine 21 is improved, and also, the customer service does not deteriorate.

When the paper currency is discharged onto the pick up window 22, the conveyance completion sensor 57 produces the signal which indicates the discharge of paper currency. That signal is taken in by the safe control 33 through the sensor reading circuit 37, and the safe control 33 subtracts the amount equivalent to a single piece of paper currency from the amount data stored in the temporary memory 35, pertaining to this transaction; thereby updating the amount data in the temporary memory 35. If the updated data indicates a value other than "0," the safe control 33 continues the operation to discharge the next piece of paper currency. In this manner, the safe control 33 continues the discharging operation till the amount data stored in the temporary memory 35 indicates a null balance "0."

If this result of subtraction reaches "0," the safe control 33 reads from the temporary memory 35 the account number, transaction type, transaction amount, and the like, which pertain to this transaction, and transfers those transaction data, along with the signal indicating the end of the transaction, to the main control 30 on the connecting lines 33a. The main control 30 controls the display driver 73 to display on the input display 23 that the discharging operation has ended. This display for indicating the end of transaction may be preferably represented by displaying "0" amount. Meanwhile, the main control 30 sends the transaction data to the print control and the interface circuit 75, and controls the circuit 75 to make the printer 28 print the details of the transaction. The printer 28 prints the record of this transaction details, and discharges it as a statement from the slot 25. At the same time, the main control 30 controls the display driver 73 to restore the display on the display screen of the input display 23 to the initial display.

Also, if the control 33 detects whether or not more than one piece of paper currency are conveyed, based on the monitor signal which is received from the conveyance condition monitoring sensor 71 through the sensor reading circuit 37 and indicates the conveyance condition of the paper currency during the conveyance of the paper currency, or detects the misalignment exceeding the limit, in other words, if it detects a conveyance anomaly, it energizes the blade driving solenoid 39 through the driver 36; thereby the blade 50 is rotated to take the position outlined by the dotted line shown in FIG. 3, or 55 in more detail; and therefore, the paper currency passage is switched to the reject box 51 side. Thus, the paper currency in the abnormal condition, which has been conveyed by being held between the conveyor belts 46 and 47, is taken in by the reject box 51. At this time, the safe control 33 does not update the amount balance data retained in the temporary memory 35, but instead, it stores in the temporary memory 35 the data which indicates the anomaly which has occurred during the paper currency conveyance. Then, the safe control 33 repeats the attempt to discharge fresh paper currency from the safe 31.

The safe control 33 retains sets of transaction data, as confirmed data, in the temporary memory 35; each set of transaction data pertains to a single transaction and consists of information such as customer account number, amount of transaction, type of transaction indicating, for example, that the present transaction is of a type to pay out, and the like. Those confirmed data are retained in the temporary memory 35 at least until the file of a specific customer is updated in the central com-

puter of this machine. As is evident from this arrangement, all the data pertaining to the details of the transaction in this machine are stored in the temporary memory in the safe 31. These data are supported by the backup power from the battery 38. Therefore, even if the power from the power source 32 is interrupted when the safe 31 has to be removed from the machine because of a certain reason, the memory contents of the temporary memory 35 are retained by the battery 38.

The on-line system which executes real-time processing of the transaction between the financial institution and its customer comprises its central computer or processor, terminal devices, and terminal controls which are connected to the computer via telecommunications lines. The automatic paper currency dispensing machine 21 of this embodiment is brought back to the business office by the financial institution personnel in charge of this machine, after the end of service, and is connected to the on-line system with the cable through the channel of the terminal control device or the a modem connected to the telecommunications lines. Then, the data is transmitted to the central computer, according to the protocol, under the control of the controls 30 and 33. As the logic connecting procedure is established in the central computer, the safe control circuit 33 reads the transaction data stored in the temporary memory 35, and transmits those data to the central computer. The transaction data which have been transmitted are erased from the memory 35, thereby preventing the duplicate transmission of the same data. When the central computer receives the transaction data, it updates the account file associated with the customer account number included in the data, based on the data such as transaction type and transaction amount, completing the processing of this transaction.

The machine 21 of the instant embodiment enables a simple execution of a detailed examination of the cash in the safe 31. The personnel in charge opens the lid 26 of the machine 21, and releases the safe 31 to take it out of the machine 21. Only the safe 31 is transported to the business office. As was described previously, the safe 31 contains not only the remaining paper currency 40 but also the temporary memory 35, where the transaction data are stored, and the reject safe 51, where the paper currency which had encountered the conveyance failure are stored. Therefore, only that safe 31 is necessary to be unlocked at the office in order to examine precisely the cash and how it had been administered. Needless to say, since the machine is portable, it can be transported to the office for the detailed examination.

FIGS. 8 and 9 partially show other examples of the safe 31 which may be adapted to the automatic

paper currency dispensing machine 21. In the figures, similar components or structural elements are designated by like reference numerals and redundant description will be avoided for simplicity. In this embodiment, the picker rollers 44 have a peripheral surface made of highly frictional material, and are mounted on a picker roller shaft 124 with a predetermined interval. The picker roller 44 is fixed to a boss 175, which is provided with a one-way clutch 176 located in its middle and bearings 177 located on both ends. The picker roller 44 is mounted on the picker roller shaft 124 through the medium of the one-way clutch 176.

The rotational force for rotating the picker roller 44 to the direction for discharging the paper currency 40 (clockwise direction in FIG. 8) is transmitted from the motor 45 to the picker roller shaft 126 through the belt 136. With this one-way clutch in place, the driving force of the motor 45 is transmitted to the picker roller 44 as the picker roller shaft is rotated to the clockwise direction; thereby rotating the picker roller 44 to the clockwise direction.

If it is attempted to rotate the picker roller 44 to the clockwise direction while the motor 45 is not moving, the picker roller 44 can be freely rotated to the above-mentioned direction about the picker roller shaft 126. Further, since each picker roller 44 is mounted on the picker roller shaft 126 through the medium of its own one-way clutch 176, it can be rotated to the clockwise direction independently from each other when the motor 44 is not moving.

In this embodiment, two photosensor units 178 and 179 are provided near the entrance point of the conveyance passage, where the paper currency is discharged from the safe 31. When one of the photosensor unit 178 detects the leading end of the paper currency 40a, the signal for halting the rotation of the motor 45 is generated. In response to the other photosensor unit 179 detecting the trailing end of the paper currency 40a, the leading end of which has been detected by the photosensor unit 178, the safe control 33 generates the signal for rotating the motor 45. The positional relation among the pulleys 55-1 positioned on the entrance side of the conveyance passage 109, photosensor unit 178, picker roller 44, and feed roller 42 is established so that the photosensor unit 178 can detect the leading end of the paper currency 40 at the moment when the leading end of the paper currency 40a has just reached the detection point C of the photosensor unit 178, that is, the right moment when the leading end of the paper currency 40a has just been secured between the conveyer belts 46 and 47 immediately after the trailing end of the paper currency 40a has just lost contact with the picker roller 44; in other words, the relationship between those components is estab-

lished so that the position C where the photosensor unit 178 detects the leading end of the paper currency 40a is slightly displaced in the conveyance direction of the paper currency 40, from the position where the paper currency 40a begins to be held between the conveyer belts 46 and 47 on the entrance side of the conveyance passage. The automatic paper currency dispensing machine, which handles more than one types of paper currency having different lengths in the conveyance direction E, is designed to satisfy the above-mentioned conditions pertaining to the shortest paper currency.

The other photosensor unit 179 is positioned so that the trailing edge of the paper currency 40a is detected by this photosensor unit 179 after the trailing end of this paper currency 40a has been released from the feed roller 42, in other words, the position where this photosensor unit 179 detects the trailing end of the paper currency 40a is slightly displaced in the conveyance direction, from the contact position between the feed roller 42 and the paper currency 40a.

The automatic paper currency dispensing machine of the instant embodiment can handle more than one type of paper currency having different lengths in the conveyance direction, such as Japanese yen paper currency (approximately 76 mm long in the conveyance direction) and the U.S. dollar paper currency (approximately 66 mm long). First, the operation for discharging the U.S. dollar paper currency, the shorter of the two, is described regarding the case in which the United State paper currency and Japanese yen paper currency are handled.

In FIG. 10, the picker roller 44 and feed roller 42 receive the driving force of the motor 45 to rotate to the clockwise direction; thereby discharging upward the endmost paper currency 40a which is in contact with the picker roller 44. Incidentally, the peripheral velocities of the picker roller 44 and feed roller 42 are established at, for example, 1,000 mm/sec, and the linear velocities of the conveyer belts 46 and 47 are established at 1,800 mm/sec, for example.

In FIG. 11, the leading end of the discharged paper currency 40a is held between the conveyer belts 46 and 47. Since the linear velocities of the conveyer belts 46 and 47 are larger than the peripheral velocities of the picker rollers 44 and feed roller 42, the paper currency 40a is conveyed as if it is pulled away from the picker roller 44 and feed roller 42. The conveyer belts 46 and 47 have sufficient conveying force to pull away the paper currency 40a.

In FIG. 12, while the paper currency 40a is conveyed upward by the conveyer belts 46 and 47, the leading edge of the paper currency 40a

reaches the detection point C where the leading edge of the paper currency is detected by the photosensor 178. When the photosensor 178 detects the leading end of the paper currency 40a, the signal for stopping the motor 45 is outputted by the safe control 33, stopping thereby the motor 45; therefore, the rotation of the picker roller 44 and feed roller 42 which have been being driven to the clockwise direction by the motor 45 comes to halt.

Here, in the machine of this embodiment which is designed so that it can handle both the U.S. dollar and Japanese yen paper currencies, one of the photosensors 178 is positioned so that the leading end of the U.S. dollar paper currency 40a, the shorter of the two, reaches the detection point C, and also, the trailing end of the paper currency 40a is released from the picker roller 44, at the moment when the leading end of this paper currency 40a has been secured between the conveyer belts 46 and 47. If the positional relation is such that the leading end of the paper currency 40a reaches the detection point C before the paper currency 40a is secured between the conveyer belts 46 and 47, the operations of picker roller 44 and feed roller to discharge the paper currency 40a stops before the paper currency is secured between the conveyer belts 46 and 47, preventing the conveyer belts 46 and 47 from pulling away the paper currency. On the other hand, if the positional relation is such that the leading end of this paper currency 40a reaches the detection point C after the trailing end of the paper currency 40a has been released from the picker roller 44, the next paper currency is discharged by the picker roller 4 with - out leaving any interval between the preceding and following paper currency. In order to prevent the occurrence of such a condition, one of the photosensors 178 is positioned as was described above.

Coming back to FIG. 9, the one-way clutch 137 is interposed between the feed roller shaft 130, on which the feed roller 42 is mounted, and the pulley 135 on which the belt 136 for transmitting the driving force from the motor 45 is suspended. In other words, since the feed roller shaft 130 can freewheel relative to the pulley 135, the feed roller 130 can be freely rotated in the clockwise direction, with reference to FIG. 8, even when the motor 45 is still. Therefore, the feed roller 42 can freely rotate when the paper currency 40a is pulled away by the conveyer belts 46 and 47 while the motor 45 is still, in other words, the feed roller 42 does not work as a load against this pulling force.

The operational steps in FIGS. 10 to 13 pertain to the case in which the paper currency 40a is the U.S. dollar paper currency. In case the Japanese yen paper currency is discharged, it works as shown in FIG. 14. The leading end of the paper

currency 40a is detected by the photosensor 178, which causes the motor 45 to stop its rotation; thereby the rotation of the picker roller 44 and feed roller 42 stop. At this time, the trailing end of this paper currency 40a still remains in contact with the picker roller 44. However, as was described above, the arrangement is such that if the picker roller 44 is wanted to rotate to the clockwise direction when the motor 45 is still, the picker roller can freewheel around the picker roller shaft 124 due to the one-way clutch 176 interposed between the picker roller 44 and the picker roller shaft 124; therefore, the picker roller 42 can freely rotate when the paper currency 40a is pulled away by the conveyer belts 46 and 47 even while the motor 45 is still, in other words, the feed roller 42 does not work as a load against this pulling force.

In FIG. 13, the trailing end of the preceding paper currency 40a, which is being conveyed by being held between the conveyer belts 46 and 47, reaches the detection point D where the paper currency is to be detected by the photosensor 179. As the photosensor 179 detects the trailing end of the paper currency 40a, the signal for restarting the rotation of the motor 45 is produced by the safe control 33. The motor 45 starts the clockwise rotation of the picker roller 44 and feed roller 42 to discharge the paper currency, and the following paper currency 40b is going to be discharged following the same procedure as the one for the preceding paper currency 40a.

FIG. 15 is a plan view showing how the paper currency 40a is discharged in the skewed condition. This figure is going to be used to understand why two picker rollers 44 are independently provided with their own one-way clutch 176. A pair of photosensors 178 are provided, one on each side across the conveyance direction of the paper currency. If the preceding paper currency 40a happens to be discharged in the skewed condition (the right being ahead of the left in the figure), the right side leading end of this paper currency 40a is first detected by the right side photosensor 178. Because of this detection, the rotation of the motor 45 is stopped, which in turn stops the rotation of the picker roller 44 and feed roller 42.

In this condition, the right side picker roller 44 has already lost contact with the paper currency 40a, but the left side picker roller 44 is still in contact with the paper currency 40a since part of the trailing end of the paper currency 40a has been left behind the left side picker roller 44 just by a length of L millimeter (mm) which is going to come in contact with the roller. Therefore, if the structure is such that each picker roller 44 is not independently provided with its own one-way clutch, for example, if the one-way clutch 137 is interposed

only between the feed roller shaft 130 and the pulley 135 in the same manner as it is done for the feed roller 42, the left side picker roller 44 rotates to discharge the paper currency 40a by the length of L when the paper currency 40a is pulled away by the conveyer belts 46 and 47. However, at this time, the right side picker roller 44 also rotates by the amount equivalent to discharge the paper currency 44a by the length of L. Further, at this time, the right side picker roller 44 has already come in contact with the following paper currency 40b; therefore, the right side of this following paper currency 40b is discharged also by the length of L, causing this following paper currency 40b to come out skewed.

In order to prevent this, in this embodiment, the left and right picker rollers 44 are independently provided with their own one-way clutch 176. With this arrangement, even if the left side picker roller 44 is rotated by the amount equivalent to discharge the paper currency 40a by the length of L, the right side picker roller 44 remains still; therefore, the following paper currency 40b does not come out slanted, and vice versa.

In this embodiment, the structure is such that the one-way clutch 137 is interposed between the feed roller shaft 130, to which the feed roller 42 is fixed, and the pulley 135. However, instead, each of the feed rollers 42 may be independently provided with its own one-way clutch as each of the picker roller 44.

Referring to FIG. 16, a single photosensor 180 is adapted in this alternative example of the paper currency discharging mechanism. When the leading end of the paper currency 40 is detected by this photosensor 180, the signal for halting the rotation of the discharging motor 45 is developed by the safe control. Also, when the leading end of the paper currency 40 is detected by that photosensor 180, the safe control 33 begins to clock, and produces, in response to an elapse of predetermined period of time, the signal for rotating the discharging motor 45. The positional relation among the pulley 55-1 positioned on the entrance side of the conveyance passage 109, photosensor 180, picker roller 44, and feed roller 42 is arranged so that the trailing end of this paper currency 40 is released from its contact with the picker roller 44 at the moment when the leading end of the paper currency 40 reaches the position where it is detected by the photosensor 180, and also, so that the leading end of this paper currency 40 is detected by the photosensor 180 immediately after the leading end of the paper currency 40 is secured between the conveyer belts 46 and 47; in other words, the detection point C is positioned to be slightly displaced in the conveyance or transfer direction E from the point where the paper cur-

rency 40 begins to be held by the conveyer belts 46 and 47 on the entrance side of the conveyance passage 109. In case more than one types of paper currency having different lengths in the conveyance E direction, the arrangement is made to accommodate the shortest paper currency in the direction E.

FIG. 17 shows a specific structure of the safe control 33 which controls a discharging mechanism such as the above. The safe control 33 generates the signal for halting the rotation of the discharging motor 45, in response to the detection of the leading end of the paper currency 40 by the photosensor 180. The safe control 33 contains a timer 186, and this timer 186 begins clocking, in response to the detection of the leading end of the paper currency 40, and after an elapse of a predetermined length of time, the control 33 generates the signal for restarting the rotation of the discharging motor 45.

Referring to FIG. 18, the safe control 33 produces a command to initiate the discharging operation, rotating thereby the discharging motor 45 (STEP 201). As shown in FIG. 19, the picker roller 44 and feed roller 42 are rotated by the rotation of the discharging motor 45, discharging the paper currency. As shown in FIG. 20, the photosensor 180 determines whether or not the leading end of the paper currency is detected (STEP 202), and if it is detected, the discharging motor 45 is halted (STEP 203). At the same time as the detection of the leading end of the paper currency 40a by the photosensor 180, clocking is started by the timer 186. After the discharging motor 45 is stopped, it is determined whether or not a specified number of pieces have been discharged (STEP 204). If the last piece of paper currency has not been discharged, the clocking is started by the timer 186 from the point of time when the leading end of the paper currency is detected in STEP 202. After a predetermined length of time, for example, after an elapse of 20 milliseconds (ms), the discharging motor 45 is rotated to continue the discharging operation (STEP 205), as shown in FIG. 21.

If it is determined that the last piece of the paper currency has been discharged in STEP 204, the discharging operation is ended (STEP 206).

If the leading end of the paper currency is not detected in STEP 202, clocking is started (STEP 207), and if the leading end of the paper currency is still not detected after an elapse of a predetermined length of time, for example, after an elapse of 500 ms, it is determined that the discharging or separating operation has failed, or a jam has occurred, and the transactional function of the machine is ceased as jam error (STEP 208). The value for the predetermined length of time is established so that the interval between the continu-

ously discharged two pieces of paper currency becomes as small as possible without allowing the leading end of the following paper currency 40b to enter the contact point between the trailing end of preceding currency 40a and the feed roller 42.

Also in this specific example, the photosensor 180 is positioned at the above mentioned location, and both of picker rollers 44 are independently mounted, through the medium of their own one-way clutch 176, on the picker roller shaft 124 which rotates by receiving the driving force from the discharging motor 45; therefore, it is possible to handle more than one type of paper currency having different lengths in the conveyance direction, such as the U.S. dollar paper currency and Japanese yen paper currency, in the same manner as the first example. Further, the left and right picker rollers 44 are independently provided with their own one-way clutch 176; therefore, even if the preceding paper currency 40a is discharged in the slanted condition because of the same reason as described in respect of the first example, it does not affect the following paper currency 40b.

FIG. 22 shows a further alternative structure of the paper currency conveyance mechanism. This example includes the reject safe 51 and the blade 50. In this specific structure, after an operation to discharge a specific number of paper currency has been completed, if an extra piece of paper currency which should not be discharged is discharged by being drawn into the discharging operation of the last piece of the specific number of paper currency, and the leading end of this paper currency is detected by the photosensor 179, a control is executed to store this paper currency in the reject safe 51, without discharging the next following paper currency.

Referring to FIG. 23, the safe control 33 has a control 189 which regulates the rotational speed of the motor 45, and this rotational speed control 189 regulates the rotational speed of the discharging motor 45, so that the rotational speed of the discharging motor 45 during the discharging operation to store in the reject safe 51 the extra paper currency which has been discharged by being drawn by the last piece of paper currency becomes slower than the rotational speed of the discharging motor 45 during the normal discharging operation.

The safe control 33 also contains a discharge counter 190. A count value is set in this counter 190 by the safe control 33 to specify the number of paper currency to be discharged, and the set value is decremented each time a piece of paper currency is discharged. By this arrangement, the control 33 determines whether or not the discharged paper currency is the last one to be discharged.

Referring to FIGS. 24 to 27, in operation, if it is instructed by a customer that n pieces of paper currency should be paid, the safe control 33 sets, in the discharge counter 190, this number n indicating the amount of payment request (STEP 221). Then, the safe control 33 starts the rotation of the main motor 48 (STEP 222), and checks if the rotation has reached a predetermined rate (STEP 223). If the predetermined rate is not reached after an elapse of a predetermined length of time, it is determined that an error has occurred (STEPS 224 and 225).

When the rotation speed of the main motor 48 becomes stable at the predetermined speed, the control 33 controls, through the rotational speed control 189, the discharging motor 45 to rotate at N1 rpm for discharging the paper currency (STEP 226). When the leading end of the discharged paper currency is detected by the photosensor 178 (STEP 227), the discharging motor 45 is stopped (STEP 228). In STEPS 226 and 227, if the leading end of the paper currency is not detected by the photosensor 178 after an elapse of a predetermined length of time while the discharging motor 45 is rotated to discharge the paper currency, it is determined that an error has occurred (STEPS 229 and 230).

In STEPS 227 and 228, when the discharging motor 45 stops, the safe control 33 subtracts one from the value n which had been set in the discharge counter 189 (STEP 231), and thereby, determines whether or not the particular paper currency is the last one to be discharged, based on whether or not n has become zero (STEP 232). If the discharged paper currency is not the last paper currency to be discharged, it is checked whether or not the trailing end of the paper currency is detected by the photosensor 179 (STEP 233), and if it is determined that the trailing end of the paper currency has been already detected by the photosensor 179, the discharging motor 45 is restarted to discharge the next paper currency (STEP 226). If the one photosensor 178 detects the leading end of the paper currency, but the other of photosensor 179 does not detect the trailing end of the paper currency after an elapse of a predetermined length of time, it is determined that an error has occurred (STEPS 234 and 235).

In STEP 232, if it is determined that the discharged paper current is the last paper currency to be discharged, it is determined whether or not the trailing end of the paper currency has been detected by the photosensor 178 (STEP 236). If this photosensor 178 does not detect it after an elapse of a predetermined length of time since the same photosensor 178 has detected the leading end of the paper currency, it is determined that an error has occurred (STEPS 237 and 238). In STEP 236,

if it is determined that the trailing end of the last paper currency has been detected by the photosensor 178, it is determined whether or not the leading end of the following paper currency has been detected by the photosensor 179 (STEP 239). If the leading end of the paper currency has not been detected by the photosensor 179, the paper currency which should not be discharged is not being discharged; therefore, the discharging operation is ended (STEP 240).

In STEP 239, if the leading end of the paper currency has been detected by the photosensor 179, this indicates the condition in which an extra piece of the paper currency, which should not be discharged after the last paper currency, has been discharged; therefore, in order to store this paper currency in the reject safe 51, the safe control 33 makes, through the medium of the rotation speed control 189, the discharging motor 45 rotate at N2 rpm which is slower than the normal discharging revolution of N1 rpm, to discharge the paper currency (STEP 241). The reason for slowing down the rotational rate of the discharging motor 45 at this time is because the time it takes for the rotation to stop must be shortened so that the next piece of the paper currency will be prevented from following this one when the rotation of the discharging motor 45 will be stopped after this paper currency will have been discharged.

After it is determined that the last paper currency has been discharged, if the leading end of the paper currency 40c is detected by photosensor 179 as shown in FIG. 28, this indicates the condition that an extra paper currency which should not be discharged is about to be discharged; therefore, the discharging motor 45 is rotated at the slower rotational speed of N2 to discharge the paper currency 45c. The discharged paper currency 40c is held and carried between the conveyer belts 46 and 47 to be stored in the reject safe 51 through the conveyance passage switched by the blade 50 as shown in FIG. 29.

It is determined whether or not the leading end of the discharged paper currency has been detected by the photosensor 178 (STEP 242). If the leading end of the paper currency is not detected by the photosensor 178 after an elapse of a predetermined length of time, it is determined that an error has occurred (STEPS 243 and 244). In STEP 242, if the leading end of the paper currency is detected by the photosensor 178, the discharging motor 45 is stopped (STEP 245). It is determined whether or not the trailing end of the paper currency, of which leading end had been detected by the photosensor 178, has been detected by the photosensor 178 (STEP 246). If the trailing end of the paper currency is not detected by this photosensor 178 after an elapse of a predeter-

mined length of time since the leading end of the paper currency had been detected by the photosensor 178, it is determined that an error has occurred (STEPS 247 and 248). In STEP 246, if it is determined that the trailing end of the paper currency has been detected by the photosensor 178, it is determined whether or not the leading end of the following paper currency has been detected by the photosensor 179 (STEP 249). If the leading end of the paper currency has not been detected by the photosensor 179, this means that the paper currency which should not be discharged is not being discharged; therefore, the discharging operation is ended (STEP 250).

In STEP 249, if it is determined that the leading end of the paper currency has been detected by the photosensor 179, this indicates the condition that the paper currency which should not be discharged is being discharged again; therefore, the operation is repeated from STEP 241. Further, if the leading end of the paper currency is detected by the photosensor 179 more than a predetermined number of times, such as three times, after the last paper currency had been discharged, it is determined that an error has occurred (STEPS 251 and 252).

FIG. 30 shows a still further alternative example of the paper currency discharging structure. In this example, the photosensor 191 is mounted at the illustrated position. When this photosensor 191 detects the leading end of the paper currency 40a, the safe control 33 develops the signal for stopping the rotation of the discharging motor 45. Also, after the detection of the leading end of the paper currency 40a through this photosensor 191, the safe control 33 begins clocking as will be described later, and after an elapse of a predetermined length of time, it outputs the signal for rotating the discharging motor 45. The positional relation between the pulley 55-1 positioned on the entrance side of the conveyance passage 109, photosensor 191, and picker roller 44 is established to satisfy such conditions that the photosensor 191 detects the leading end of this paper currency 40a at the right moment when it occurs simultaneously so that the leading end of the paper currency 40a reaches the point where it is detected by the photosensor 191; the trailing end of the paper currency 40a is released from the contact with the picker roller 44; and the leading end of the paper currency 40a is securely held between the conveyer belts 46 and 47.

Referring to FIG. 31, when the leading end of the paper currency 40a is detected by the photosensor 191, the safe control 33 begins clocking through the timer 186, and after an elapse of a predetermined period of time, for example, 20 ms, it outputs the signal for restarting the rotation of the

discharging motor 45.

Referring to FIG. 32, when the command to initiate the discharging operation is issued, the safe control 33 rotates the discharging motor 45 (STEP 371). The rotation of the discharging motor 45 rotates the picker roller 44 and feed roller 42 to discharge the paper currency 40a. In FIG. 34, the leading end of the discharged paper currency 40a is held between the conveyer belts 46 and 47, and then, the paper currency 40a is conveyed as far as when its leading end reaches detection point F. In response to the leading end of the paper currency 40a detected by the photosensor 191, the safe control 33 produces the signal for stopping the discharging motor 45, so that the discharging motor 45 stops, which in turn, halts the clockwise rotation of the picker roller 44 and feed roller 42 generated by the discharging motor 45 to discharge the paper currency (STEP 373).

Clocking is started the moment the leading end of the paper currency 40a is detected by the photosensor 191. After the discharging motor 45 is stopped, it is determined whether or not a specified number of paper currency has been discharged (STEP 374). If the last paper currency has not been discharged, clocking is started by the timer 186 from the moment when the leading end of the paper currency is detected in STEP 272, and after an elapse of a predetermined length of time, the discharging motor 45 is rotated to restart the discharging operation (STEP 375). In STEP 374, if it is determined that the last paper currency has been discharged, the discharging operation is ended (STEP 376). In STEP 372, if the leading end of the paper currency is not detected, clocking is started (STEP 377), and if the leading end of the paper currency is not yet detected after an elapse of a predetermined length of time, for example, 500 ms, it is determined that a separation failure or paper jam has occurred, and the transactional function of the machine is halted as a jam error (STEP 378).

Referring now to FIG. 36, in this embodiment, the paper currency is normally discharged with predetermined intervals of $L1$ mm between the preceding and following ones, and their conveyance speed is $V1$ mm/sec. The necessary time for switching the blade 50 is $t0$ ms. Since the interval between the paper currency 40-1 and 40-2 is $L1$, the following paper currency 40-2 is sent in on the conveyer belt after an elapse of $L1/V1 = t1$ msec since the first paper currency 40-1 has passed the blade 50. In order to increase the number of the separated paper currency per unit time, it is established that $t0 > t1$. If the paper currency interval is established as the above, switching of the blade 50 falls behind, but there occurs no problem, since the paper currency is being normally discharged and does not need to

be rejected.

Referring to FIG. 33, under the normal condition, the conveyer motor 48 maintains high revolutions (STEP 391), but if a piece of paper currency in a poor condition which is not suitable to be paid out is detected by transmission-type photosensors 49 and 56, FIG. 3 (STEP 392), the signal for slowing down the rotational speed of the conveyer motor 48 is outputted (STEP 393). The conveyance speed of the paper currency held between the conveyer belts 46 and 47 becomes slow since the rotational speed of the conveyer motor 48 slows down. Further, when the paper currency in poor condition is detected by the transmission-type photosensors 49 and 56, the blade 50 is driven to switch the paper currency conveyance passage in the direction of the reject safe 51. With the above arrangement, the paper currency is conveyed at a relatively slow speed compared to the normal one, steered by the blade 50, and is stored in the reject safe 51. The above-mentioned slow conveyance speed is established so that there is sufficient time for the blade 50 to switch the paper currency conveyance passage.

If the paper currency in poor condition is detected by the transmission type photosensors 49 and 56, the discharging motor 45 stops its rotation, and the discharging operation of the following paper currency is halted until this paper currency in poor condition is stored in the reject safe 51. After the paper currency in poor condition is stored in the reject safe 51 (STEP 394), the motor 45 restarts its rotation to discharge the rest of the paper currency. Also, the conveyor motor 48 increases its rotational speed (STEP 391) to regain the normal paper currency conveyance speed.

Referring to FIG. 37, if a piece of paper currency 40-4 is skewed and the preceding paper currency 40-3 is holding the normal posture, the preceding paper currency 40-3 does not need to be rejected though the following paper currency 40-4 must be rejected because it is skewed. At this time, let the interval between the paper currency 40-3 and 40-4 be $L2$ mm in the shortest distance. If the paper currency in poor condition is detected by each sensor and a command is issued to slow down the rotational speed of the conveyer motor 48, for example, if the conveyance speed is controlled to be $V2$ mm/sec, the following paper currency 40-4 is sent in after $L2/V2 = t2$ msec since the preceding paper currency 40-3 had passed the blade 50. Therefore, if $t0$, the time it takes to switch the blade 51, and the value of the rotational speed $V2$ are established to satisfy $t0 < t2$, the blade 50 can be switched by the time the following paper currency 40-4 reaches the blade 50 after the preceding paper currency 40-3 had passed blade 50; therefore, the paper currency

40-4 can be stored in the reject safe 51. After the paper currency in poor condition 40-4 is stored in the reject safe 51, the rotational speed of the conveyer motor 48 is accelerated to regain the speed V1.

According to the automatic paper currency dispensing machine having such a structure as the above, detection means for detecting the position of the discharged paper currency is mounted as described above, and driving means for the picker roller and feed roller is controlled based on the detection results from this detection means. Therefore, the intervals between the pieces of continually discharged paper currency can be set shortened, which in turn makes it possible to increase the number of paper currency discharged per unit of time.

Further, the one-way clutch is interposed along the driving force transmission linkage from the driving means to the picker roller; therefore, it is possible to discharge more than one type of paper currency having different lengths in the conveyance direction, while preventing skewing of or damages to the paper currency, in other words, it is possible to provide a highly reliable discharging mechanism.

Further, in case the picker rollers are mounted on both the left and right sides relatively to the discharging direction of the paper currency, each of the picker roller is independently provided with its own interposed one-way clutch; therefore, even if the preceding paper currency is discharged in the skewed condition, the following paper currency is not affected by this condition, in other words, reliability is further improved.

If an extra piece of paper currency has been halfway discharged following the last paper currency, that extra paper currency can be discharged all the way and stored in the reject safe; therefore, it is safe from the point of crime prevention. Further, during this discharging operation, the driving means for the picker roller is operated at a slower speed, so that the driving means can be stopped in a shorter time when the discharging operation is to be halted; therefore, no more extra piece of paper currency is going to be discharged.

If the paper currency being conveyed happens to be not suitable for dispensing, the conveyance speed of conveying means is slowed down to store this paper currency in the reject safe; therefore, a sufficient time can be spent to switch the paper currency conveyance passage to the direction of the reject safe, and in addition, the interval can be shortened for the paper currency which are continuously sent in under the normal conveyance condition.

Referring to FIG. 38, the automatic paper currency dispensing machine in accordance with a

further alternative embodiment of the invention has a casing 418. On the right front side of this casing 418, three paper currency storage safes 419 are removably or detachably mounted in the vertical layers from the top. Those paper currency storage safes 419 have an identical structure. They have an opening 58 formed on the front side to discharge the paper currency during the dispensing operation, and also, a connector 426 on the rear side, which is fitted to each of the connectors 422, 423, and 234 provided on the casing side, as shown in FIG. 39, to secure the connection to the control 434, which will be described later. There are provided on the front panel of the casing 418, paper currency collection trays 427, 428, and 429, each of which flanks the corresponding paper currency discharge opening. The pieces of paper currency discharged from the corresponding paper currency discharge openings are stacked in these trays to be collected by the customer. Further, there is provided on the upper left side (if the front panel of this casing 418 a card handling unit for handling the card, that is, card read/write printer (CRP) 430. This card handling unit 430 has functions to read the magnetic information from the card inserted by the customer, to write on the card the updated information pertaining to the contents of the executed current transaction, and to print the contents of the executed transaction on the statement strip. This card handling unit 430 is also provided with a slot 431 formed for the card to be inserted.

Below this card slot 431, a display 432, which preferably comprises a plasma display or CRT, is provided to display instructions for the input operation which is followed by the customer, or information pertaining to the inputted data. Further below this display, a key pad 433 having multiple keys is provided, and those keys are pressed by the customer to carry out the operation to input the password, amount requested to be paid, and the like. In the lower section of the casing 418, a control unit 434 is installed, which controls the above mentioned structural components as well as the entire machine. Further, a power supply 435 which powers each of the components of this machine is provided adjacent to the control unit 434.

Three safes 419 may have a substantially identical structure. In this embodiment, they are equivalent to the one such as shown in FIG. 40, in which the safe 31 which was described with reference to FIG. 3 is provided with additional components: connector 426, DIP switch 56 and currency type identifying sensor unit 448 and memory 460, which will be described later. In the figures, similar components or structural elements are designated by like reference numerals and redundant descriptions will be avoided for simplicity.

The currency type identifying sensor 448 is mounted along the conveyance passage 109, and develops the signal corresponding to the type of the paper currency which is discharged from a paper currency storage 400 and conveyed through the conveyance passage 109 in the paper currency storage safe 419.

As is more evident in FIG. 41, the paper currency storage 400 contains a pair of guides 451a and 451b. They are the paper currency guides to define the paper currency storage location on the basis of the longitudinal measurement of the paper currency 40, and they are structured so that one, 451a, is fixed, and the other, 451b, is movable. This movable paper currency guide 451b is removably supported by a projection 452. This projection 452 is provided in two rows placed toward both front and rear ends of the storage space 54 of the paper currency 40, as shown in FIG. 41, which is a plan of the safe viewed from above, with its upper base being open. In the instant embodiment, each row comprises four pieces of projection 451b, providing grooves 453a, 453b, and 453c; therefore, the width of the storage space 400 can be changed in three steps. The movable paper currency guide 451b is inserted and fitted in the selected one of the grooves 453a, 453b, and 453c, so that the paper currency guide 451b is supported in the upright position.

The paper currency guide 451b can be fitted in any one of the three grooves 453a, 453b, and 453c, which offer three choices of paper currency size, and the storage location which corresponds to the type of paper currency to be stored is defined by selecting the fitting location. More specifically, if the paper currency guide 451b is engaged in the most inward groove 453a, the width between the opposing paper currency guides 451a and 451b becomes just right for storing the one-thousand yen note for the smallest size; in the middle groove 453b, the five-thousand yen note for the medium size; and in the most outward groove 453c, the ten-thousand note for the largest size.

Referring to FIG. 42, a DIP switch 456 is provided at the bottom on the front panel of the lower base 53, and this is operated, after the placement of the paper currency, to set up the paper currency type data representative of the types of paper currency stored in the safe 419. As shown in FIG. 43, the DIP switch 456 has switches 456a to display four digits. It is established that "0" denoted by this switch 456a indicates low, and "1" indicates high. For example, if the one-thousand yen note is stored, the display generated through the manipulation of the switches 456a shows "0001;" "0010" for the five-thousand yen note; and "0011" for the ten-thousand yen note. With this arrangement in place, the information pertaining to

the types of the paper currency stored in the safe 419 can be inputted.

Since the paper currency storage safe 419 has a structure which can accommodate any type of paper currency as was described above, in other words, it is only necessary to engage the paper currency guide 451b to one of the grooves 453a, 453b, and 453c, which corresponds to the size of the type of paper currency to be stored. For example, let's take the case in which the one-thousand yen note is wanted to be stored. First, the lock 61 is released with an unshown key to open the upper base 54. Next, the stage 41 for pressing the paper currency 40 toward the picker roller 44 is moved back toward the reject safe 51 and fixed there, so that the space for storing the paper currency is secured between it and the picker roller 44 on the opposite side. Then, the movable paper currency guide 451b is engaged with the most inward groove 453a to secure the space having the width to match the length of the one-thousand yen note, in coordination with the paper currency guide 451a, and the desired number of one-thousand yen notes are stored in this space to hold the orderly upright position. Next, as the stage 41 is released from its fixed position, the stage 41 springs back to press the paper currency 40 toward the picker roller 44, completing the loading process of the paper currency 40.

When the upper base 54 is closed and the lock 61 is set, the DIP switch 456 is operated to indicate what type of paper currency is stored in this safe 419. In this case, "0001" is set since one-thousand yen notes are stored. In the same manner, necessary types of paper currency, for example the five-thousand yen notes and the ten-thousand yen notes, are stored, and the pertinent information pertaining to the paper currency type is indicated by the DIP switch 456. It is not necessary to store all of the available types of paper currency as was described above. Instead, only the ten-thousand yen notes, or a combination of the thousand yen notes and the ten-thousand yen notes may be stored; therefore, the type of paper currency to be stored can be determined to offer the best efficiency for the selected operational mode. At this time, the types of the available paper currency may be displayed as customer information on the display 432 through the main control 434, which reads the arrangement of the DIP switch 456.

After the preparation of the safes is completed in the above-mentioned manner, the safes are inserted, back side first, and loaded into the safe installation slot in the casing 418 of the machine, and the connector 426 which is provided on the back side of each paper currency storage safe 419 is connected to one of the concave connectors

422, 423, and 424 provided on the casing 418. Behind the rear panel on which the connector 426 is attached, that is, within the safe 419, there are motor 45 for driving to separate and discharge the paper currency, conveyer motor 48, connecting wires for transmitting the start or stop signal to the actuator of the blade 51, and sensors 49, 56, 57, and 448 for detecting the conveyance anomalies or identifying the type of paper currency. Also, there are wires, not shown, installed for transmitting the detection signals.

When each of the connectors 426 is connected to one of the connectors 422, 423, and 424, and the unshown switch of the power source 435 is turned on, the power is supplied through the connectors 422, 423, and 424, and connector 426 to the components within the safe 419, and the information representing the paper currency type set up by the DIP switch 456 is sent to the control 434. The main control 434 receives in the above-mentioned manner the information representing the type of the paper currency 40 stored in the installed safe 419. When there occurs a dispensing request from the customer, the main control 434 gives a command to the paper currency storage safe 419 to discharge the paper currency, based on this information representing the type of paper currency.

Referring to FIG. 44, the automatic paper currency dispensing machine contains an internal operation panel 457, and this is a unit provided within the casing 418 to be operated by the personnel of the financial institution during the maintenance checkup and the like. This machine is also provided with a paper currency discharging unit 458 for discharging the paper currency from the storage safe 419 installed in the safe installation slot. The control 434 is provided with a storage safe management memory 459 which stores various information pertaining to the type of the paper currency stored in the storage safe 419, and the executed transactions, as operational history and trouble record of the safe 419. This operational history includes the counts and the amount of the transactions executed by the automatic paper currency dispensing machine, and the trouble record includes the error counts data pertaining to double discharge, detection of damaged paper currency, and the like; in other words, the information about all the transactions executed by any of the storage safes 419 installed in the machine, and all the things which happen to any of them are stored.

More specifically, the control 434 knows what type of paper currency is stored in which one of the storage safes 419, based on the information from the storage safe 419. Let it be that the storage safe 419 storing the one-thousand yen notes is installed in the uppermost safe installation slot; the

storage safe 419 storing the five-thousand yen notes, in the middle slot; and the storage safe 419 storing the ten-thousand yen notes, in the lowest slot. If an amount of, for example, 57,000 yen, is requested by the customer, the main control 434 controls the paper currency discharging unit 458 to discharge five units of the ten-thousand yen note from the storage safe 419 in the lowest slot, one unit of five-thousand yen note from the storage safe 419 in the middle slot, and two units of the thousand yen note from the uppermost slot. The paper currency discharging unit 458 discharges from the safe 419 the specified number of paper currency, and then, sequentially carries out the conveying, detecting, collecting, and discharging steps. Meanwhile, the information in the storage safe management record section 459 is updated. That is, the transaction count information is incremented by one, and the paper currency count information pertaining to the discharged paper currency is updated to reflect the values incremented by five from five units of the ten-thousand yen note, one from one unit of the five-thousand yen note, and two from two units of the one-thousand yen note, respectively. Also, if at this time a double discharge occurs, the value in the information which records the double discharge counts is incremented by one.

In this way, the automatic paper currency dispensing machine grasps the information pertaining to the executed transactions by means of storing the various transaction information pertaining to the executed transaction, all together in the control 434. This information is called upon for the supervision of the paper currency amount handled during the transactions, or for the maintenance checkup of the mechanical sections such as the paper currency dispensing unit 458, after the end of the operation.

The storage safe 419 is provided with its own storage safe management memory positioned adjacent to the reject safe 51, and as shown in FIG. 40, this independently stores the operational history and trouble record of the pertinent safe 419. The storage safe management memory 460 is electrically connected to the control 434 as the connector 425 of the safe 419 is connected to the connector 422, 423, or 424 of the machine main assembly. When the power source 435 is turned on after the installation of the safe, it is made possible by the control from the control 434 for the machine to be operated, and at the same time, it is made possible for the storage safe management memory 460 to be accessed for the collection of the transaction information or the addition of the updated information.

The storage safe management memory 460 is provided with an operational data format to store

the operational data, and a trouble data format to store the trouble data, as shown in FIGS. 45 and 46, respectively. First, as shown in FIG. 46, the operational data is set up to store the individual dispensing operation counts and paper currency counts for each of the thousand, five thousand, and ten thousand notes; the total dispensing operation count and paper currency count for the entire paper currency; the output values from the first and second sensors 49 and 56 which detect whether or not the paper currency discharged during the dispensing operation are fit for the dispensing; the driving time of the motor 45 for separating and discharging the paper currency and the motor 48 for conveying the paper currency; and other various information.

Further, as shown in FIG. 46, the trouble data is designed to store, in addition to a portion of the above-mentioned operational data, the various trouble information such as total reject counts for each paper currency type; skew reject counts to show the number of times excessive skewing occurs, on the paper currency type basis; reject counts of double discharge for each paper currency type; jam counts to show the number of times the paper currency jams, on the paper currency type basis.

Coming back to FIG. 44, the control 434 contains a transaction information control section 463. The control 463 accesses each storage safe management memory 460 in the individual storage safe 419 through the connector 425 and the connectors 422, 423, or 424, to collect the various information pertaining to the executed transactions, or to update it with additional information.

Referring to FIGS. 46 and 48, in operation, when data representative of the amount of payment, (for example 57,000 yen) is entered by the customer through the key pad 433 (STEP 501), this input information is transmitted to the main control 434, and based on the paper currency type information obtained from the storage safe 419, the control 434 instructs the storage safes 419, which hold the paper currency pertinent to the requested amount, to discharge the paper currency. First, the control 434 issues to the paper currency discharging unit 458 a command to pay five units of the ten-thousand yen note (STEP 502). In response to this instruction, the picker roller 44 and feed roller 42 of the safe 419, which stores the ten-thousand yen note and is loaded in the lowermost level slot, are driven to rotate to separate and send out the paper currency piece by piece, which is held between and conveyed by the conveyer belts 46 and 47 (STEP 503). When a single piece of paper currency is discharged and its degree of skewing falls within a predetermined range (STEP 504), the paper currency 40 is just

deposited into the collection tray 429 from the paper currency discharge opening 58 (STEP 506). At this time, the control 457 counts the discharged paper currency through the sensor 57. If more than two units of paper currency are simultaneously discharged, they are stored in the reject safe 51 (STEP 505), and the operation to separate the paper currency is restarted. At the moment when five pieces of the discharged paper currency are counted, it is determined that five pieces of ten-thousand yen note have been deposited in the collection tray 429 (STEP 507); therefore, the rotation of the picker roller 44 and feed roller 42 of the ten-thousand yen note safe 419 is stopped, halting the operation to separate and discharge the ten-thousand yen note (STEP 508).

Then, as soon as it is confirmed that five units of the ten-thousand yen note have been normally paid out in the above-mentioned manner, one unit of the five-thousand yen note is discharged in the same manner. Next, a command is sent to the thousand yen note safe 419 on the uppermost level, to pay two units of the thousand yen note (STEP 509). After these two units are deposited in the tray 427 like the ten-thousand yen notes, the operation to separate and discharge the thousand yen notes is stopped (STEPS 510 to 515). Finally, the customer picks up the paper currency from the collection trays 427, 428, and 429, which ends the operation to dispense the paper currency (STEP 516).

In the above mentioned manner, five units of the ten-thousand yen note are discharged from the storage safe 419 on the lowest level; one unit of the five-thousand yen note, from the storage safe 419 on the middle level; and two units of the thousand yen note, from the storage safe 419 on the uppermost level, respectively. Those individual discharging operations cause the information pertaining to the types and count values of the discharged paper currency 40 to be updated in the storage safe management memory 460 through the transaction information control 463.

Referring to FIG. 49, during the operation to discharge the ten-thousand yen notes for the transaction to pay 57,000 yen, if no detection signal is sent out from the conveyance detection sensor 57, the control 434 determines that a jam has occurred (STEP 531), and ceases the discharging operation of the ten-thousand yen note safe 419 (STEP 532). If, for example, three pieces of the ten-thousand yen note have been already deposited in the collection tray 429, a command is sent to the safe 419 on the middle level by the control 434, to make the rest of payment, that is twenty thousand yen, using the five-thousand yen notes (STEP 533); therefore, the picker roller 44

and feed roller 42 of the five-thousand yen note safe 419 are driven to rotate, separating and discharging, one by one, pieces of the five-thousand yen note, which are held between and conveyed by the conveyer belts 46 and 47 (STEP 534), and deposited into the collection tray 428 from the paper currency discharging opening 22 (STEP 535). When four units of the five-thousand yen note are deposited in the collection tray 428 (STEP 536), the rotation of the picker roller 44 and feeder roller 42 of the five-thousand yen note safe 419 is stopped, in other words, the operation to separate and discharge the ten-thousand yen note is stopped (STEP 537), ending the jam handling process (STEP 538). Incidentally, if the five-thousand yen note gets jammed, the thousand yen note is paid as the replacement in the same manner. If the thousand yen note gets jammed, the payment of the thousand yen note is ceased; therefore, the dispensing operation thereafter is carried out as a limited operation to dispense just the ten-thousand yen and five-thousand yen notes.

In this embodiment, a mechanism to take back into the safe 419 the paper currency deposited in the paper currency collection trays 427, 428, and 429, that is retrieval mechanism, is not illustrated. If this retrieval function is added, the dispensing operation is structured in the following manner. For example, if the ten-thousand yen note gets jammed, this fact is displayed. Then, the payment is made using, instead, the five-thousand yen note after the customer's approval, indicated by pressing the confirm key. If there is no approval, the paper currency in the collection tray are retrieved into the machine and the card is returned to the customer, followed by a display such as "Presently, payment is made by only the five-thousand and ten-thousand yen notes" presented on the display 432.

Further, this embodiment is described referring to the case in which three types of paper currency, that is the ten-thousand, five-thousand, and one-thousand yen notes, are handled. However, all the paper currency may be the ten-thousand yen notes, and in such a case, a message such as the above is not necessary, in other words, it is only necessary to cease the discharging operation of the safe, in which the jam has occurred, and restart the paper currency dispensing operation with use of the rest of safes. Then, the normal transaction may be restored after the arrival of the maintenance person who removes the jammed paper currency to restore the normal operation.

During the paper currency dispensing service operation, if an erroneous conveyance of the paper currency 40, for example, simultaneous conveyance of more than two units of paper currency, is

detected by the sensors 49 and 56, the information pertaining to the double discharge reject counts for each paper currency type is updated, and for example, if excessive skewing is detected, the information pertaining to the skew reject counts for each paper currency type is updated, in the same manner as the paper currency discharge counts and the like. If the other factors which cause the paper currency to be rejected are detected, the information of the addresses which are pertinent to the respective factors are accessed, and the information pertaining to the total reject counts are updated by the control 434 through the transaction information control 463.

This information indicates the reject occurrence rate for each of storage safes 419; therefore, the safe with a high reject occurrence rate can be identified, suggesting the need for a maintenance checkup by the maintenance personnel or for a replacement operation. For example, if the value indicating the double discharge reject counts is large, the discharging operation can be stabilized by checking or replacing the components, such as the feed roller 42 or reverse roller 43, for discharging the paper currency 40.

Further, the operational data in the storage safe management memory 460 also contains information which is useful for checking the various sensors and actuators in the safe 419. The sensor units 49 and 56 contain a pair consisting of a light emitting device to emit light and a photosensitive device to sense this light, one of which is positioned above and the other of which is below the conveyance passage 109. If foreign substance, such as paper dust, is deposited and accumulated on the light emitting or light sensing section of the sensors, the output values of the sensors are sometimes deteriorated. If such a condition happens, it may occur that the sensors cannot sense the emitted light signal, and consequently, they may react as if they have detected the presence of the paper currency even when the paper currency 40 is not passing by the sensor units. Therefore, in order to prevent such an occurrence, the values for the output levels of the sensor 49 or 56 are stored, through the transaction information control 463, at a position having a predetermined address in the operational data; therefore, the maintenance personnel can be suggested to perform a cleaning operation and the like before the above-mentioned values deteriorate to the critical values at which the erroneous detection begins to occurs.

Further, the same holds true regarding the actuators. For example, if the data pertaining to the cumulative driving hours of the separating and discharging motor 45 is updated and stored, through the transaction information control 463, at a position having a predetermined address in the

operational data, and the rated life E (hour) is established, it becomes possible by comparing those data to inform the maintenance personnel of the component replacement timing before the rated life of the motor 45 expires. Thus, the troubles which are likely to occur to the storage safe 419 can be prevented by identifying them in advance as described above. Incidentally, the operation to collect those operational data and trouble data is carried out by the maintenance personnel, using an operational component such as unshown keys of the internal operation panel 457 of the machine main assembly.

The above-described embodiment is directed to the automatic cash transaction machine functioning as an automatic paper currency dispensing machine which handles the paper currency dispensing transaction. However, needless to say, the present invention is not limited to be applied only to the automatic paper currency dispensing machine, and can be also applied to a machine which handles deposit transactions or a machine which handles both deposit and withdrawal transactions. In other words, if the information pertaining to the types and counts of currency to be deposited, error counts of the cash receiving mechanism, and the like, are stored in the machine to be used for the execution of deposit transactions, and if the information pertaining to the dispensing operation, which was described referring to this embodiment, are stored, in addition to the deposit transaction, in the machine to be used for the execution of both deposit and withdrawal transactions, it can be easily accomplished not only to keep the record of the respective transaction amounts, but also, to locate where the troubles have occurred. Further, it is needless to say that the present invention can be applied to a machine which handles not only paper currency, but also coins.

If it happens that the paper currency storage safe 419 in the middle level slot, which stores the five-thousand yen note, has become empty during the above transaction, the main control 434 executes a control to discharge the paper currency from a different safe to match this amount of five-thousand yen. In other words, since the control 434 knows which type of paper currency is stored in which one of paper currency storage safes 419 which are respectively placed in the uppermost, middle, or lowermost slot, it can execute the control to discharge exact units of the one-thousand yen note in place of the five-thousand yen note. Therefore, in this case, the payment request can be met through the instruction to discharge a total of seven units of the one-thousand yen note from the paper currency storage safe 419 in the uppermost slot.

As described in the foregoing, if the double discharge or skewing is detected during the dispensing operation, the involved units of paper currency are stored in the reject safe 51, and then, the discharging and conveying operations are repeated until the right number of paper currency in the normal condition will have been delivered. Further, if the currency types which are instructed to be discharged by the control 434 do not match the result of the currency type identification which is carried out by the currency type identification sensor 448 on the actually discharged units of paper currency, the blade 50 is rotated to send the involved currency into the reject safe, as when the abnormal conveyance occurs.

The disagreement between the currency type information held by the control 434 and the type of paper currency which is actually discharged and identified by the currency type identification sensor 448 may occur in such a case when a one-thousand yen note is mixed up and stored in the safe for the ten-thousand yen notes, or when the paper currency guide 451b is fitted in the outermost groove 453c which corresponds to the ten-thousand yen note, but the paper currency which have been actually stored are of the five-thousand yen note. However, even if the paper currency of a type different from the type established by the DIP switch 456 has been stored, the discharged paper currency never fails to be identified by the currency type identification sensor 448; therefore, it is not going to be mistakenly paid out to the customer. Further, if all units of the paper currency stored in a particular safe are of a type different from the currency type information indicated by the DIP switch 456, all pieces of the paper currency discharged from this safe are sent to the reject safe 51. Therefore, the control 434 is provided with a control function to halt the operation temporarily; therefore, if a particular safe continuously experiences a predetermined number of rejects, for example 10 times, it is determined that there has been a setting mistake caused by the person in charge or some other reasons, and the operation of the machine is temporarily halted. With the above arrangement, it becomes possible to carry out a smooth paper currency dispensing operation.

Also, when the paper currency are discharged, if a display such as "50 thousand yen is paid from the lowermost opening; five thousand yen, from the middle opening; and two thousand yen, from the uppermost opening" is presented on the display 432, it is possible to minimize an incident such that the customer leaves the cash behind. Also, if it is arranged so that the information pertaining to the types of paper currency set up by the DIP switch 456 is shown on the LED display, for example, of

the DIP switch 456, it becomes possible for the person in charge to have a look at the DIP switch 456 and to find out easily which type of paper currency is stored in which safe.

FIGS. 50 and 51 show a further alternative embodiment in which a signal to indicate the type of the currency stored in the safe 419 is outputted. In the figure, the guide sensors 659a, 659b, and 659c are provided in the respective grooves 453a, 453b and 453c of the projection 452. These sensors comprising detection devices, such as photocouplers, detect whether or not the paper currency guide 451b is fitted in one of the grooves 453a, 453b, and 453c. The signal from those guide sensors 659a, 659b, or 659c is used by the control 434 to determine in which one of the grooves 453a, 453b, and 453c the paper currency guide 451b is engaged, in other words, to identify the currency type.

These guide sensors 659a, 659b, and 659c are formed to have a concave cross section profile, that is, to have a groove 659g located in the middle, as shown in FIG. 52 which represents the sensor 659a. The sensor 659a is positioned to constitute a segment of the groove 453a, in such a manner that the center line of this groove 659g is aligned to form an approximately straight line with the center line of the groove 453a of the projection 452. The output signal of this guide sensor 659a is sent to the connector 426 through the connecting wires 659e and 659f, and then is transmitted to control 434 through the connector 422, 423, or 424 of the machine's main assembly. The paper currency 40 stored in the storage area 400 is supported from underneath with currency table 660.

The procedure for storing the paper currency in the paper currency storage safe 419 is approximately the same as that in the above-mentioned embodiment. Here, when the paper currency guide 451b is fitted in one of the grooves 453a, 453b, and 453c of the projection 452, the corresponding guide sensors 659a, 659b, or 659c outputs the signal to indicate the presence of this paper currency guide 451b. Therefore, when this safe 419 is installed in the automatic paper currency dispensing machine, the type of the paper currency 50 stored in the safe 419 is automatically identified by the control 434 even if the DIP switch 456 is not provided. In other words, even if the information pertaining to the type of the stored paper currency 40 is not manually set, the currency type information is surely transmitted to the control 434. Therefore, the control 434 uses the currency type information obtained as the results of the detection by the guide sensors 659a, 659b, or 659c provided in the paper currency storage safe 419, to instruct each paper currency storage safe 419 to carry out the dispensing operation in response to the pay-

ment request from the customer.

In the above-mentioned alternative embodiment, the guide sensor 659a and the like are photocouplers. However, they do not need to be photocouplers as long as they are detection means for detecting the presence or absence of the paper currency guide 451b. Also, the structure is such that the grooves are formed at three locations in each of two projections 452, totaling six grooves, each of which is provided with its own guide sensor, totaling six sensors. However, the structure may be such that three guide sensors may be provided on only one of the projections 452.

In the aforementioned embodiment, the structure is such that the separating and discharging means for separating the paper currency and discharging it from the paper currency storage space; conveying means for conveying the paper currency to the paper currency discharging opening; reject safe; conveyance direction switching means for guiding the paper currency toward the reject safe; various detection means for detecting the suitability or unsuitability of the paper currency for the dispensing operation; and the like are provided within the paper currency storage safe, but needless to say, there is nothing to interfere with the structure in which the above-mentioned components are provided outside the safe, that is, on the machine's casing. It does not matter as long as the structure is such that the paper currency guide can be adjusted to alter the width of the space where the paper currency is stored, and that the currency type information obtained based on the engaging location of this paper currency guide can be retained.

According to these embodiments, if it become impossible for one of the safes to carry out the paper currency dispensing operation, the paper currency dispensing operation is taken over by the other safe or safes, in other words, each safe has an independent paper currency dispensing function which is not tied to each other's function. Therefore, even if a jam occurs in one of the safes, the dispensing operation can be continued by securing the paper currency dispensing function of the other safes. With this arrangement, it becomes possible to contain the effect of the jam, which has occurred in one of the safes, as a partial malfunction of the machine; therefore, the probability of stopping the entire operation of the machine during the occurrence of jam is minimized, in other words, the operational efficiency is improved.

In addition, since the various information pertaining to the executed transactions, such as the types and counts of the traded cash, independent reject counts for the double discharge, skewing, and the like; rated life of the driving means; and the output values of the detection means, is recorded

in the storage safe management memory of the storage safe, the operational information and trouble data can be grasped for each of the storage safe. As a result, not only the amount of transaction is grasped, but also the areas where troubles may occur can be easily and accurately identified for each of the storage safes during the maintenance check up carried out by the maintenance personnel and the like; therefore, it becomes possible to carry out an accurate and swift maintenance operation, and operational efficiency can be improved. Also, since the areas where troubles may occur can be repaired in advance, based on the information stored in the manner described above in the storage safe management memory, troubles which are so large as to halt the entire operation can be prevented; therefore, the trouble rate becomes small and the operational efficiency improves.

Further, in those embodiments, it is made possible to accommodate all types of paper currency just by switching the engaging location of the paper currency guide within the paper currency storage safe. The information pertaining to the types of the stored currency can be transferred from the input means or the detection means provided adjacent to the grooves, to the control section, by installing the safe in the machine casing. Therefore, it is not necessary to prepare various safes to accommodate various types of paper currency, as it is in the prior machine. The safe may be installed in any installation slot, and also, it is not necessary to match strictly the installation slot to the paper currency type; therefore, the installation becomes simple.

Further, if it is desired that only one type of paper currency be handled, all of the safes are filled with the same type of paper currency, and are installed in the respective slots. With this arrangement, it becomes possible to set up various operational modes which are most suitable for the respective situations. For example, the operational mode can be set only for the currency of a type with a high transaction rate, such as the ten-thousand yen note. With this set up, even if one of multiple safes installed becomes empty, or a trouble has occurred in one of the safes, it becomes possible to utilize the other safes; therefore, it becomes possible to increase the number of paper currency of an identical type without increasing the size of the machine, so that the number of times the person in charge has to fill the paper currency, and the duration of time this filling operation keeps the machine from operating can be reduced, improving customer service.

Further, in the application example in which the currency type information is transmitted to the control section by means of detecting the engaging location of the paper currency guide, an input error,

such as there being a discrepancy between the type of the paper currency which is actually stored and the currency type information which is entered through the input means such as DIP switch, or an input miss, such that it is completely forgotten to input the currency type information, disappears. Therefore, more accurate currency type information can be obtained.

FIGS. 56 and 57 refer to a further alternative embodiment of the present invention. This embodiment is basically similar to the embodiment described so far, except that the motor 736 and the conveyer motor 738 which work for the safe 702 to carry out the discharging or separating operation is placed away from the safe 702. As shown in the drawing, a power transmission joint mechanism 735 is provided within the safe 702, and this is mechanically and removably engaged to the separation motor 736 positioned within the machine, but outside the safe 702, to drive intermittently the picker roller 44 to rotate, so that the paper currency 50 is discharged upward with a predetermined interval. In addition, the safe 702 is provided with another power transmission joint mechanism 737, and this is engaged to the pulleys 55-1 which suspend the conveyer belts 46 and 47. This power transmission joint 737 is mechanically and removably engaged to the conveyer motor 738 positioned also within the machine but outside the safe 702, to transmit the driving force to drive the conveyer belts 46 and 47.

The safe 702 is removably installed in the machine casing 418, in the same manner as the other embodiments. Two power transmission joint mechanisms 735 and 737 are structured to be mechanically connected to the separating motor 736 and conveyer motor 738, respectively, when the safe 702 is installed in an operable manner in the casing 418. Though not illustrated in detail, a gear mechanism which can be removably engaged, or a friction link mechanism in which high friction components are placed in contact, is preferably adapted. Of course, when the safe 702 is removed from the casing 418, those power transmission joint mechanisms 735 and 737 are mechanically separated from the separating motor 736 and conveyer motor 738, respectively.

In this embodiment, the blade 50 of the safe 702 is structured to position itself, as shown in FIG. 55, to guide the paper currency 40 to the reject safe 51 in the normal condition. In particular, a locking mechanism may be provided to lock the blade 50 in this position in response to the separation of the safe 702 from the casing 418. The safe control 460 provided individually in the safe 702 drives the blade 50 to take the position shown in FIG. 54 only when it determines that no double conveyance is happening to the paper currency 40

which is being conveyed through the conveyance passage 109, and also, the degree of skewing falls within a permissible range, so that the paper currency 40 is guided to the paper currency discharge opening 58. If the paper currency 40 which is subjected to the double conveyance, or the paper currency 40, the skewing degree of which is beyond the permissible range, is detected by the sensor units 49 and 56, of course, the safe control circuit 460 drives the blade 50 to take the position to guide the paper currency 40 to the reject safe 51.

According to this embodiment, the blade provided along the conveyance passage within the safe is always directed toward the reject safe side, and only when it is determined by the transmission type of photosensors or other types of photosensors that the paper currency is being conveyed without being subjected to the double conveyance and being skewed beyond the permissible range, is it switched to the direction of the paper currency discharge opening, so that the paper currency is discharged from the paper currency discharge opening. Therefore, when the safe is removed from the dispensing machine, the blade is never switched since the sensors do not function. Consequently, even if the power transmission joint section at the end of the safe is manually operated and the paper currency are conveyed through the conveyance passage, all of them end up being stored in the reject safe, in other words, the apprehension that the paper currency within the safe may be taken out is eliminated. Also, since the separation motor and the conveyer motor are not provided within the safe, the weight of the safe can be reduced to offer better portability.

In the embodiments described so far, the paper currency collection tray is provided for each safe, but it is needless to say that it may be structured so that a single paper currency collection tray is provided, which is connected to the paper currency discharge opening of each safe, through a common conveyance passage.

Now then, an embodiment such as the above is described referring to FIGS. 58 and 59, in which there is a single pick-out window connected to plural safes through a common conveyance passage. The automatic paper currency dispensing machine of this embodiment has the casing 815, on the front panel of which, that is, the panel where the customer faces, a pick-up slot 816 is formed, into which the paper currency is discharged. The pick-up slot 816 is provided with the shutter 821 which can be opened or closed. Also, the card slot 817 is formed on the front panel of the casing 815, where the card is inserted or ejected. The casing 815 has a rear door 818, which can be opened by maintenance personnel to access the interior of the

machine. Within the casing 815, the discharging mechanism unit 819 is contained so as to be flanked with the pick up slot 816, and also, the card reader/printer (CPR) 820 is contained to be flanked with the card slot 817.

In this embodiment, the discharging unit 819 comprises three discharging modules 822. The discharging modules 822 may have a basically identical structure, and are removably installed in the discharging mechanism unit 819 from behind the machine by opening the rear door 818. The discharging module 822 contains, as shown in FIG. 60, a casing 822a which is generally rectangular, and can be stacked within the discharging mechanism unit 819. Discharging module 822 contains a removable safe 825, in which the paper currency 40 to be dispensed is stored. The dispensing module 822 further comprises a conveyance passage mechanism 826 to sandwich and convey the paper currency discharged from the safe 825 and a different conveyance passage mechanism 827 to sandwich and convey the paper currency delivered through the preceding conveyance passage mechanism 826. Both conveyance passage mechanisms 826 and 827 comprise conveyer belts, which will be described later, and rollers and pulleys which support these belts. When the discharging modules 822 are stacked as shown in FIG. 59, the conveyance passage mechanism 827 communicates with the discharging modules 822, forming a common conveyance passage for the paper currency.

It can be better understood by referring to FIGS. 61 and 62 how the power is transmitted to the conveyance passage mechanism 827. The dispensing unit 819 contains a gear 828, which rotates by receiving the driving force from the driving means, not shown, such as the motor contained in the discharging mechanism. The conveyance passage mechanism 827 has a gear 829, which detachably engages with a gear 839 of the discharging mechanism unit 819, or the gear 839 of another discharging module 822 positioned right above this discharging module, to receive the external driving force and transmit it to the conveyance passage mechanism 826. The gear 829 is fixed on an axis 830, and a pulley 831 is fixed on this axis 830. A conveyer belt 832 is suspended on the pulley 831, whereby the power received externally through the gear 828 is transmitted to the conveyer belt 832. This pulley 831 and conveyer belt 832 are included in the conveyance passage mechanism 826. In the same manner, the gear 829 is also engaged with a gear 833, to drive the conveyance passage mechanism 827. The gear 833 is fixed on an axis 834, on which a pulley 835 is fixed. On the pulley 835, a conveyer belt 836 is suspended, whereby the power received externally

through the gear 828 is transmitted to the conveyer belt 836. Those pulley 835 and conveyer belt 836 are included in the conveyance passage mechanism 827.

The gear 833 and a toothed pulley 837 are integrally formed to share the same axis. On this toothed pulley 837, a toothed belt 838 is suspended on one end, and this toothed belt 838 is suspended on a toothed pulley 839 on the other end. The toothed pulley 839 is integrally formed with a gear 840 to share the same axis. Therefore, when the gear 833 is driven, this gear 840 is driven through the toothed pulley 837, toothed belt 838, and toothed pulley 839. The toothed gear 840, together with the toothed pulley 839, constitutes the power output means for transmitting the power from this discharging module 822 to another discharging module 822 positioned right below the preceding discharging module 822.

The discharging module 822 is stored and stacked in the dispensing mechanism unit 819 of the automatic paper currency dispensing machine, whereby the gear 828, which is the power output means of the discharging mechanism unit 819, engages with the gear 829, which is the power input means of the discharging module 822 stacked at the top. With this arrangement, the pulley 831, conveyer belt 832, pulley 835, and conveyer belt 836, which constitute the conveyance or transport passage mechanisms 826 and 827 of the discharging module 822, are driven to rotate. Further, the gear 840, which is the power output means of the discharging module 822 positioned at the top, engages with the gear 829, which is the power input means of the discharging module 822 positioned right below. Thus, the pulleys and conveyer belts which constitute the conveyance passage 826 and 827 of the discharging module 822 positioned right below are also driven to rotate. As shown in FIG. 59, the same is true for the transmission of power to the discharging module 822 positioned at the bottom.

The safe 825 stored in the discharging module 822 may basically have the same structure as the safe 31 or 702 in the embodiments described so far. FIG. 63 shows its basic structure, but in the instant embodiment, the structure may be the same as the safe 31 except that a reject paper currency storage space 854 should be prepared in place of the reject safe 51 of the safe 31. However, this difference is not essential. In this embodiment, the conveyer motor 48 which drives the conveyer belts 46 and 47 within the safe 825 is mounted outside the safe 835, but it is also acceptable to eliminate this conveyer motor 48, as in the safe 702 in FIG. 57, and receive externally the driving force for these conveyer belts 46 and 47 through a gear coupling or the like.

Going back to FIG. 59, the discharging mechanism unit 819 has a paper currency collection stage 861, which collects only the paper currency which is normally delivered. Right above this stage 861, there is another stage 862 for collecting the statement strip. This pair of stages 861 and 862 comprise a temporary holding area 863 of this embodiment. It is structured so that the stage 861 can be retracted by the unshown driving means from a position J outlined by the solid line to another position K outlined by the single-dot chain line, and the paper currency deposited on this stage 861 can be passed onto the lower conveyer belt 867 which constitutes a conveyance passage mechanism 866, which will be described later. Also, it is structured so that the stage 862 has a gap of a predetermined width so that it does not interfere with the rotation of the upper conveyer belt 868 toward the lower conveyer belt 867 of the conveyance passage mechanism 866, which will be described later.

The discharging mechanism unit 819 further contains another conveyance passage mechanism 864, which comprises a conveyer belt, rollers, and the likes, to sandwich and convey the paper currency. This common conveyance passage mechanism 864 is structured so that its entrance end communicates with the conveyance passages 826 and 827 of the discharging module 822 stacked right at the top, and its exit end is positioned to flank the tip of the stage 861.

The discharging mechanism unit 819 also has a box 865. This box 865 is a temporary storage box which is placed below and behind the temporary holding area 863 and retrieves and stores the paper currency which the customer forgets to pick up. This temporary storage box 865 is detachably attached to the discharging mechanism unit 819. The discharging mechanism unit 819 further contains yet another conveyance passage mechanism 866, and this conveyance passage mechanism 866 comprises a lower conveyer belt 867 and an upper conveyer belt 868. The lower conveyer belt 867 is placed so that one end of it flanks the shutter 821, right below the temporary holding area 863, and the other end of it is positioned above the temporary storage box 865. The upper conveyer belt 868 is arranged to be able to rotate, as shown by an arrow L, about one of its own ends, on the shutter 821 side, and coordinates with the lower belt 867 to sandwich the paper currency and convey it either forward or backward. The discharging mechanism unit 819 is also provided with yet another conveyance passage 869. This is positioned at one of the side ends of the stage 862 of the temporary holding area, and constitutes a conveyance passage through which the statement is delivered.

A card reader/printer 820 contains a card read/write unit 870, which reads the identification information, account number information, and the like, which specify the customer, or writes the transaction information. The card reader/printer 820 is loaded with printing paper set 872 consisting of a continuous strip paper, on which the statement is printed, and journal paper, on which the transaction is recorded. The pertinent information is printed on this printing paper set 872 by a printer consisting of a printing head and its driver mechanism. After printing, the strip is sent to the discharging mechanism unit 819 as the statement 873 by card reader/printer 820, and the journal paper is rolled up by a winding mechanism 875 for journal paper.

As shown in FIG. 58, a key pad 876 comprising multiple keys is provided on the front panel of the casing 815. This key pad 876 is used by the customer to input the password, amount to be paid out, and the like. Also, a display 877 is provided on the front panel of the casing 815, and this is used to present the customer instruction for input procedure or other information. Further, though not illustrated, a voice synthesizer is provided within the casing, which generates voices corresponding to the information presented on the display 877.

For example, the ten-thousand yen note is stored in the safe 825 stacked at the top; the ten-thousand yen note, also in the middle safe 825; and the one-thousand yen note is stored in the bottom safe 825. It is needless to say that the selection of currency type combination is optional.

First, the customer inserts the card 871 through the card slot 817, and inputs the amount to be paid (for example, 55,000 yen) through the key pad 876. Then, a command to discharge five units of the ten-thousand yen note is sent by the unshown control section to the discharge module 822 stacked at the top. Next, the picker roller 44 and feed roller 42 within the safe 825 are rotatively driven, whereby the paper currency 40a is separated piece by piece, and is held between and conveyed by conveyer belts 46 and 47. If it is found, as the identification results of the conveyance condition by the sensors 56 and 49, that there is no double conveyance nor chain conveyance, and the degree of skewing is also within a permissible range, this paper currency 40a is conveyed through the conveyance passage 826, conveyance passage 827, and conveyance passage 864 to be deposited on the temporary holding area 863, and is temporarily held there. If there occurs a double conveyance, chained conveyance, or skewing beyond the permissible range, the conveyance direction is switched by the blade 50 and the paper currency is stored in the reject note storage 854.

As the necessary units of the ten-thousand yen note are deposited on the stage 861 of the temporary holding area 863, the separation and conveyance of the ten-thousand yen note from the uppermost safe 825 is ceased. However, if the paper currency in the ten-thousand yen paper currency safe 825 runs out before all of the necessary five units of the ten-thousand yen note are discharged, the paper currency discharging operation is taken over and continued by the middle discharging module 822, which follows the same procedure.

Next, a command to discharge five units of thousand yen note is sent to the one-thousand yen note safe 825 at the bottom, the paper currency is conveyed, as the ten-thousand yen note is, through the conveyance passages 826 827 of this one-thousand yen note safe 835, conveyance passages 827 of the middle and uppermost discharge modules 822, and the common conveyance passage 864, to be deposited on the stage 861 of the temporary holding area 863, and then, the separation and conveyance of the thousand yen note is ceased. Incidentally, just as is in the case of the ten thousand yen note, the paper currency which is abnormally delivered is not discharged from the discharging module 822, but instead, is stored in the reject note storage 854.

In this mode of depositing the paper currency on the stage 861, the upper conveyer belt 868 of the conveyance passage 866 is opened in advance upward from the lower conveyer belt 867. Therefore, when the units of paper currency matching the amount and unit counts requested by the customer are deposited on the stage 861, the detail of this transaction is printed on the printing paper set 872 by the printer 874. Then, the printed section of this printing paper set 872 is cut as a form of the statement 873 by the unshown cutter, and sent into the conveyance passage 869. This statement 873 is sent from the card read/printer 820 to the discharging mechanism unit 819, and conveyed further through the conveyance passage 869 onto the stage 862 of the temporary holding area 863.

At this time, the upper conveyer belt 868 of the conveyance passage 866 swings downward to close and comes in contact with the lower conveyer belt 867. At the same time, the stage 861 retracts itself down to the position K from the position J, and by this series of operations, the statement on the stage 862 as well as the paper currency on the stage 861 are held between the lower and upper conveyer belts 867 and 868. Then, the paper currency and statement are conveyed by both of these conveyer belts 867 and 868 as far as the pick up window 816. At this moment, the shutter 821 is opened by the unshown means, making it possible for the customer to

access the paper currency and statement 873. If the paper currency are not picked out by the customer within a predetermined length of time after the opening of the shutter 821, in other words, if the customer forgets to pick up the paper currency, the paper currency and statement are conveyed to the direction opposite to the above mentioned one, by both of the conveyer belts 867 and 868 of the conveyance passage 866 after an elapse of the predetermined period of time, and are dropped into the temporary storage box 865 at the end of the passage. Meanwhile the shutter 821 is closed.

As described above, in this embodiment, the paper currency to which abnormal conveyance conditions occur due to the discharge or separation failure is not discharged out of the safe; therefore, the paper currency jam which occurs outside the safe can be prevented. Also, the safe may be of the same structure, and it is not necessary for various types of safes to be prepared to accommodate different types of note, as they are in the prior embodiment. Since the means for separating and discharging the paper currency is provided within the safe, if a trouble occurs to the separating and discharging means, the machine can be made to recover from the trouble just by exchanging the detachable safe, enabling the restart-up of the machine in an extremely short time. Further, since it can be determined, during the recovery of the paper currency in the safe, whether or not the separating and discharging means in a particular safe is abnormal, on the basis of the count of the paper currency stored in the reject note storage, it becomes possible to carry out a repair or exchange operation before a trouble occurs.

Further, since the paper currency conveyance passage of the safe, along which the identification means are provided, is positioned to face rearward relative to the direction in which the paper currency is arranged in the safe, the machine sized can be reduced.

Also, when the discharging modules are stored in the automatic paper currency dispensing machine, being stacked on top of each other, the power input means of one of the discharging modules engages with the power output means of the discharging mechanism unit, as well as the power output means and power input means of the adjacent discharging modules engage to each other, whereby the driving power is transmitted from the discharging mechanism unit to all of the discharging modules; therefore, the structure of the power output means of the discharging mechanism unit can be made simple, and the operation to install or remove the discharging module can be easily carried out.

While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by those embodiments. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.

Claims

1. A negotiable-instrument handling machine comprising:

a first storage for storing a negotiable instrument;

discharging means for discharging the negotiable instrument from said first storage;

conveying means for conveying the discharged negotiable instrument; and

a first casing for encasing said storage, discharging means, and conveying means, and having a first opening formed, from which the negotiable instrument conveyed through said conveying means is discharged;

CHARACTERIZED IN THAT

said machine further comprises:

a second casing (418) having a plurality of installation slots for storing detachably said first casing (53, 54), and a plurality of second opening (427, 428, 429) formed corresponding to said plurality of installation slots, said second opening (427, 428, 429) being positioned to communicate with said first opening (58) when said first casing (53, 54) is in the installation slot;

a first control circuit (33, 34, 35) provided within said first casing (53, 54) for controlling said discharging means (44, 45, 42, 43) and conveying means (48, 109);

a second control circuit (434) provided within said second casing (418) for controlling said first control circuit (33, 34, 35); and

connecting means comprising a first connector (426) provided on said first casing (53, 54), and a second connector (422, 423, 424) provided on said second casing (418) for interconnecting said first control circuit (33, 34, 35) to said second control circuit (434) when said first casing is stored in the installation slot.

2. A machine in accordance with claim 1

CHARACTERIZED BY

a pair of guide members (451a, 451b) facing each other within a storage (400) provided within said first casing (53, 54) for guiding the negotiable instrument (40, 40a) in said storage (400) toward said discharging means (44, 45, 42, 43), at least one (451b) of said pair of guide members (451a, 451b) being movable

relative to said first casing (53, 54);

holding means (452) for selectively defining a plurality of holding positions, at which said one guide members (451b) is held in parallel to the other (415a) of the guide members, so that the distance between said guide members (451b) can selectively accommodate the lengths of the available negotiable instruments (40) which are arranged substantially perpendicularly to the direction to which the negotiable instruments (40) are discharged by said discharging means (44, 45, 42, 43); and

input means (456, 456a, 659a, 659b, 659c) provided on said first casing (53, 54) for generating a signal indicating a paper currency type of the negotiable instrument (40, 40a) stored in said storage (400).

3. A machine in accordance with claim 1 CHARACTERIZED BY data storage means (35, 46) provided within said first casing (53, 54) for storing, under the control of said first control circuit (33, 34, 35), data associated with the transactions executed by said machine.

4. A machine in accordance with claim 3 CHARACTERIZED BY instructing means (457) for entering an instruction to read the data stored in said data storage means (35, 460); said second control circuit (434) controlling said data storage means (35, 460) in response to said instructing means (457) to read the data from said data storage means (35, 460).

5. A machine in accordance with claim 1 CHARACTERIZED IN THAT said machine further comprises:

detecting means (49, 56, 71) provided within said first casing (53, 54) for detecting, under the control of said first control circuit (33, 34, 35), whether or not the negotiable instrument (40a) is in a proper condition while being conveyed through said conveying means (48, 109);

a second storage (51) provided within said first casing (53, 54), for storing the negotiable instrument (40a); and

selecting means (50, 50a) provided within said first casing (53, 54) and positioned between said conveying means (48, 109) and said first opening (58) for selectively directing, under the control of said first control circuit (460, 33, 34, 35), the negotiable instrument (40a) delivered through said conveying means (48, 109) to either of said first (58) and second storages (51);

said first control means (33, 34, 35) con-

trolling, in response to said detecting means (49, 56, 71) detecting the improper condition of the negotiable instrument (40a) while being conveyed through said conveying means (48 and 109), said selecting means (50, 50a) to guide the delivered negotiable instrument (40a) to said second storage (51).

6. A machine in accordance with claim 5 CHARACTERIZED IN THAT when the negotiable instrument (40a) cannot be discharged from said first casing (53, 54) in one of the plurality of installation slots, said second control circuit (434) controls discharging the negotiable instrument (40a) from said first casing (53, 54) installed in another of the plurality of installation slots.

7. A machine in accordance with claim 5 CHARACTERIZED BY driving means (736, 738) provided within said second casing (418) for generating a driving force to drive said discharging means (44, 45, 42, 43) and conveying means (48, 109);

power transmission means (735, 737) provided within said first casing (53, 54) and mechanically connected to said driving means for receiving a driving force from said driving means (736, 738) and transmitting the driving force to said discharging means (44, 45, 42, 43) and conveying means (48, 109) when said first casing (53, 54) is installed in the installation slots;

said selecting means (50 and 50a) directing, in response to said detecting means (49, 56, 71) detecting the improper condition of the negotiable instrument (40a) while being conveyed through said conveying means (48 and 109), under the control of said first control circuit (33, 34, 35), the delivered negotiable instrument (40a) to said second storage (51); and otherwise, directing the negotiable instrument (40a) delivered through said conveying means (48 and 109) to said first opening (58).

8. A negotiable-instrument handling machine comprising:

a first storage for storing a negotiable instrument;

discharging means for discharging the negotiable instrument from said first storage;

conveying means for conveying the discharged negotiable instrument; and

a first casing for encasing said storage, discharging means, and conveying means, and having a first opening formed, from which the negotiable instrument conveyed through said

conveying means is discharged;

CHARACTERIZED IN THAT

said machine further comprises:

a second casing (26, 26a) of a portable size having an installation slot to store removably said first casing (53, 54), and having a second opening (22) formed to be positioned to communicate with the first opening (58) when said first casing (53, 54) is in the installation slot;

operating means (23, 24) provided on said second casing (26, 26a) for manually entering instructions and data including a request for dispensing the negotiable instrument (40, 40a);

displaying means (23) provided on said second casing (26, 26a) for visually displaying the condition of said machine and data;

a first control circuit (33, 34, 35) provided within said first casing (53, 54) for controlling said discharging means (44, 45, 42, 43) and conveying means (48, 109);

a second control circuit (30) provided within said second casing (26, 26a) for controlling said first control circuit (33, 34, 35) and displaying means (23), in response to said operating means (23, 24).

9. A negotiable-instrument handling machine comprising:

mechanical discharging means for storing a negotiable instrument, and discharging and conveying the stored negotiable instrument;

a first casing for storing said mechanical discharging means, and having a first opening formed to discharge the conveyed negotiable instrument;

CHARACTERIZED IN THAT

said machine further comprises:

a first storage (400) for storing the negotiable instrument (40, 40a);

first discharging means (44, 45, 42, 43) for discharging the negotiable instrument (40, 40a) from said first storage (400);

first conveying means (48, 109) for conveying the discharged negotiable instrument (40, 40a);

a second casing (825) for encasing said storage (400), discharging means (44, 45, 42, 43), and conveying means (48, 109), and having a second opening (58) formed to discharge the negotiable instrument (40a) delivered through said conveying means (48, 109), from said second casing (825);

a third casing (822a) capable of being stacked on top of each other within said mechanical discharging means (819) for storing said second casing (825);

second conveying means (826) provided within said third casing (822a) for conveying the negotiable instrument (40a) discharged from said second opening (58) to a first position directed to the outside of said third casing (822a);

third conveying means (827) provided within said third casing (822a) for conveying the negotiable instrument (40a), delivered to a second position directed to the outside of said third casing (822a), to the first position;

the second position meeting, when said third casings (822a) are stacked up on top of each other, with the first position of adjacent one of said third casings (822a);

first power transmission means (829) provided within said third casing (822a) for receiving, through the third position, the power from outside said third casing (822a), to transmit the power to said second and third conveying means (826, 827); and

second power transmission means (829) provided within said third casing (822a) for transmitting the power out of said third conveying means (827) at a fourth position;

the fourth position meeting, when said third casings (822a) are stacked up on top of each other, with the third position of adjacent one of said third casings (822a), said second power transmission means (829) being mechanically connectable, when said third casings (822a) are stacked up on top of each other, with said second power transmission means (829) of adjacent one of said third casings (822a);

said mechanical discharging means (819) further comprising:

fourth conveying means (864) for conveying the negotiable instrument (40a) delivered to the first position to a first opening (816), and

driving means (828) mechanically connectable to said first power transmission means (829) of said third casing (822a) positioned at an end, when said third casings (822a) are stacked up, for supplying the power to said first power transmission means (829).

10. A machine in accordance with claim 9

CHARACTERIZED BY

temporary holding means (861) located between said fourth conveying means (864) and the first opening (816) for holding the negotiable instrument (40a) delivered through said fourth conveying means (864); and

means (865) for retrieving, after an elapse of a predetermined period of time, the negotiable instrument (40a) being held by said temporary holding means (861).

11. A safe comprising:

a first storage for storing a negotiable instrument;

discharging means for discharging the negotiable instrument from said first storage;

conveying means for conveying the discharged negotiable instrument; and

a first casing for encasing said storage, discharging means, and conveying means, and having a first opening formed, from which the negotiable instrument conveyed through said conveying means is discharged;

CHARACTERIZED IN THAT

said safe further comprises:

detecting means (49, 56, 71) provided within said first casing (53, 54) for detecting whether or not the negotiable instrument (40a) is in a proper condition while being conveyed through said conveying means (48 and 109);

a second storage (51) provided within said first casing (53, 54), storing the negotiable instruments (40a); and

selecting means (50, 50a) provided within said first casing (53, 54) and positioned between said conveying means (48, 109) and said first opening (58) for selectively directing the negotiable instrument (40a) delivered through said conveying means (48, 109) to either of the first (58) and second storages (51); and

a control circuit (33, 34, 35) provided within said first casing (53, 54) for controlling said discharging means (44, 45, 42, 43), conveying means (48, 109), and selecting means (50, 50a), in response to said detecting means (49, 56, 71);

said control circuit (33, 34, 35) controlling, in response to said detecting means (49, 56, 71) detecting an improper condition of the negotiable instrument (40a) while being conveyed through said conveying means (48, 109), said selecting means (50, 50a) to guide the delivered negotiable instrument (40a) to said second storage (51).

12. A safe in accordance with claim 11

CHARACTERIZED IN THAT

said discharging means (44, 45, 42, 43) comprises:

a picker roller (44) being rotatable and in contact with the negotiable instrument (40, 40a) stored in said first storage (400) for discharging the negotiable instrument with which it is in contact;

pressing means (41) for pressing the negotiable instrument (40, 40a) stored in said first storage (400), toward said picker roller (44), so that the most forward piece of the negotiable

instrument (40, 40a) is put in contact with said picker roller (44);

a feed roller (42) rotatable for feeding the negotiable instrument (42a) discharged by said picker roller (44);

a reverse roller (43) rotatable and positioned to face said feed roller (42), so that no more than one piece of the discharged negotiable instrument (40a) is sent out;

driving means (45) for driving said picker roller (44) and feed roller (42); and

a one-way clutch (137) interposed along a power transmission linkage from said driving means (45) to said feed roller (42);

said conveying means (48, 109) comprising:

groups of rollers (55, 55-1) facing each other and rotatable; and

belts (46, 47) suspended and capable of travelling facing each other by said groups of rollers (55, 55-1);

said detecting means (49, 56, 71) comprising:

a first detection circuit (178) for detecting a leading end of the discharged negotiable instrument (40a) at a first position (C), and producing a first signal for halting a driving action of said driving means (45); and

a second detection circuit (179) for detecting a trailing end of the discharged negotiable instrument (40a) at a second position (D), and producing a second signal for starting the driving action of said driving means (45);

the first position (C) being displaced from a third position in a conveyance direction in which the negotiable instrument (40a) is conveyed by a length of a first distance to satisfy such a condition that, when the leading end of the negotiable instrument (40a) reaches the first position (C), the trailing end of the negotiable instrument (40a) is released from the hold of said picker roller (44), and after said conveying means (49, 56, 71) takes hold of the vicinity of a leading tip of the negotiable instrument (40a) between said belts (46, 47) to assure the conveyance of the negotiable instrument (40a) at a third position, the leading end of the negotiable instrument (40a) reaches the first position (C) (FIG. 11);

the second position (D) being displaced from a position, where the negotiable instrument (40a) is gotten hold of between said feed roller (42) and reverse roller (43), in the conveyance direction of the negotiable instrument, by a length of a second distance, to satisfy such a condition that, after the trailing end of the negotiable instrument (40a) is released from the hold of said feed roller (42), the

trailing end of the negotiable instrument (40a) reaches the second position (D) (FIG. 13).

13. A safe in accordance with claim 11

CHARACTERIZED IN THAT

said discharging means (44, 45, 42, 43) comprises:

a picker roller (44) being rotatable and in contact with the negotiable instrument (40, 40a) stored in said first storage (400) for discharging the negotiable instrument with which it is in contact;

pressing means (41) for pressing the negotiable instrument (40, 40a) stored in said first storage (400) toward said picker roller (44), so that the most forward piece of the negotiable instrument (40, 40a) is put in contact with said picker roller (44);

a feed roller (42) rotatable for feeding the negotiable instrument (42a) discharged by said picker roller (44);

a reverse roller (43) rotatable and positioned to face said feed roller (42), so that no more than one piece of the discharged negotiable instrument (40a) is sent out;

driving means (45) for driving said picker roller (44) and feed roller (42); and

a first one-way clutch (137) interposed along a driving power transmission linkage from said driving means (45) to said feed roller (42);

said conveying means (48, 109) comprising:

groups of rollers (55, 55-1) facing each other and rotatable; and

belts (46, 47) suspended and capable of travelling facing each other by said groups of rollers (55, 55-1);

said discharging means (44, 45, 42, 43) further comprising:

a second one-way clutch (176) interposed along a power transmission linkage from said driving means (45) to said picker roller (44);

said detecting means (49, 56, and 71) comprising:

a first detection circuit (178) for detecting a leading end of the discharged negotiable instrument (40a) at a first position (C), and producing a first signal for halting a driving action of said driving means (45); and

a second detection circuit (179) for detecting a trailing end of the discharged negotiable instrument (40a) at a second position (D), and producing a second signal for starting the driving action of said driving means (45);

the first position (C) being displaced from a third position in a conveyance direction in

which the negotiable instrument (40a) is transported by a length of a first distance to satisfy such a condition that, when the leading end of the negotiable instrument (40a), which is the shortest one, measured in the conveyance direction, among the available negotiable instrument (40, 40a) reaches the first position (C), the trailing end of the negotiable instrument (40a) is released from the hold of said picker roller (44), and after said conveying means (49, 56, 71) takes hold of the vicinity of a leading tip of the negotiable instrument (40a) between said belt (46 and 47) to assure the conveyance of the negotiable instrument (40a) at a third position, the leading end of the negotiable instrument (40a) reaches the first position (C) (FIG. 11);

the second position (D) being displaced from a position where the negotiable instrument (40a) is gotten hold of between said feed roller (42) and reverse roller (43), by a length of a second distance in the conveyance direction of the negotiable instrument, to satisfy such a condition that, after the trailing end of the negotiable instrument (40a) is released from the hold of said feed roller (42), the trailing end of the negotiable instrument (40a) reaches the second position (D) (FIG. 13).

14. A safe in accordance with claim 11

CHARACTERIZED IN THAT

said discharging means (44, 45, 42, 43) comprising:

a picker roller (44) being rotatable and in contact with the negotiable instrument (40, 40a) stored in said first storage (400) to discharge the negotiable instrument with which it is in contact;

pressing means (41) for pressing the negotiable instrument (40, 40a) stored in said first storage (400) toward said picker roller (44), so that the most forward piece of the negotiable instrument (40, 40a) is put in contact with said picker roller (44);

a feed roller (42) rotatable for feeding the negotiable instrument discharged by said picker roller (44);

a reverse roller (43) rotatable and positioned to face said feed roller (42), so that no more than one piece of said discharged negotiable instrument (40a) is sent out;

driving means (45) for driving said picker roller (44) and feed roller (42); and

a first one-way clutch (137) interposed along a driving power transmission linkage from said driving means (45) to said feed roller (42);

said conveying means (48, 109) comprising:

ing:

groups of rollers (55, 55-1) facing each other and rotatable; and

belts (46, 47) suspended and capable of travelling facing each other by said groups of rollers;

said discharging means (44, 45, 42, 43) further comprising:

a second one-way clutch (176) interposed along a power transmission linkage from said driving means (45) to said picker roller (44);

said detecting means (49, 56, 71) further comprising:

a detection circuit (180) for detecting a leading end of the discharged negotiable instrument (40a) at a first position (C);

said control circuit (33, 34, 35, 460) comprising:

timing means for halting a driving action of said driving means (45) in response to said detection circuit (18), starting to clock, and after an elapse of a predetermined period of time, restarting the driving action of said driving means (45);

the first position (C) being displaced from a second position in a conveyance direction in which the negotiable instrument (40a) is transported by a length of a first distance to satisfy such a condition that, when a leading end of the negotiable instrument (40a), which is the shortest one, measured in the conveyance direction, among the available negotiable instrument (40, 40a) reaches the first position (C), a trailing end of the negotiable instrument (40a) is released from the hold of said picker roller (44), and after said conveying means (49, 56, 71) takes hold of the vicinity of a leading tip of the negotiable instrument (40a) between said belt (46, 47) to assure the conveyance of the negotiable instrument (40a) at the second position, the leading end of the negotiable instrument (40a) reaches the first position (C) (FIG. 20).

15. A safe in accordance with claim 13 or 14, CHARACTERIZED BY

a rotatable axis (124) rotatable by said driving means (45), and extending in a direction substantially perpendicular to a direction to which said negotiable instrument (40, 40a) is conveyed;

two of said picker roller (44) being provided, which are mounted on said rotatable axis through the medium of a corresponding pair of said second one-way clutch (176).

16. A safe in accordance with claim 12 or 13, CHARACTERIZED IN THAT when said detecting means (49, 56, 71) detects the improper condition of the negotiable instrument (40a) while being conveyed through said conveying means (48, 109), said control circuit (33, 34, 35) controls said conveying means (48, 109) to reduce the speed at which said conveying means (48, 109) conveys the negotiable instrument (40a), and controls said selecting means (50, 50a) to direct the delivered negotiable instrument (40a) toward said second storage (51).

17. A safe in accordance with claim 12 or 13, CHARACTERIZED IN THAT after the last piece of a specified number of the negotiable instrument (40, 40a) to be dispensed is detected, while being conveyed through said conveying means (48, 109), by said detecting means (49, 56, 71), and in addition, another negotiable instrument (40a) is detected, while being conveyed through said conveying means (48, 109), by said detecting means (49, 56, 71), said control circuit (33, 34, 35) controls said conveying means (48, 109) to reduce the speed at which said conveying means (48, 109) conveys the negotiable instrument (50, 50a), and controls said selecting means (50, 50a) to direct the delivered negotiable instrument (40a) toward said second storage (51).

Fig. 1

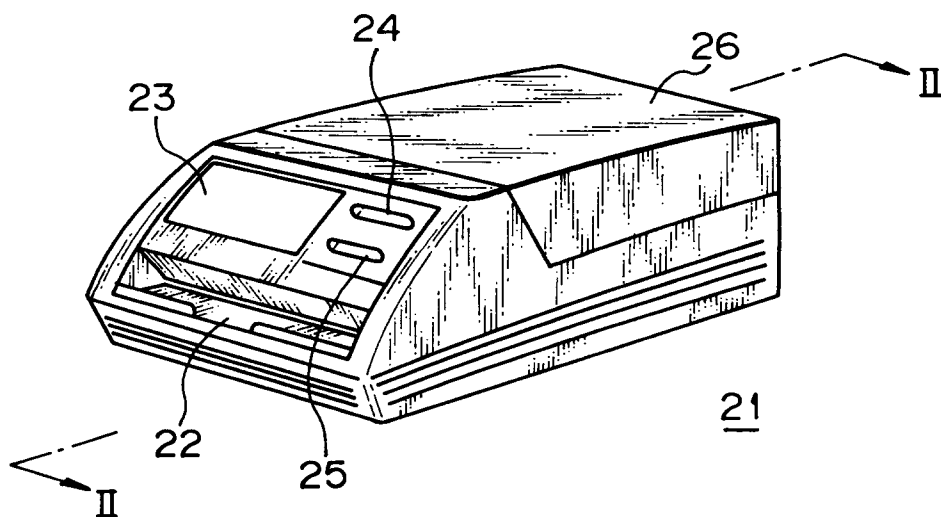


Fig. 3

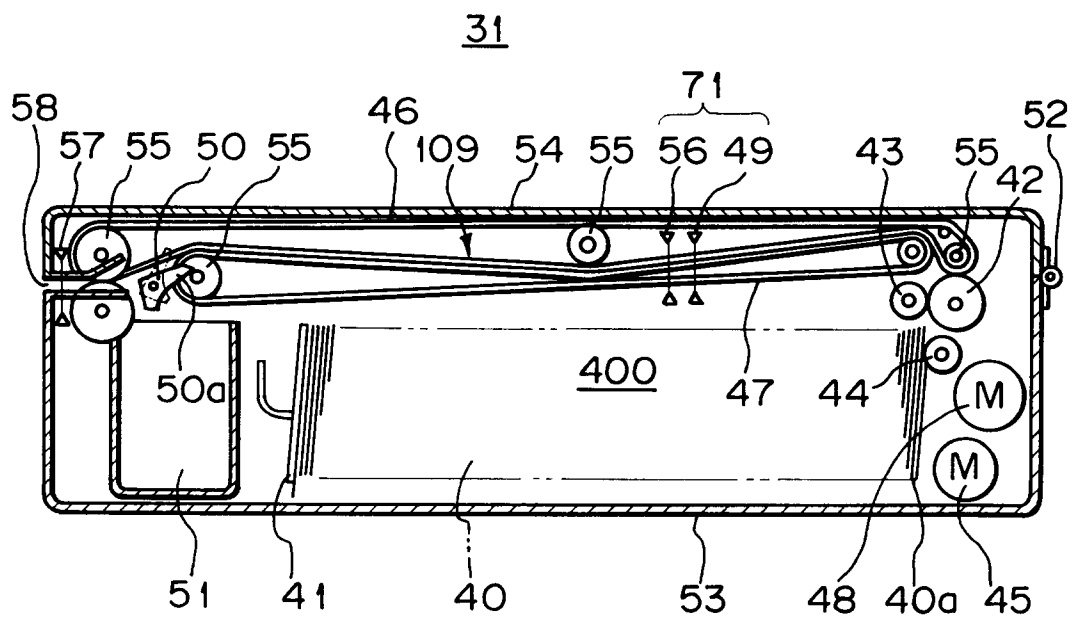


Fig. 2

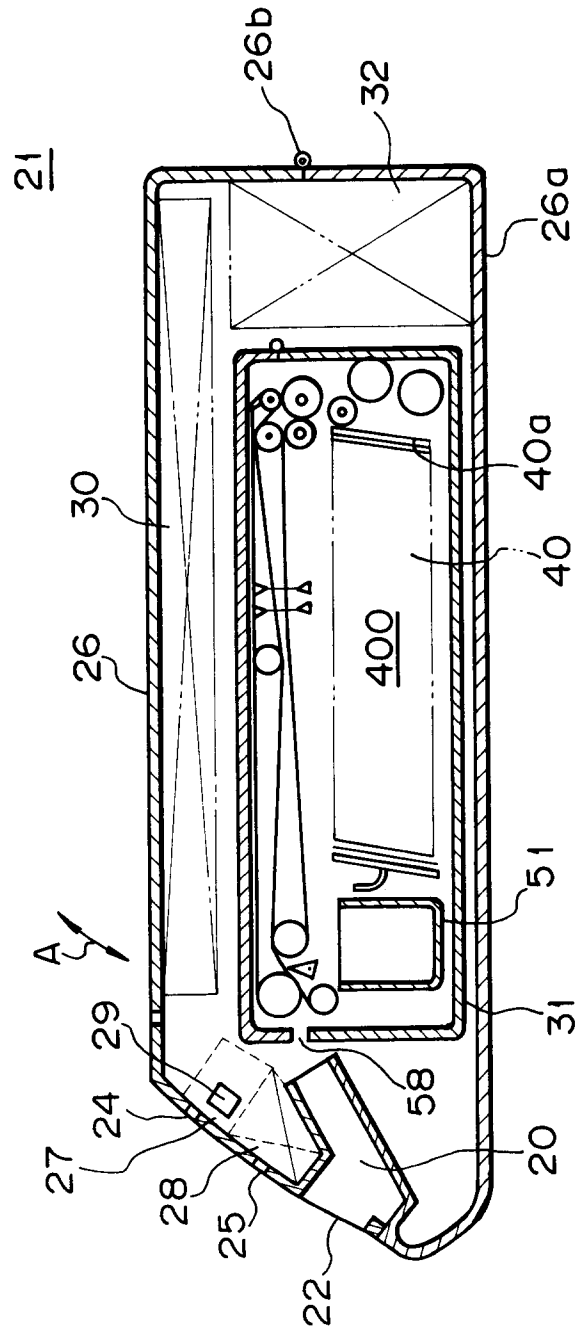


Fig. 4

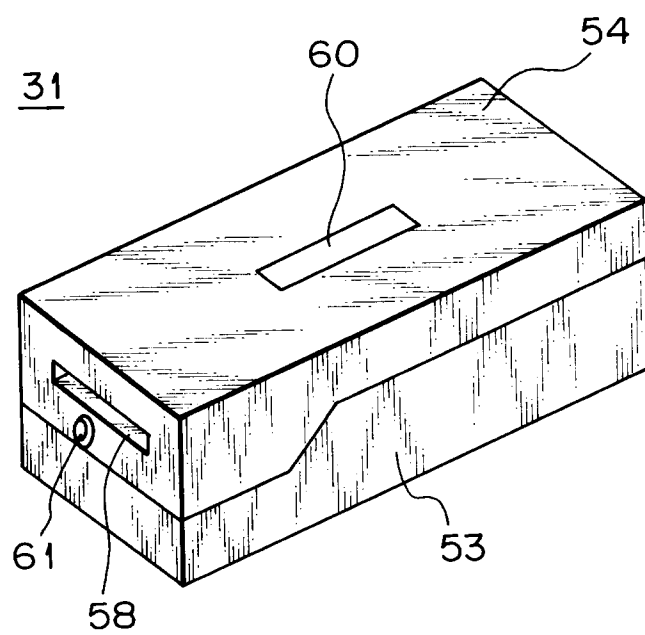


Fig. 5

31

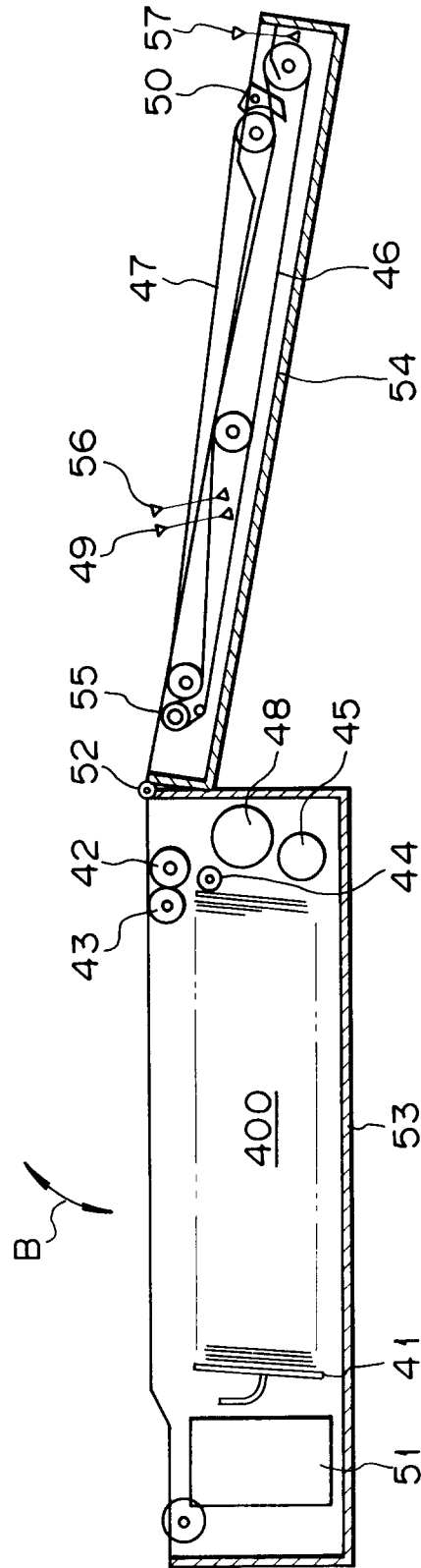


Fig. 6

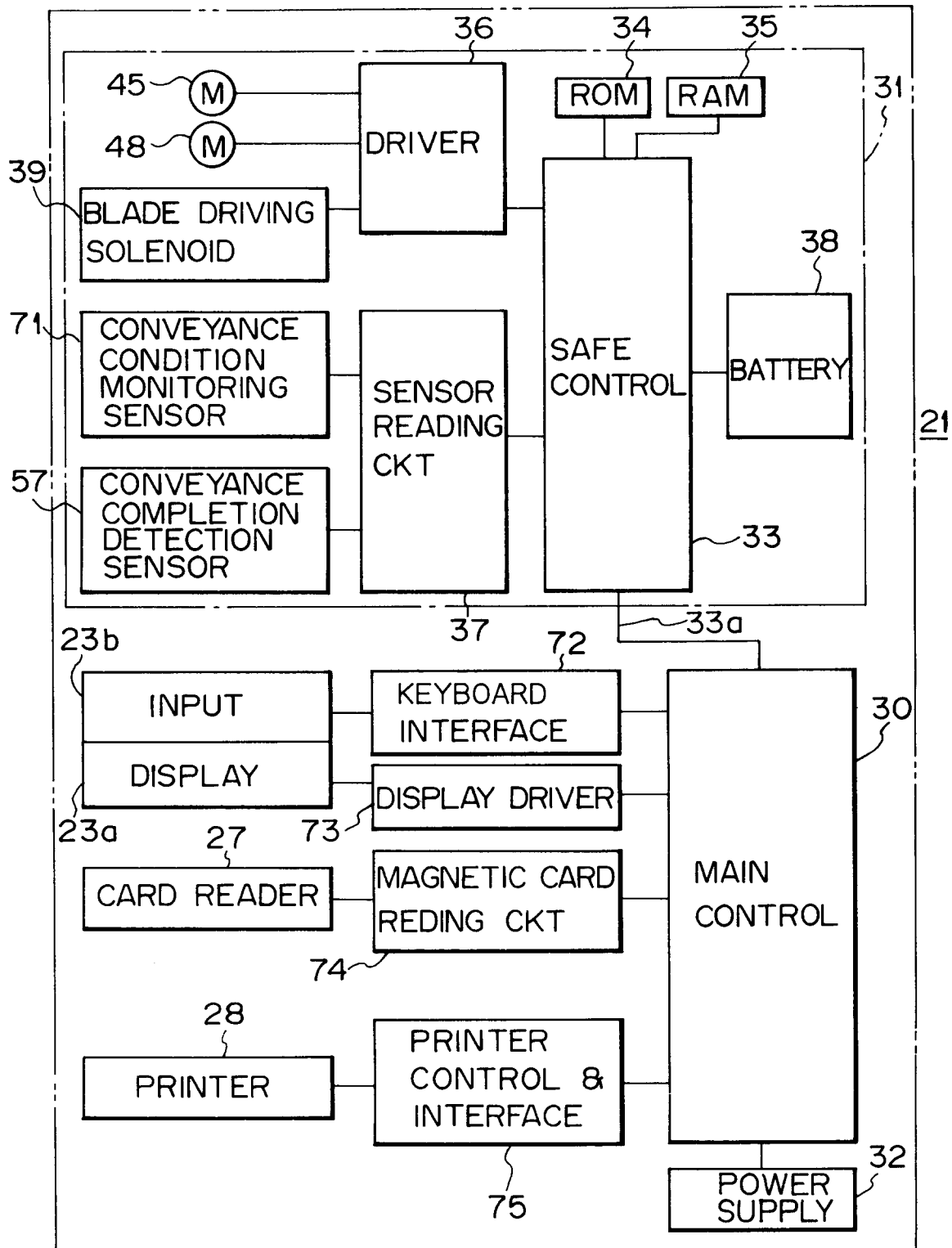


Fig. 7

23c

7	8	9	CANCEL
4	5	6	
1	2	3	*
0	CORRECTION	CONFIRM	

Fig. 8

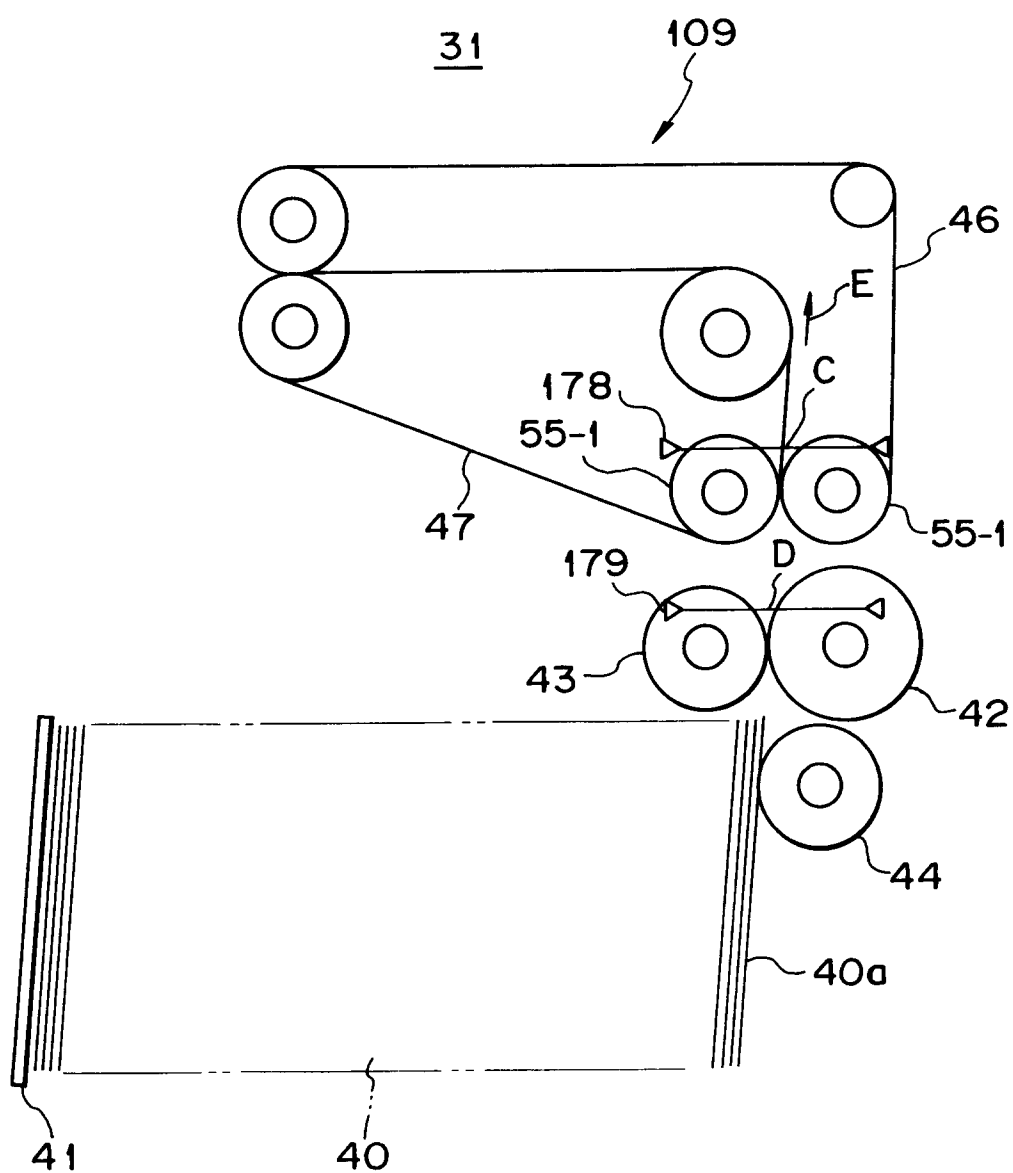


Fig. 9

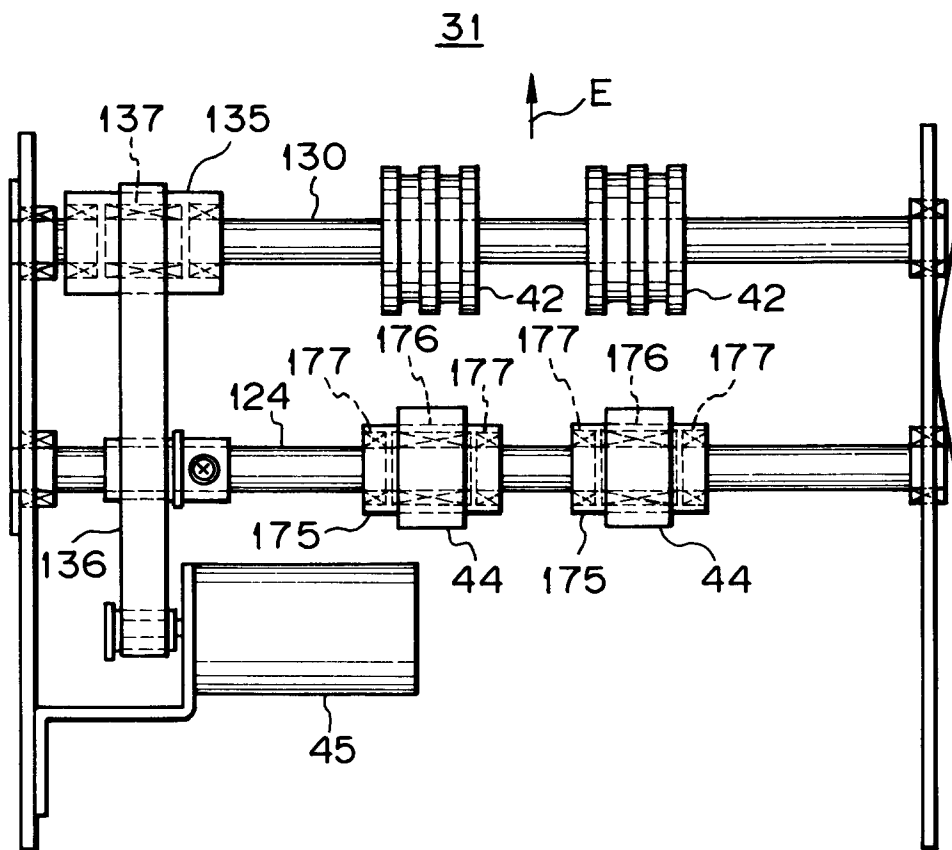


Fig. 10

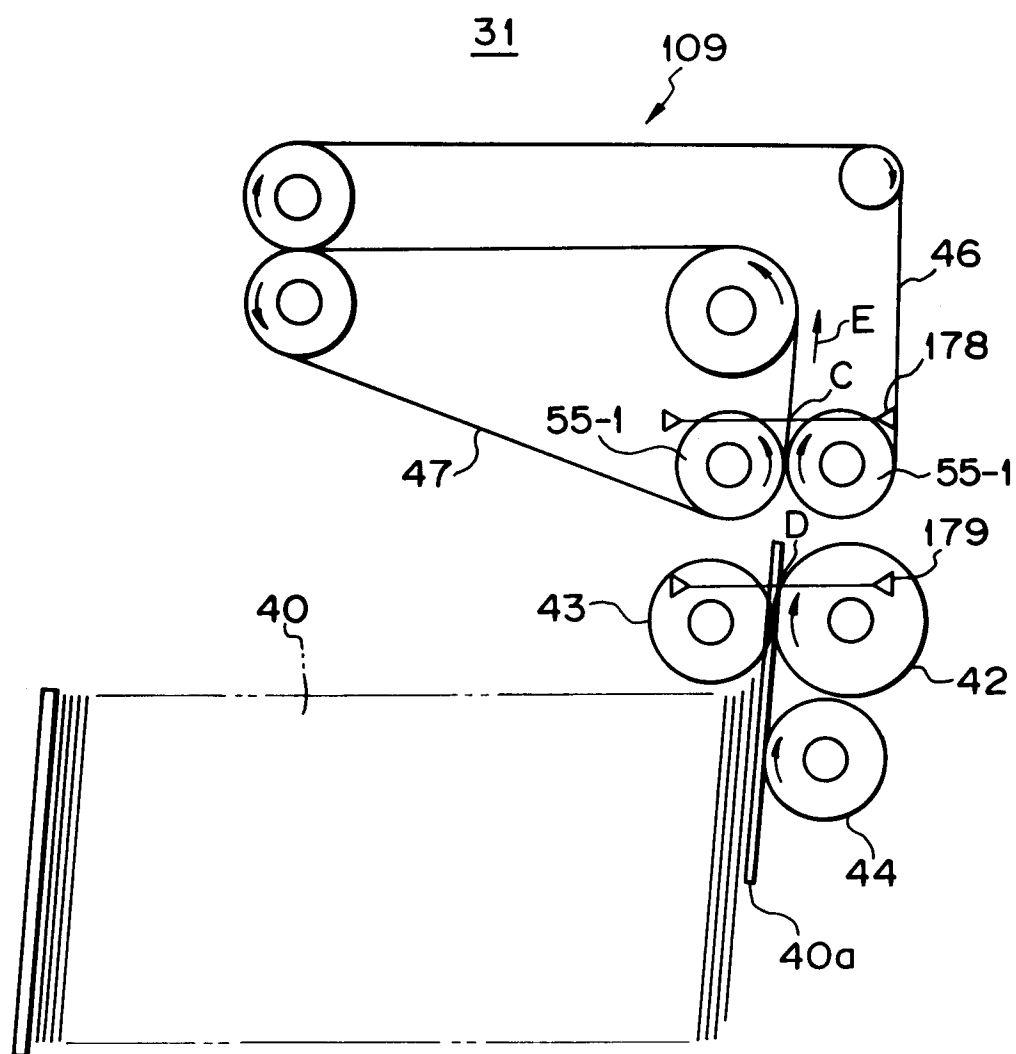


Fig. 11

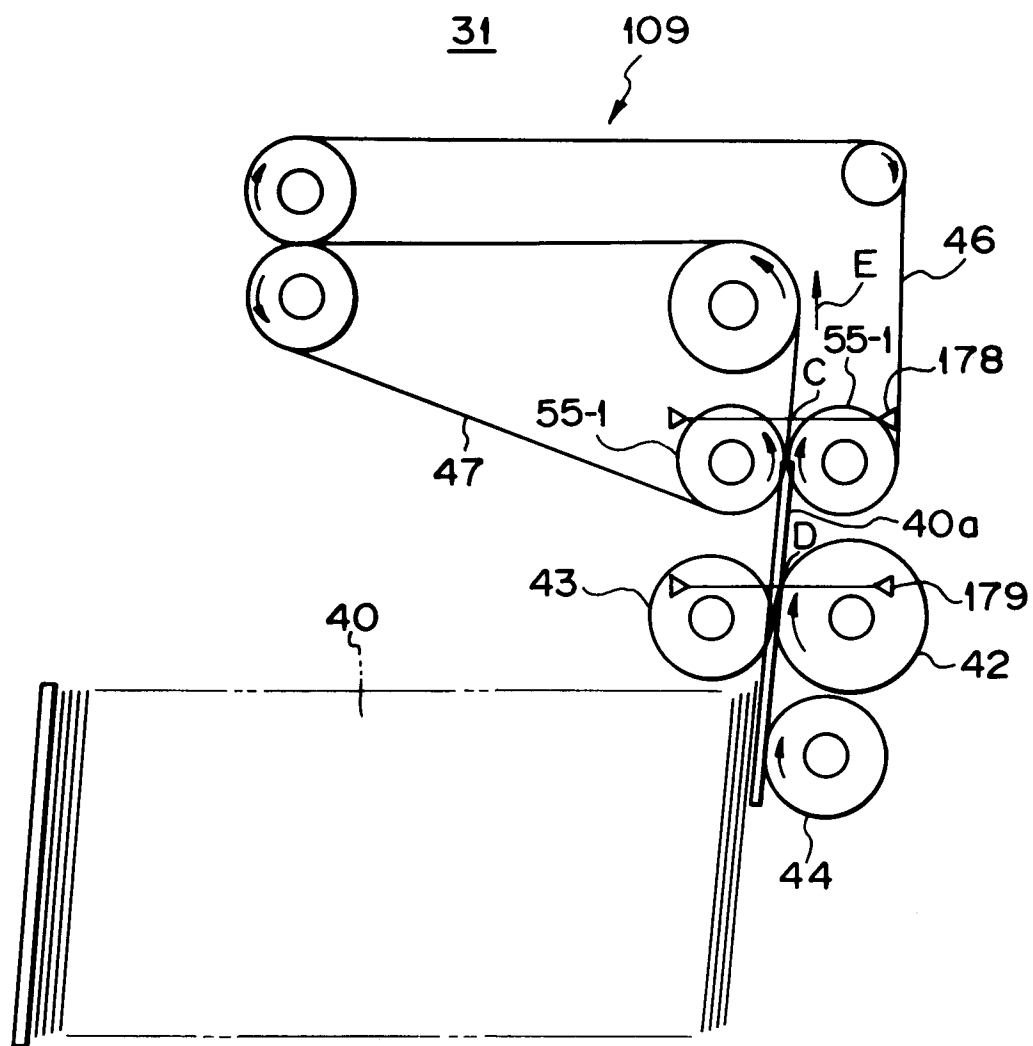


Fig. 12

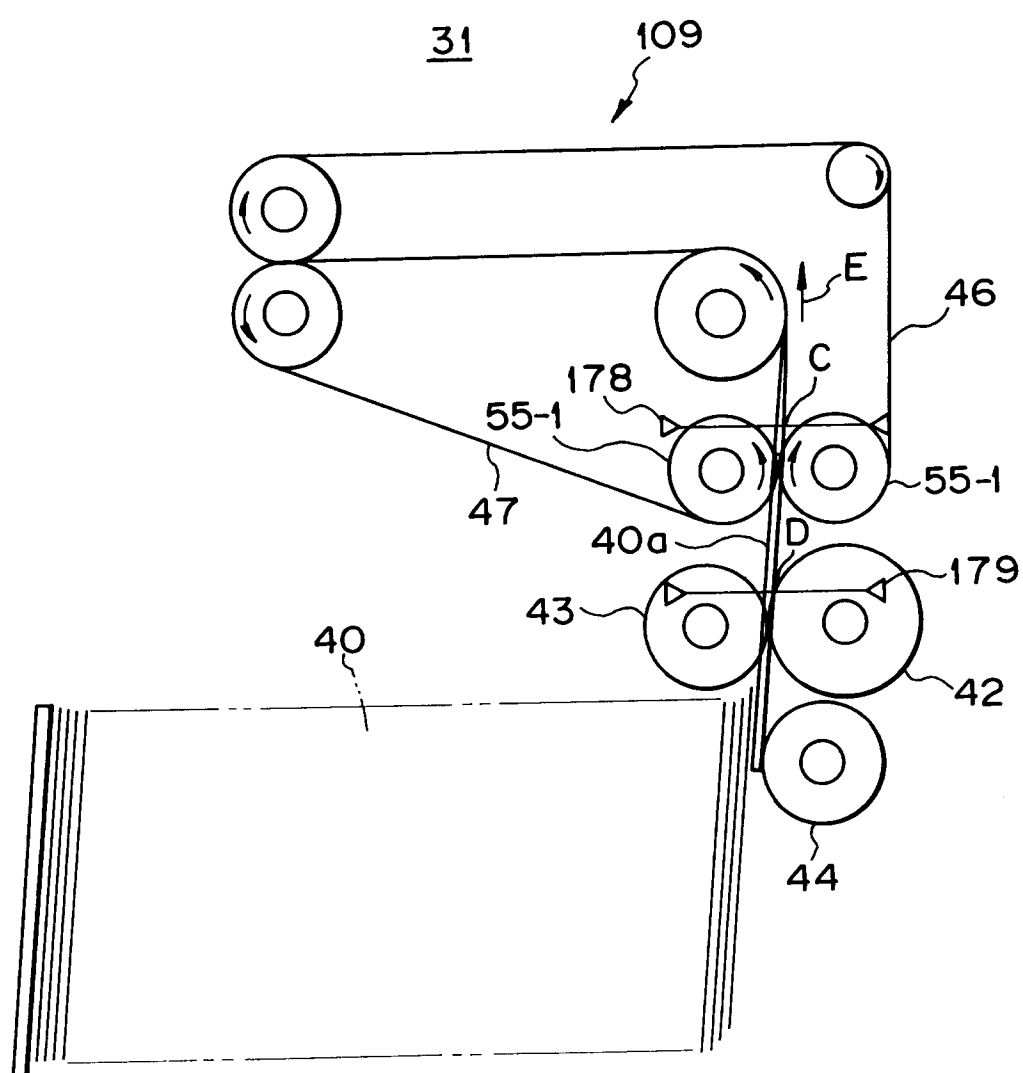


Fig. 13

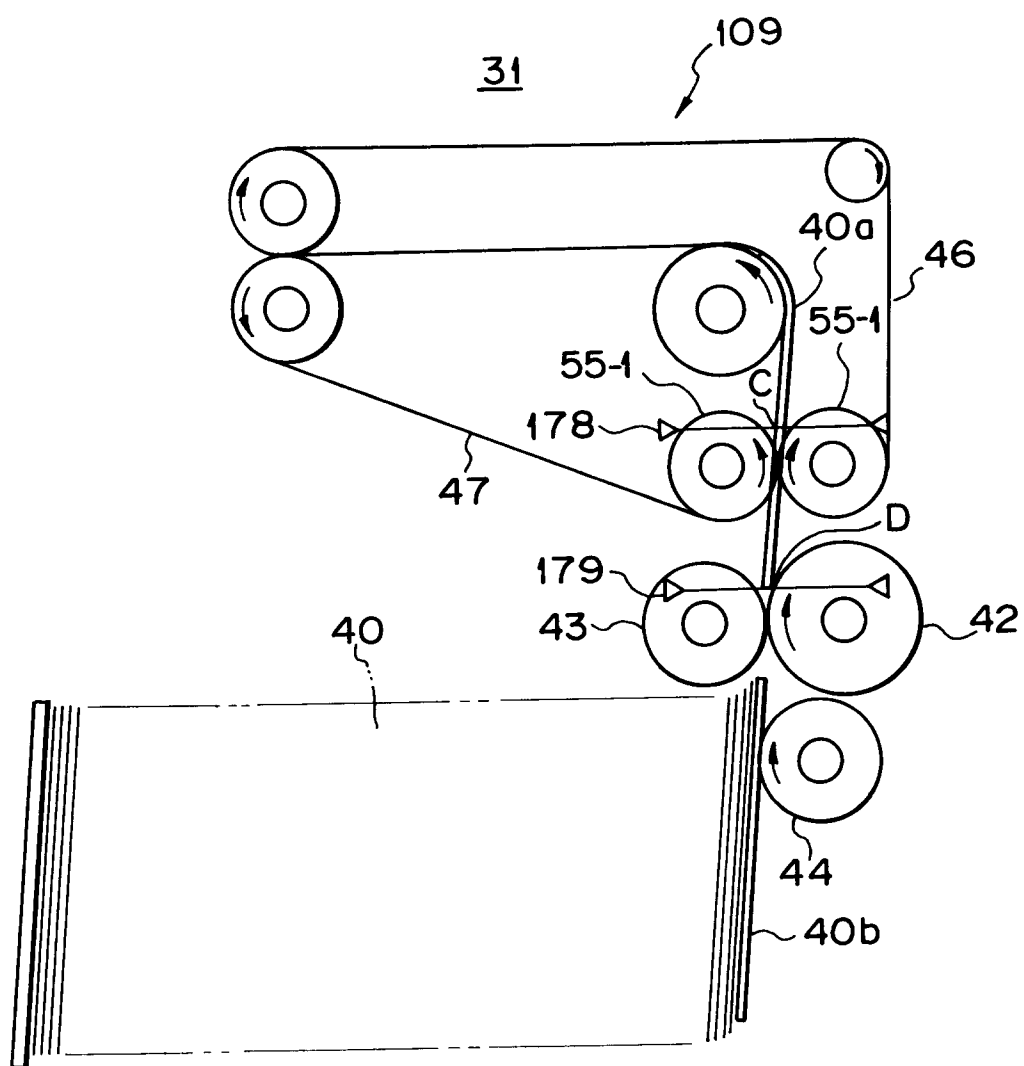


Fig. 15

31

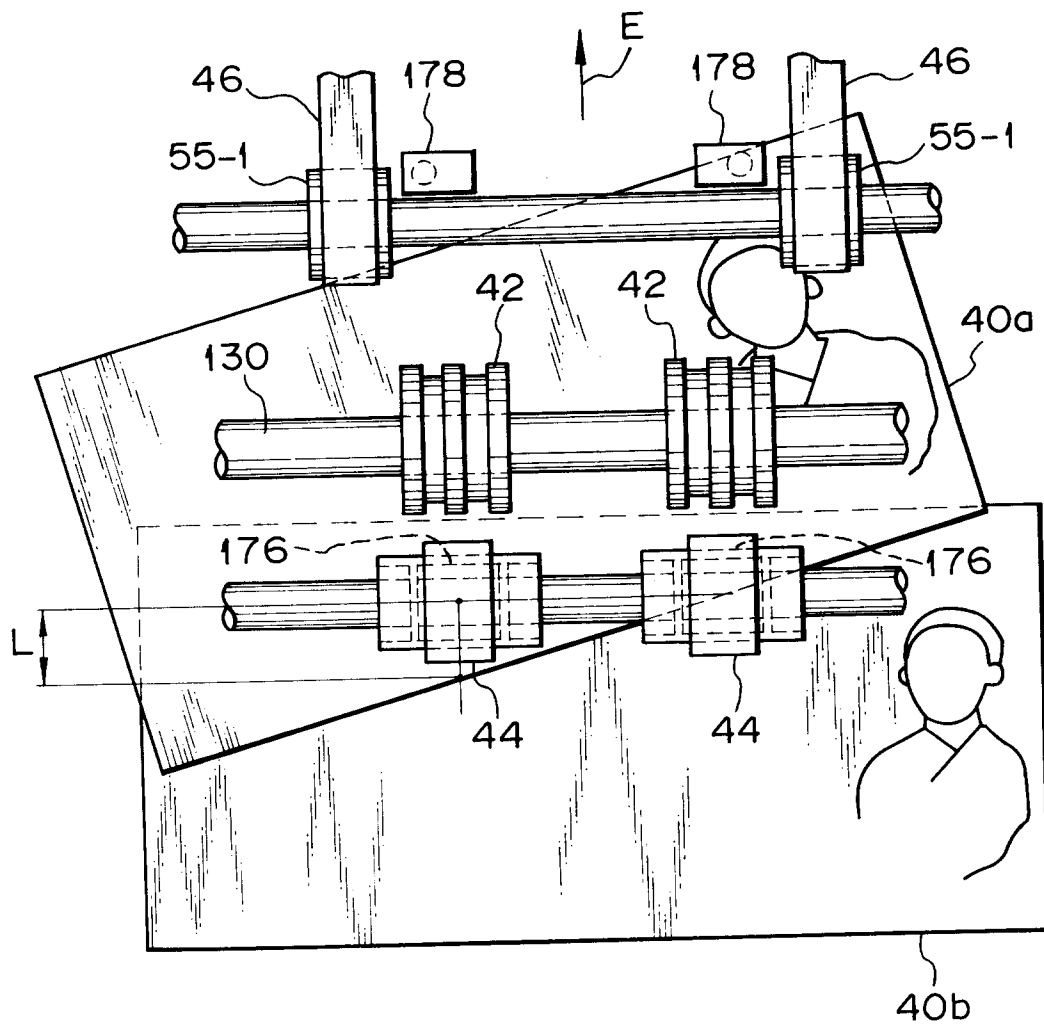


Fig. 16

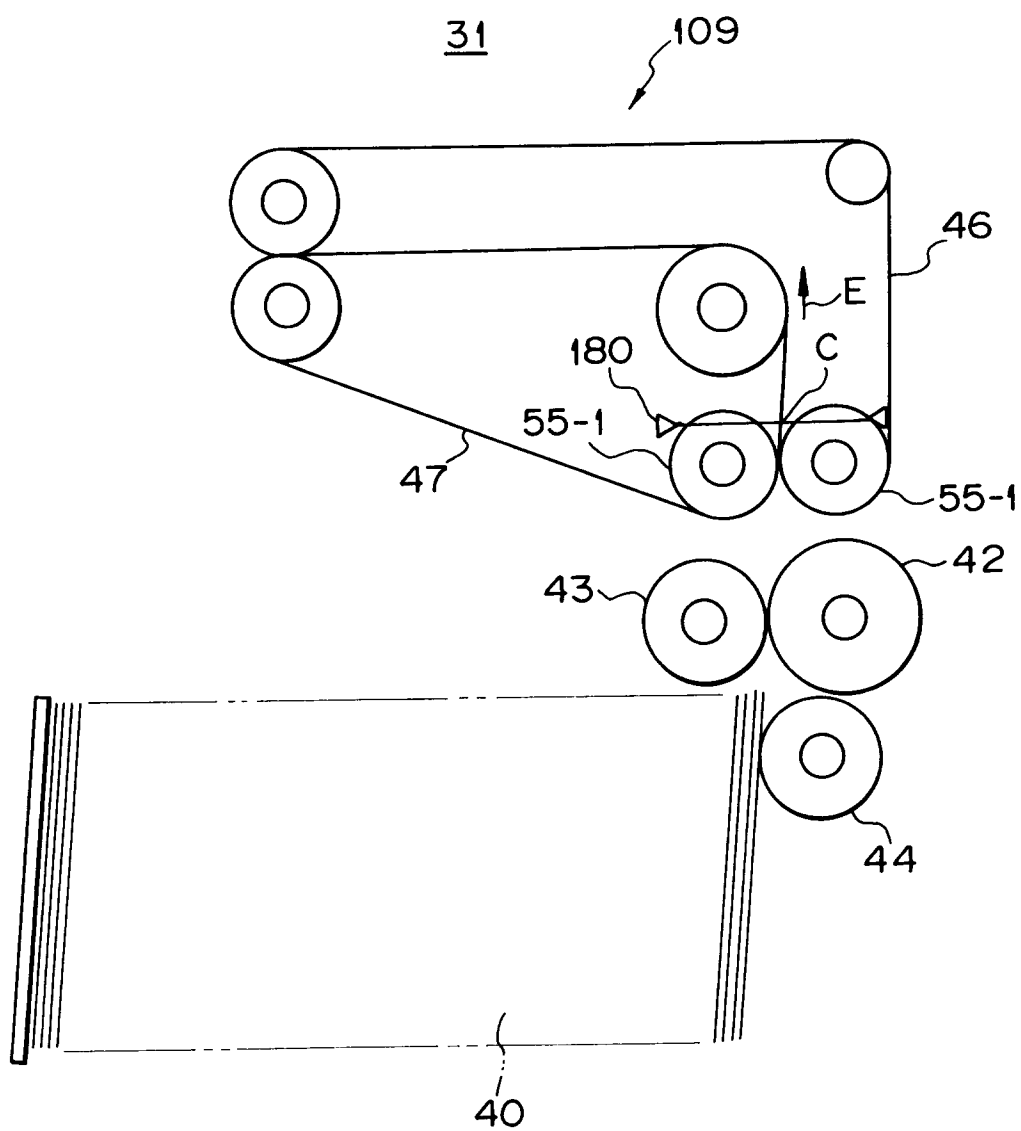


Fig. 17

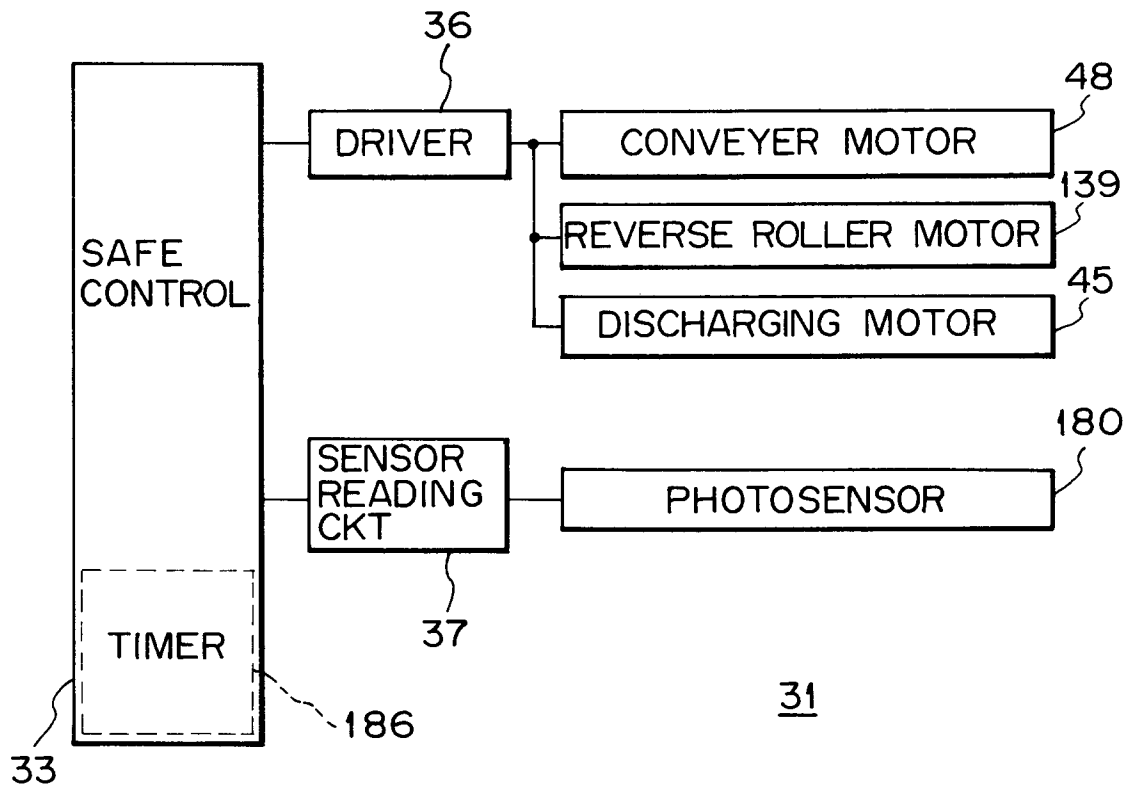


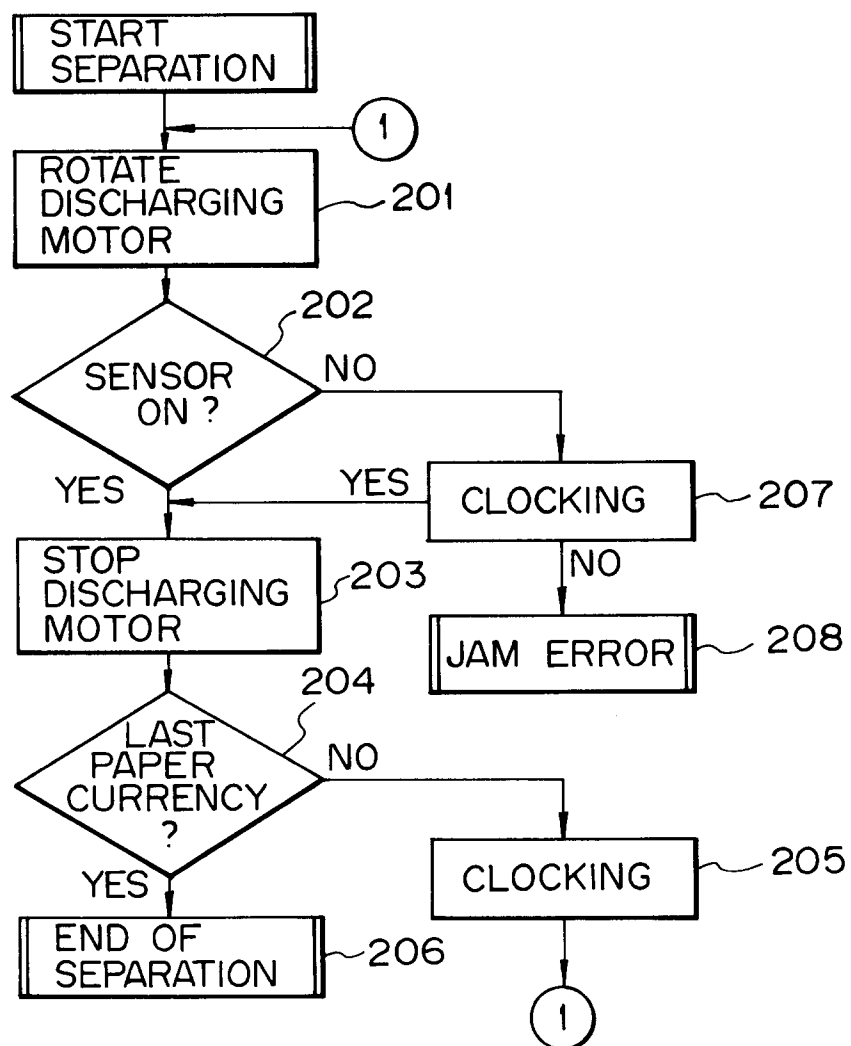
Fig. 18

Fig. 19

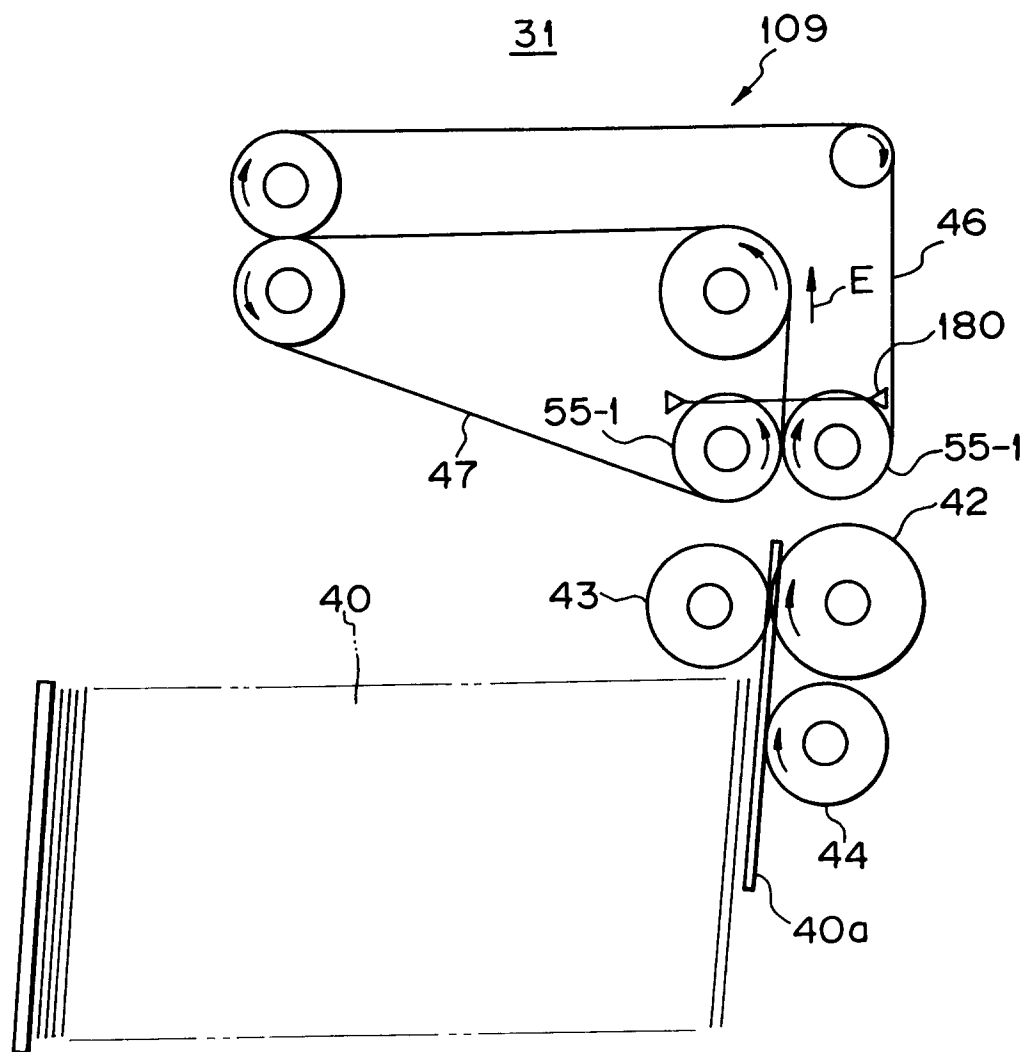


Fig. 20

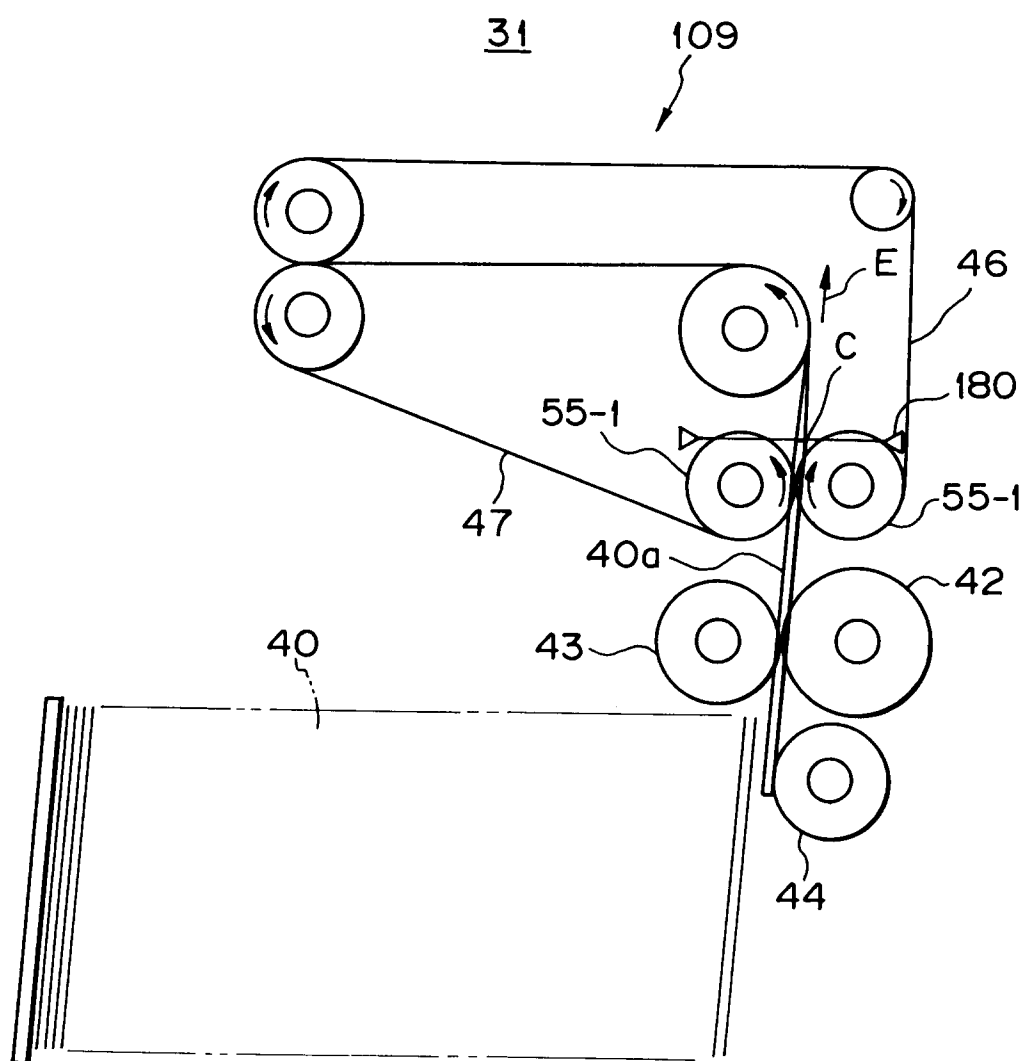


Fig. 21

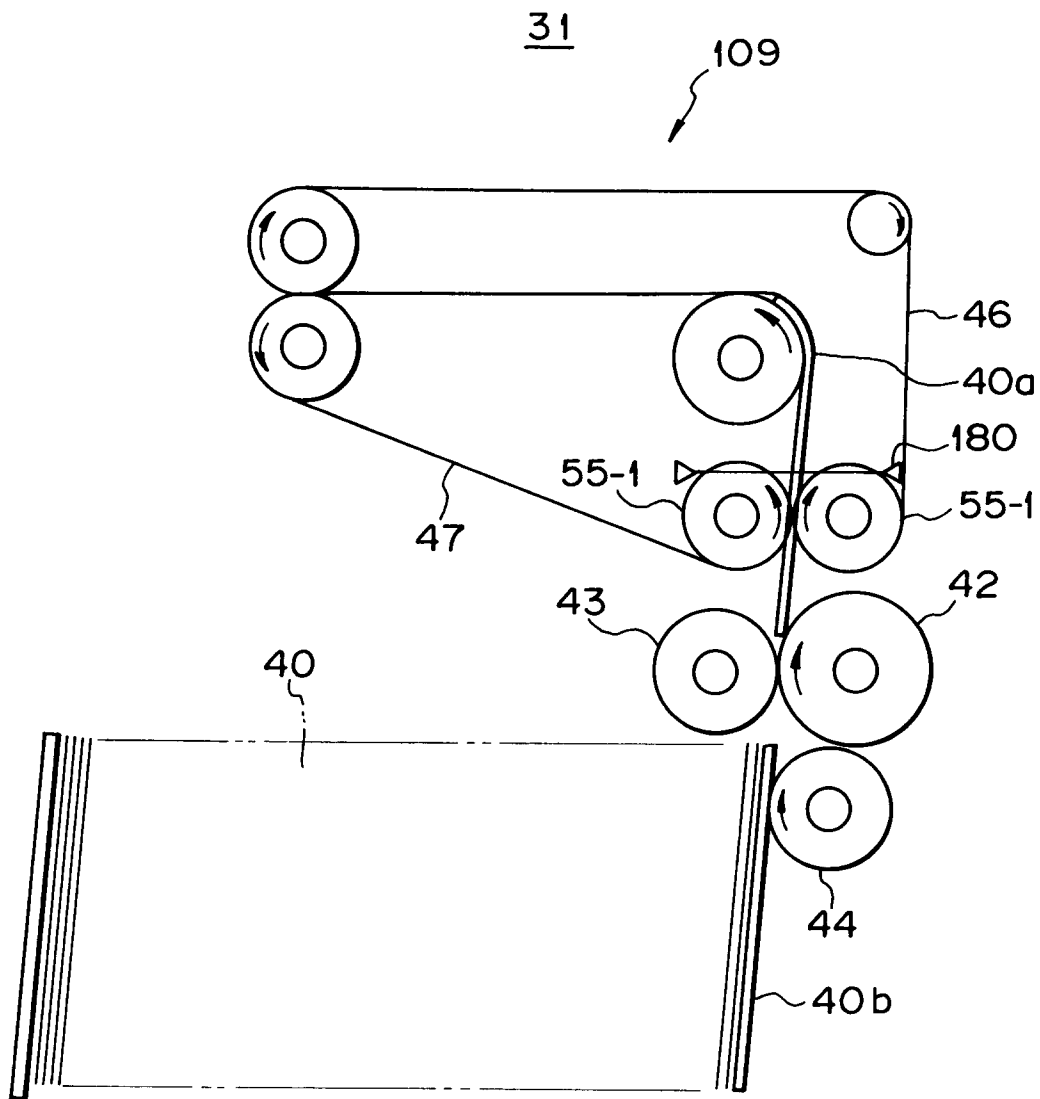


Fig. 22

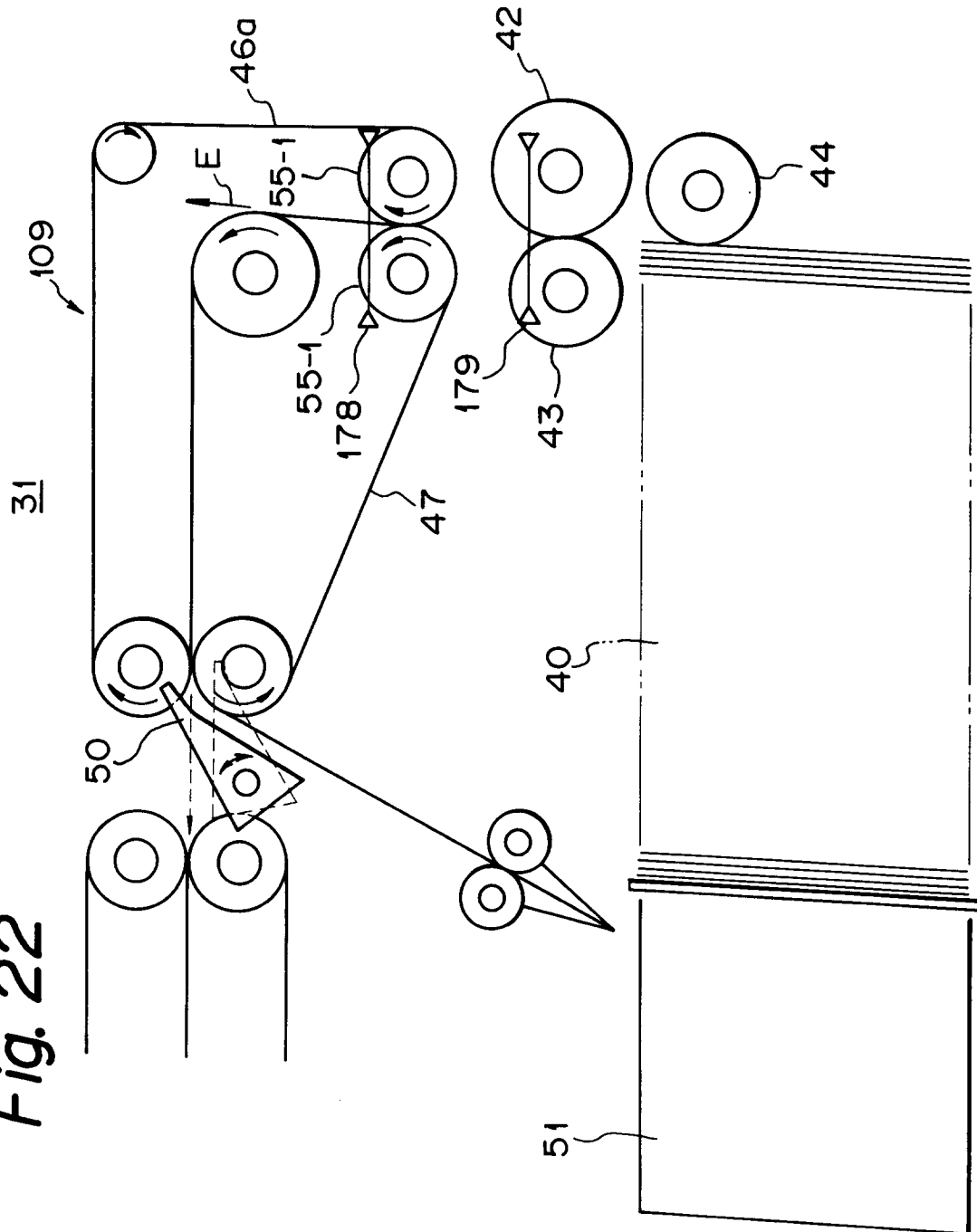


Fig. 23

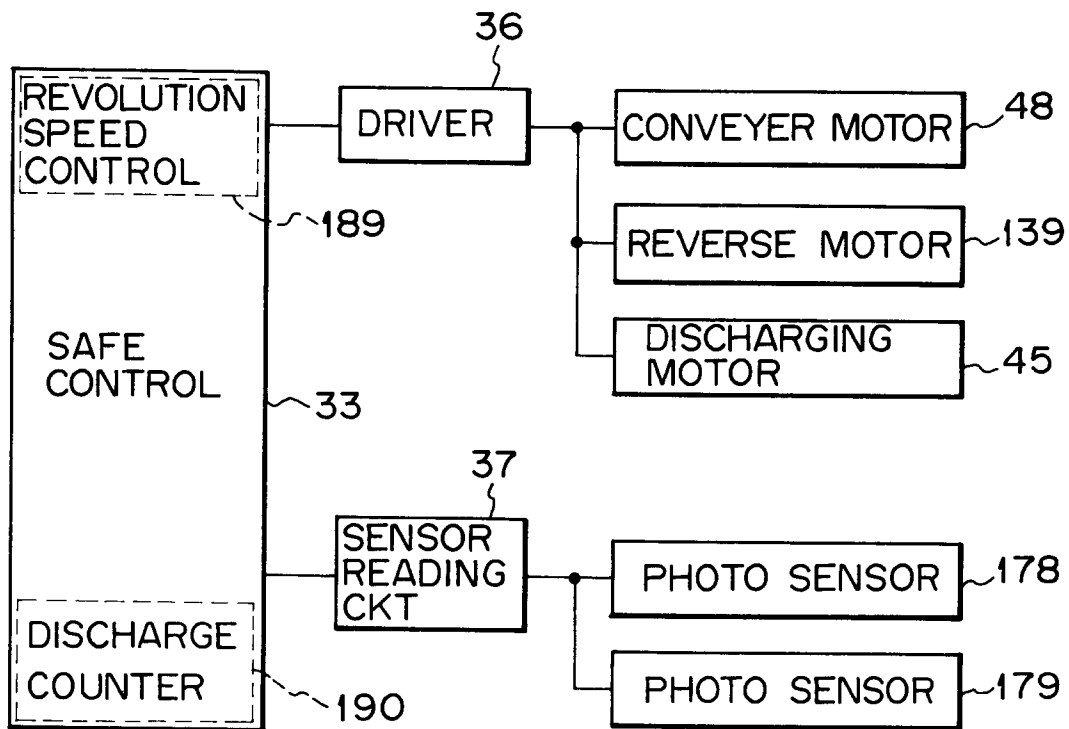


Fig. 24

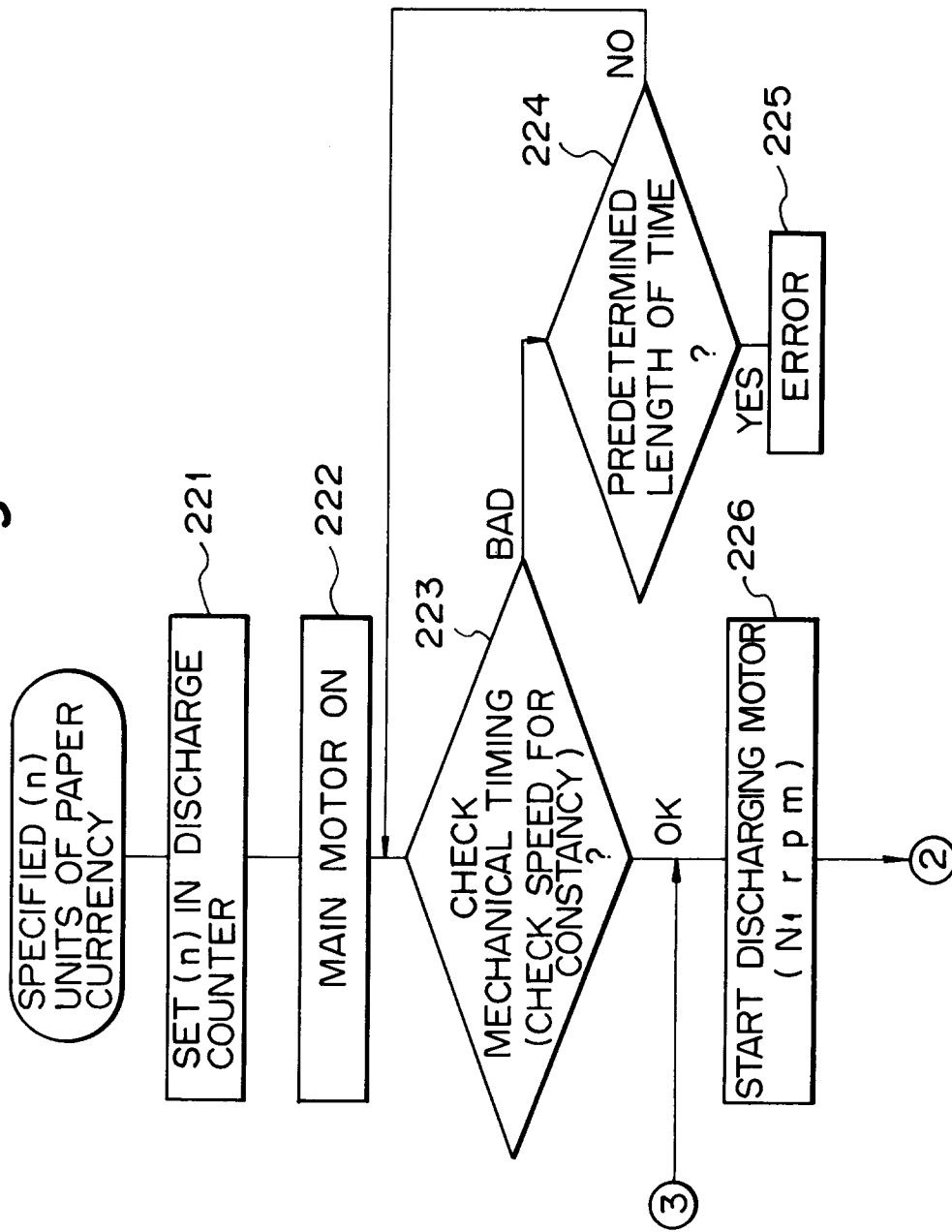


Fig. 25

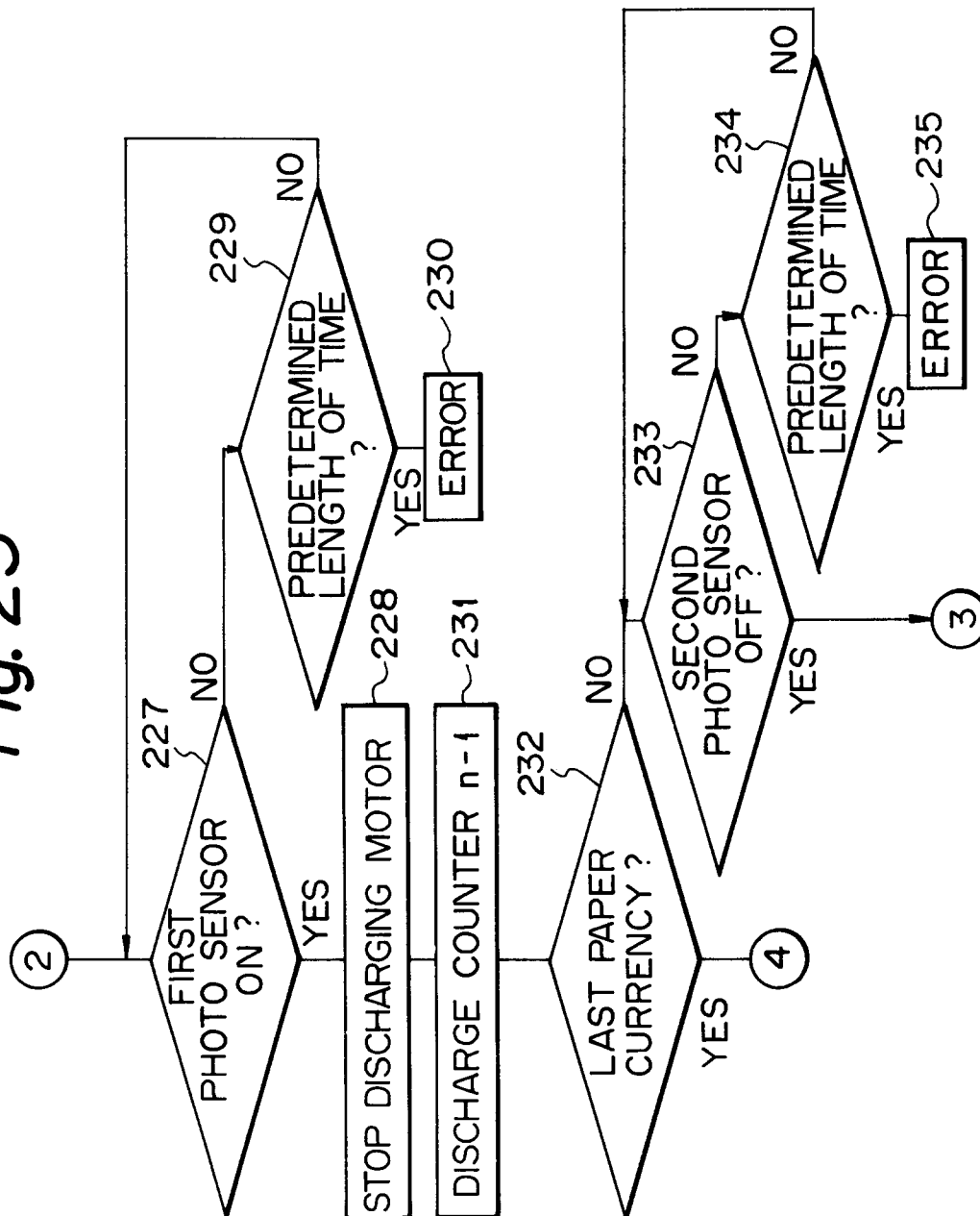


Fig. 26

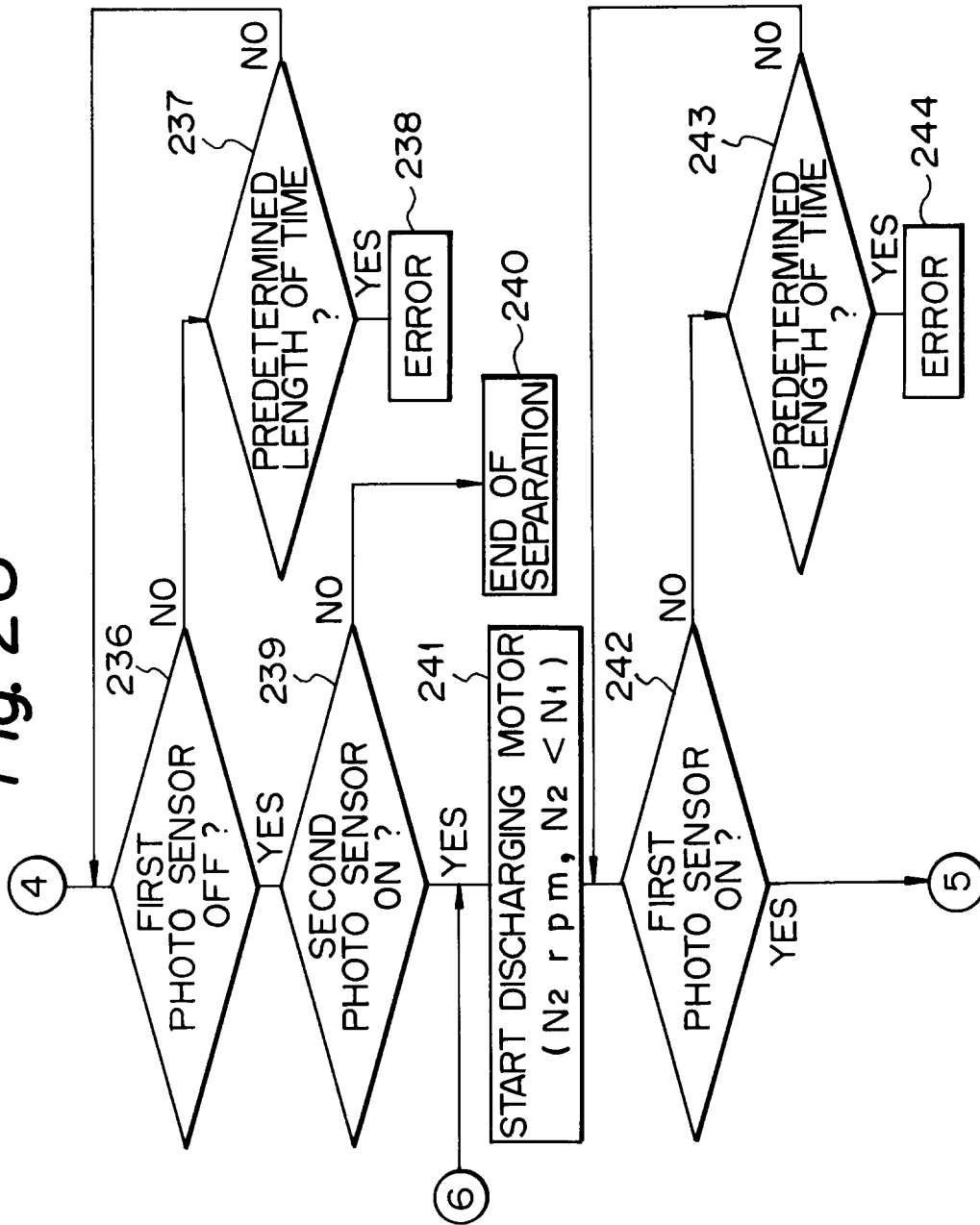


Fig. 27

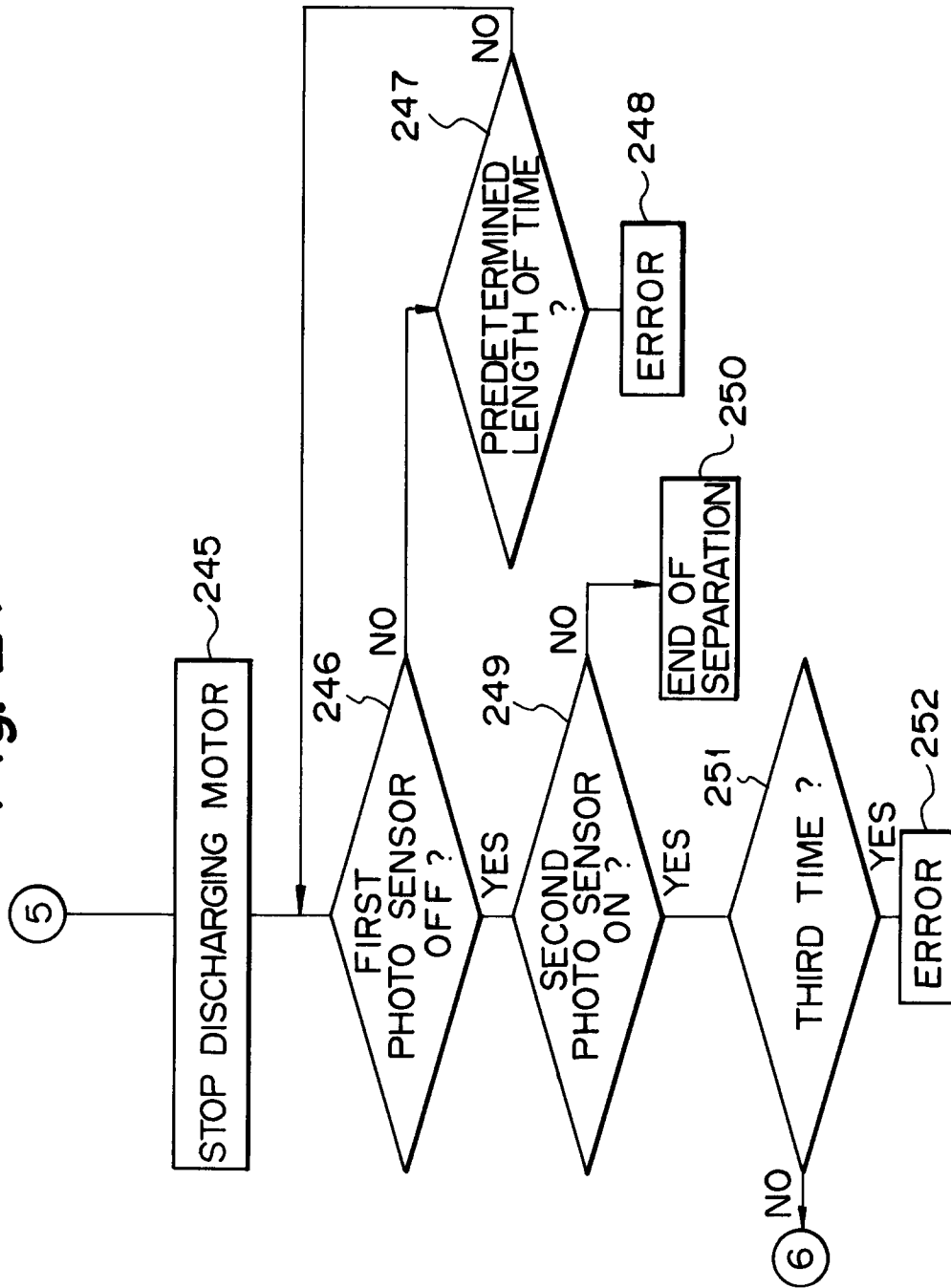


Fig. 28

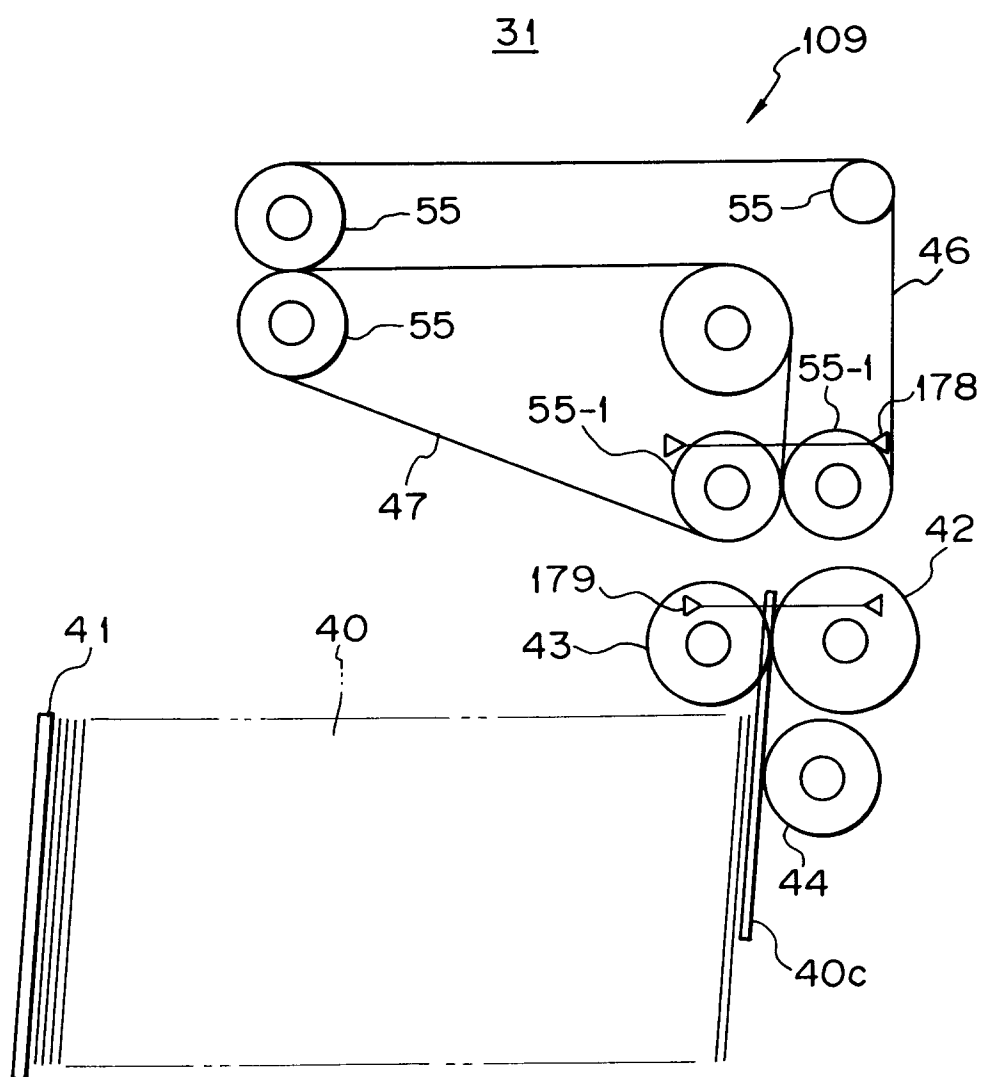


Fig. 29

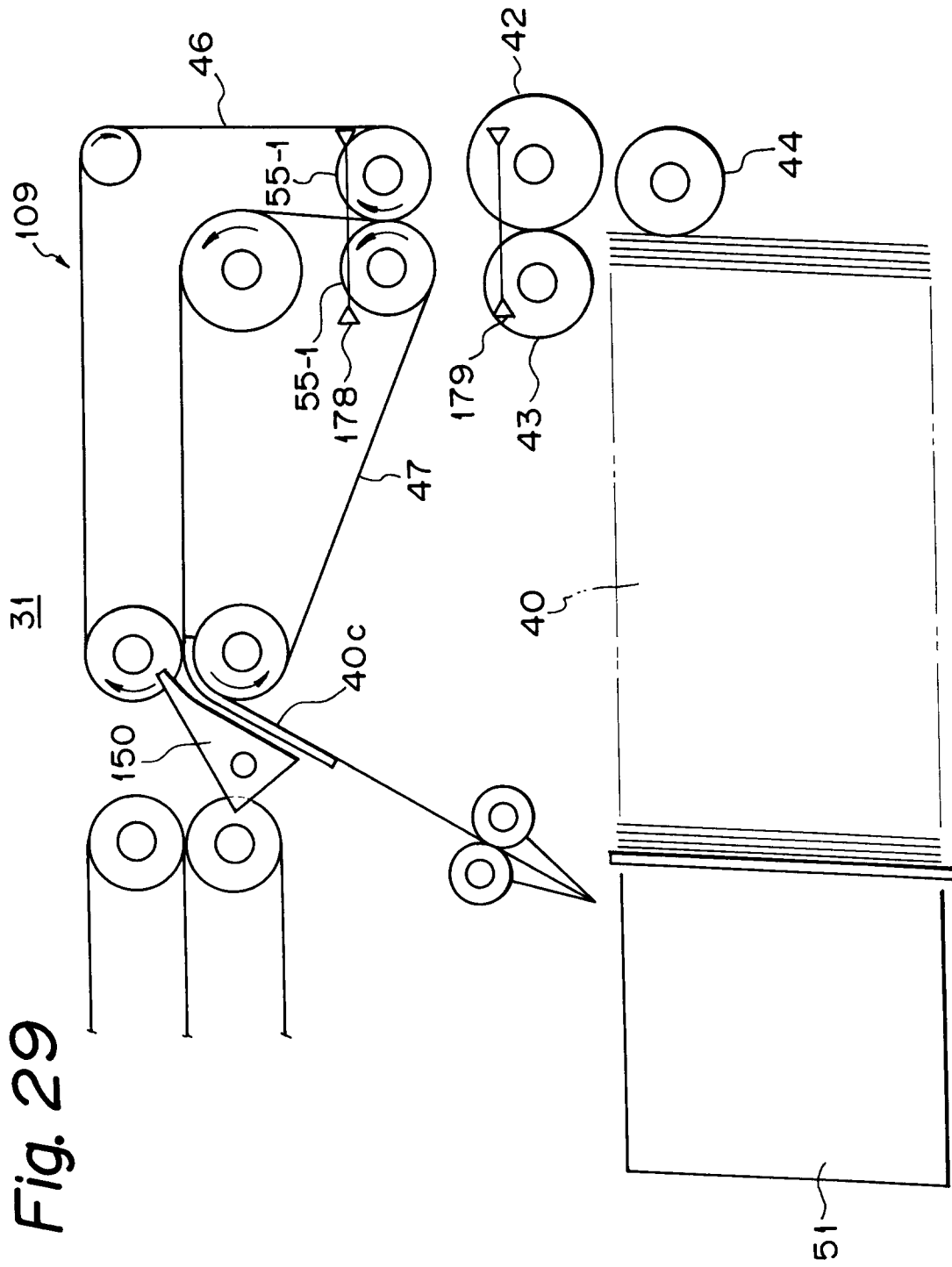


Fig. 30

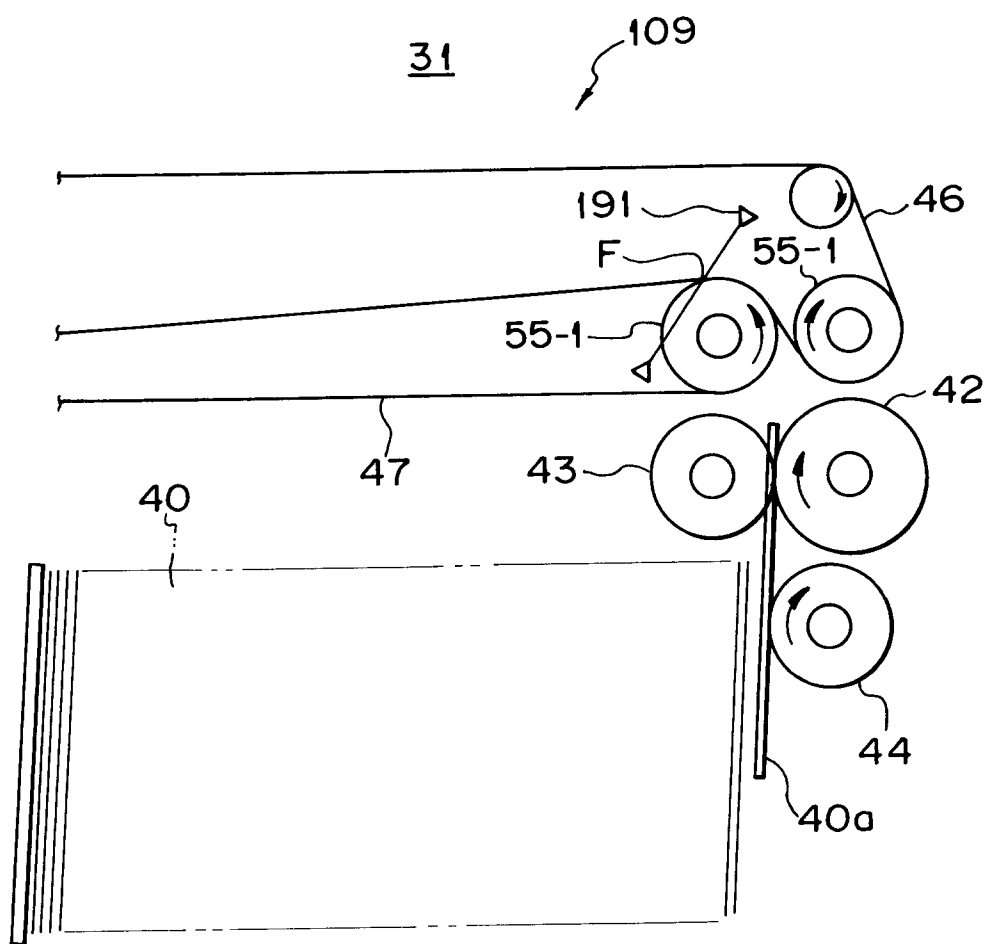


Fig. 31

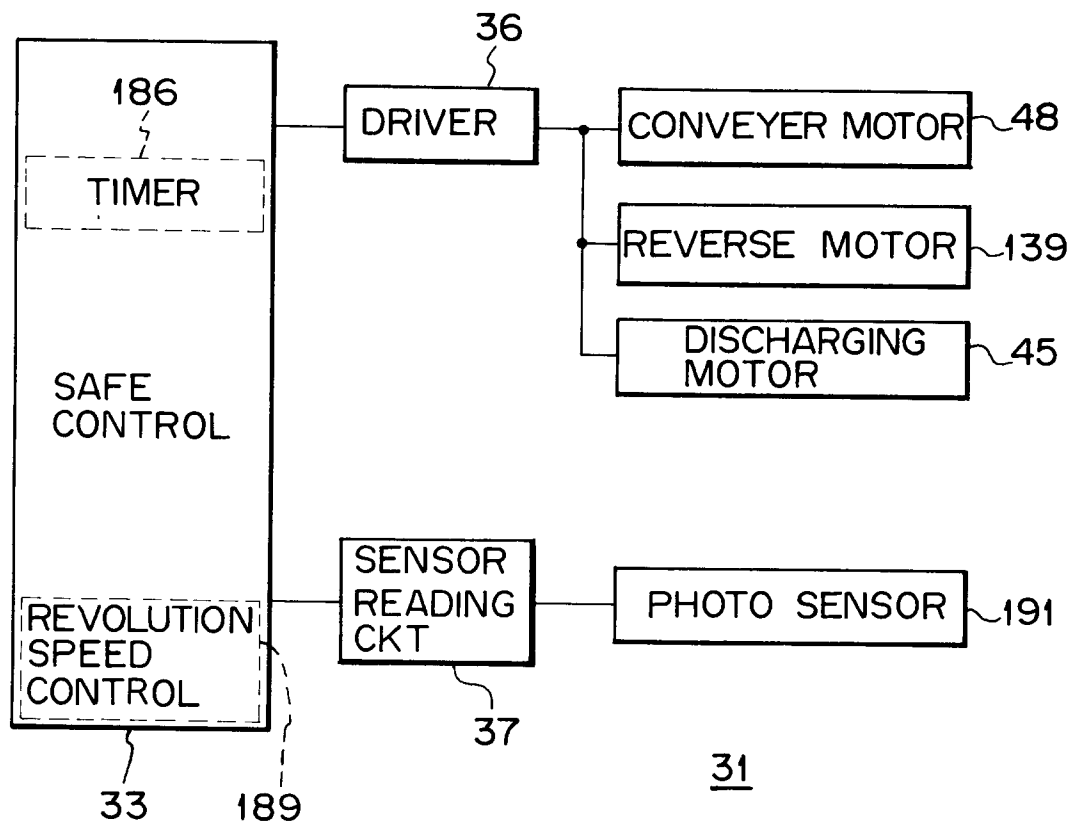


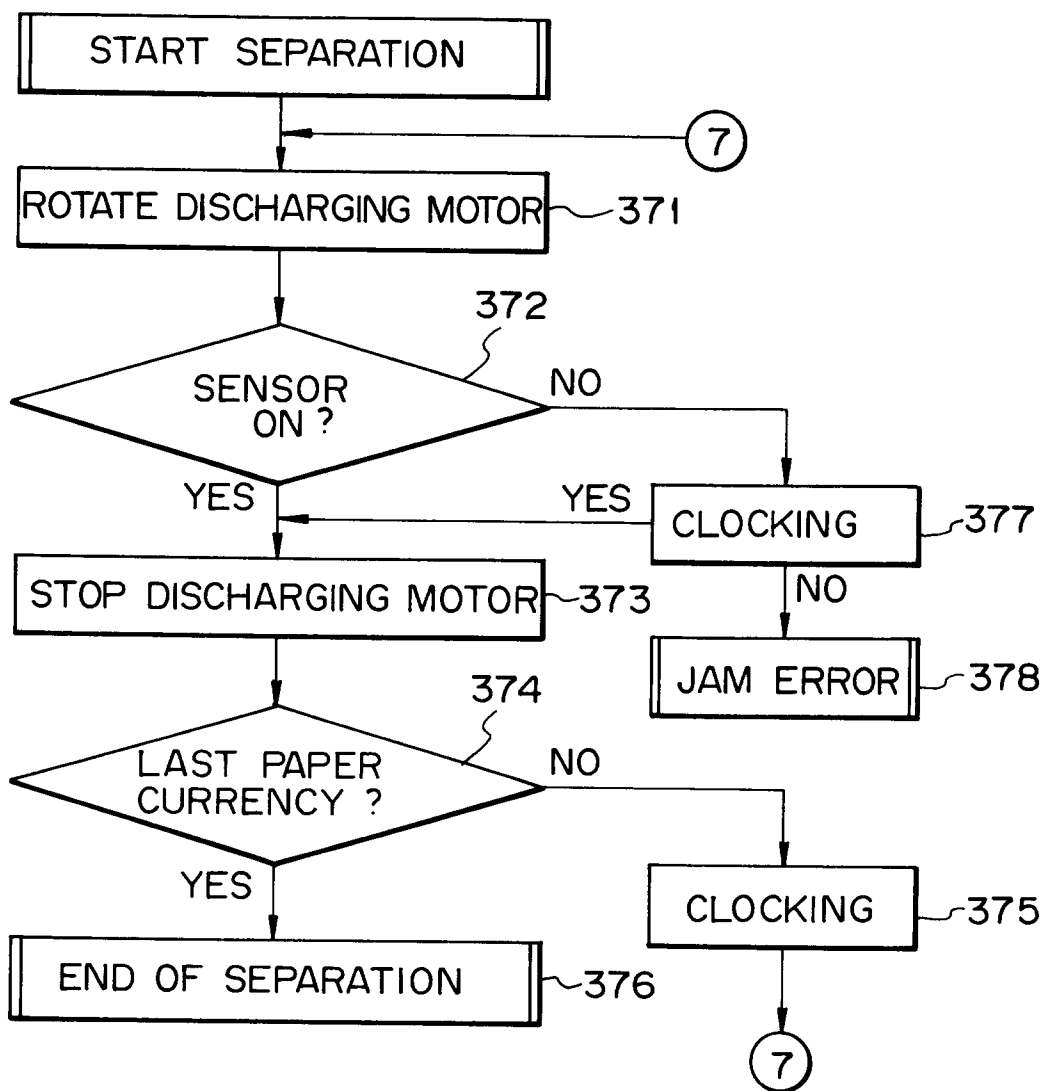
Fig. 32

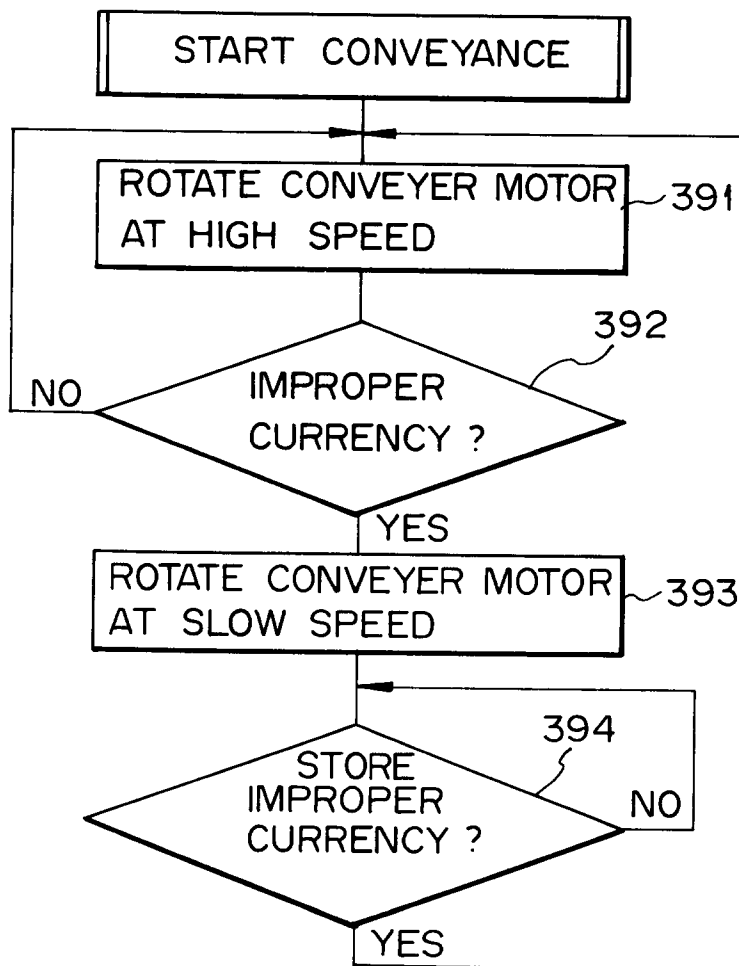
Fig. 33

Fig. 34

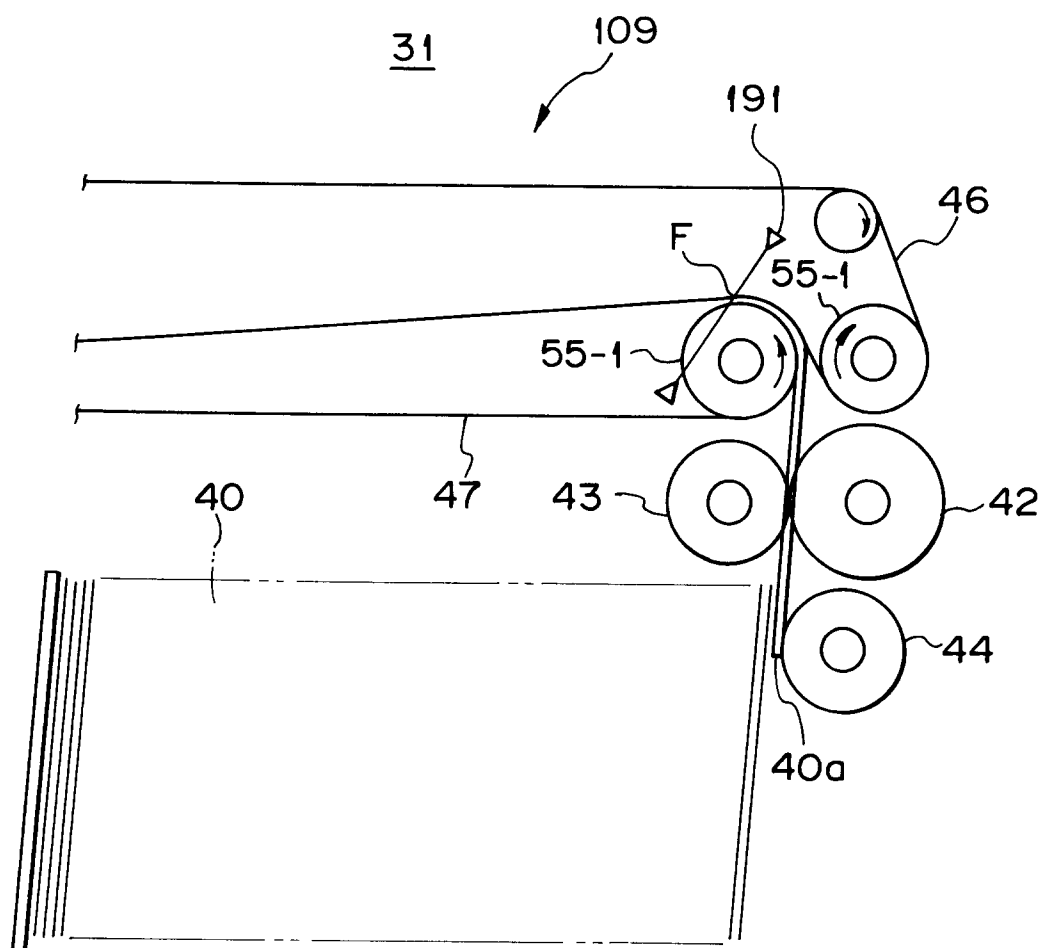


Fig. 35

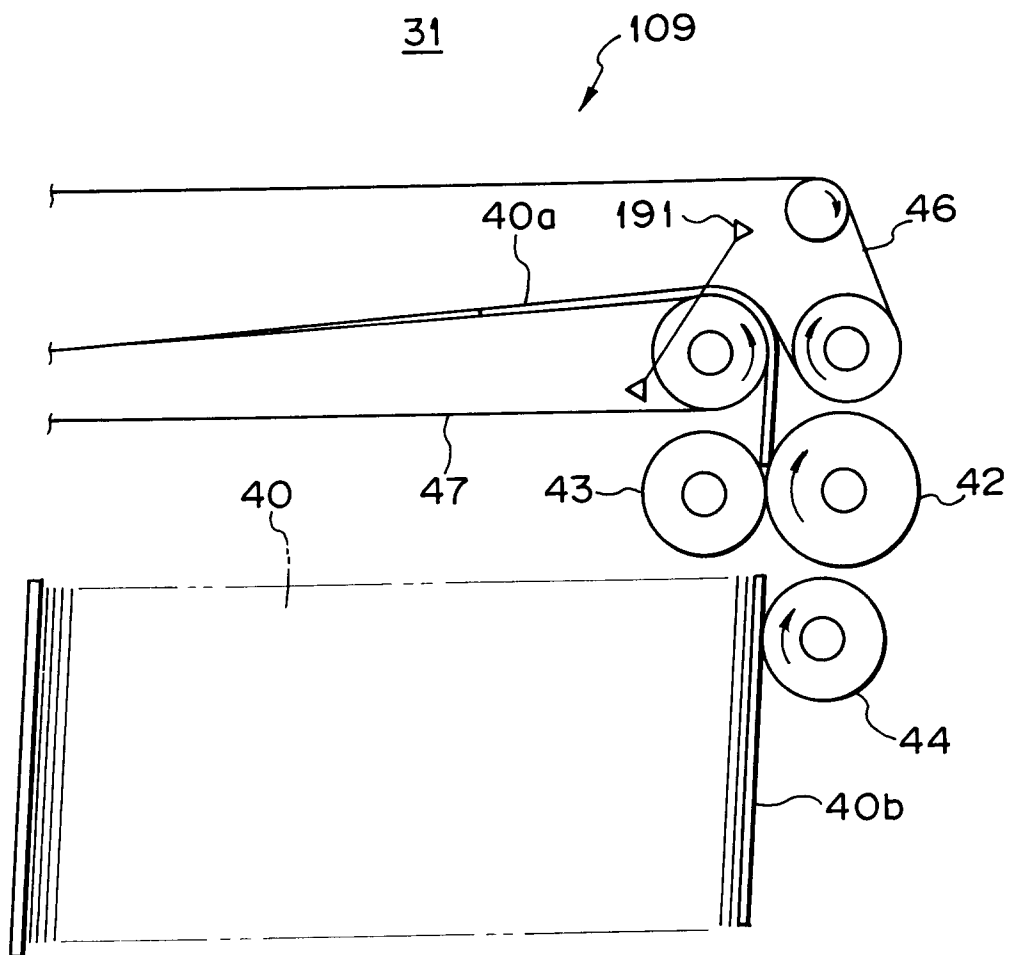


Fig. 36

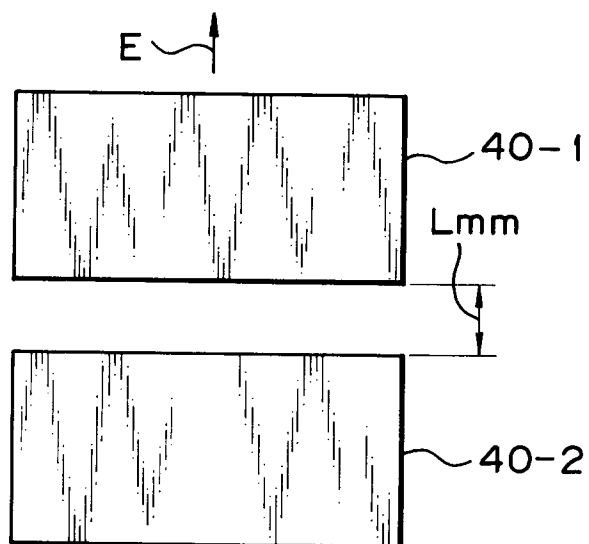


Fig. 37

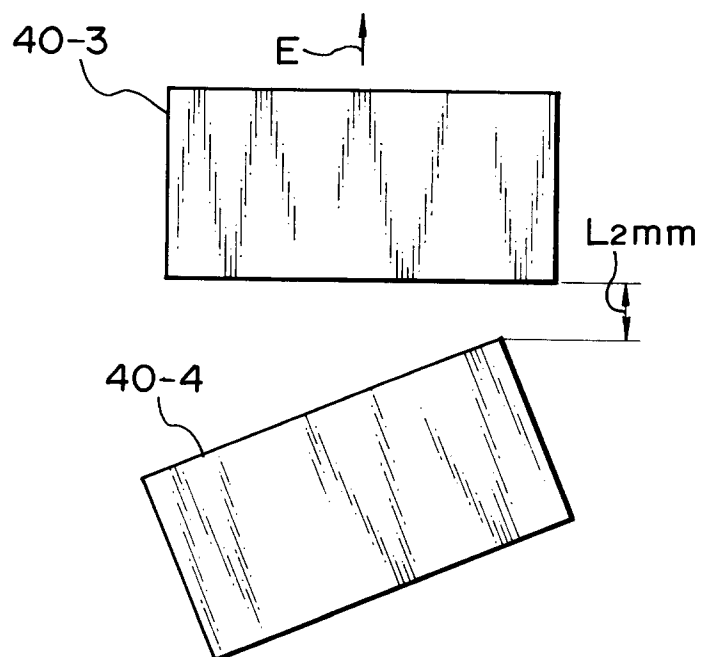


Fig. 38

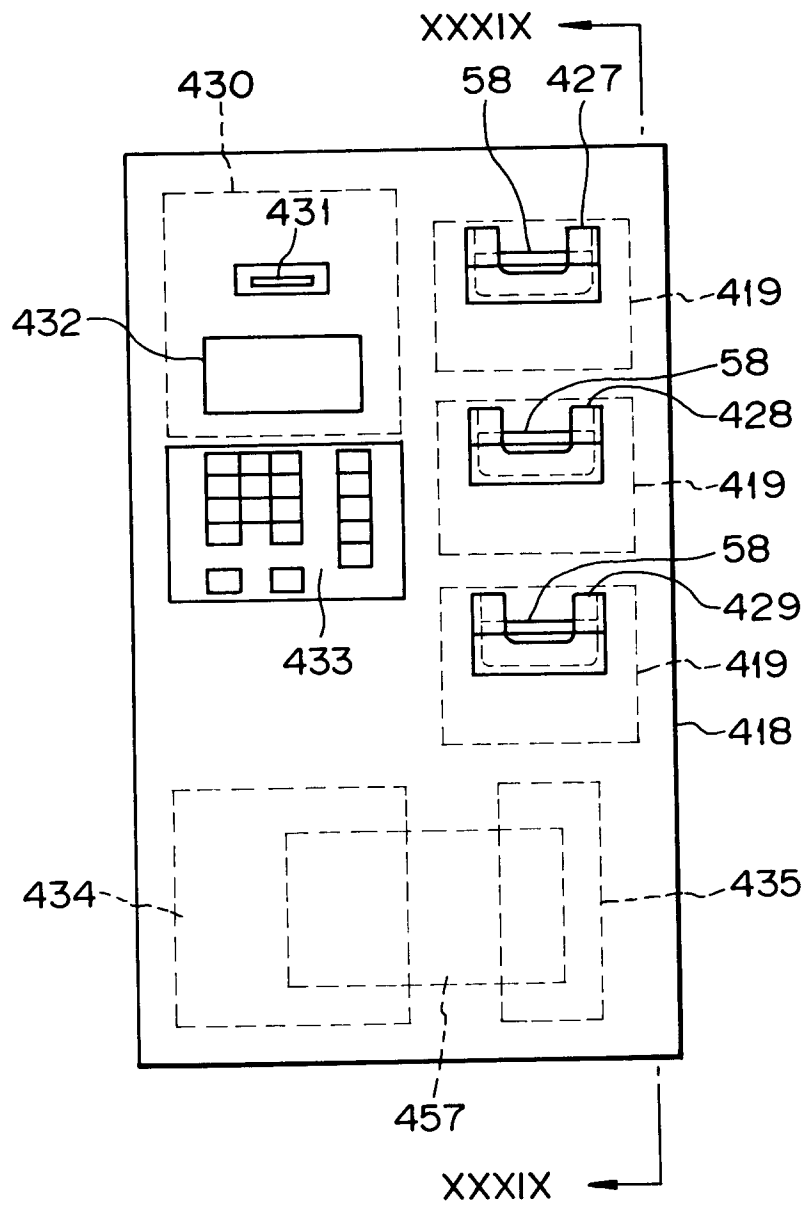


Fig. 39

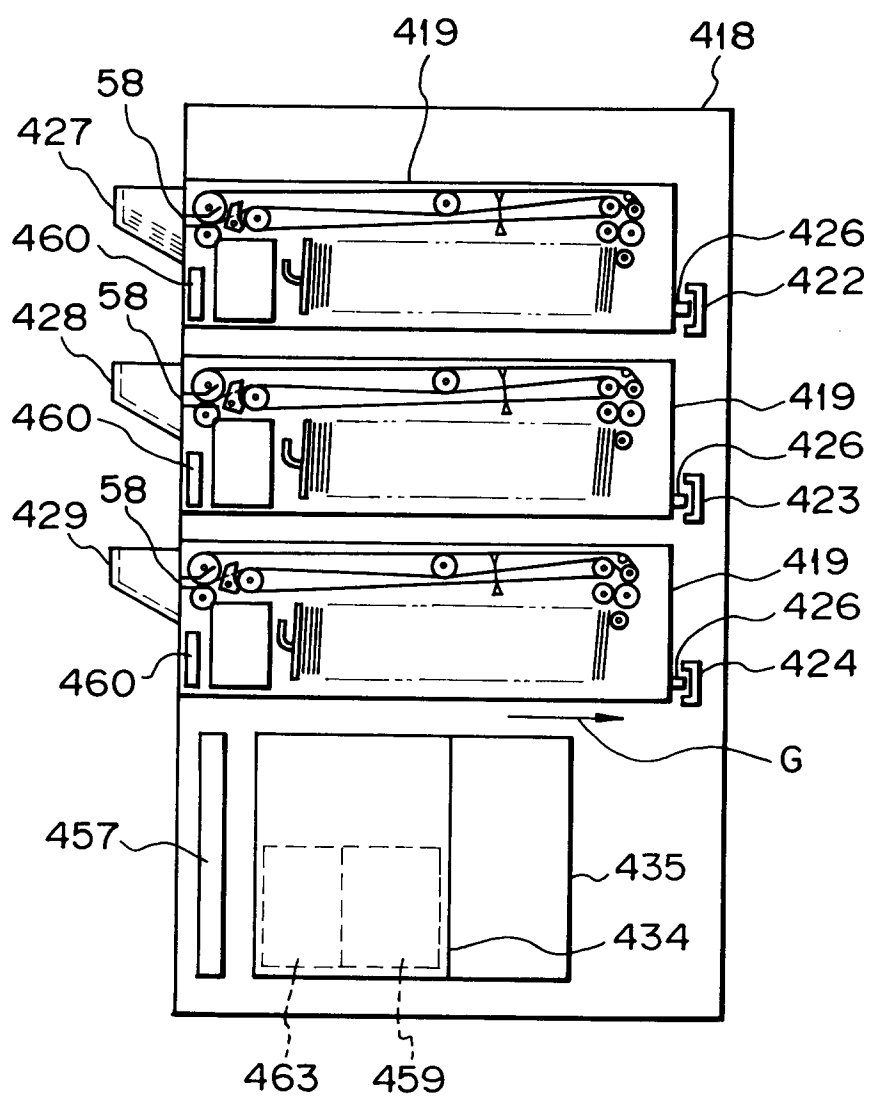


Fig. 40

419

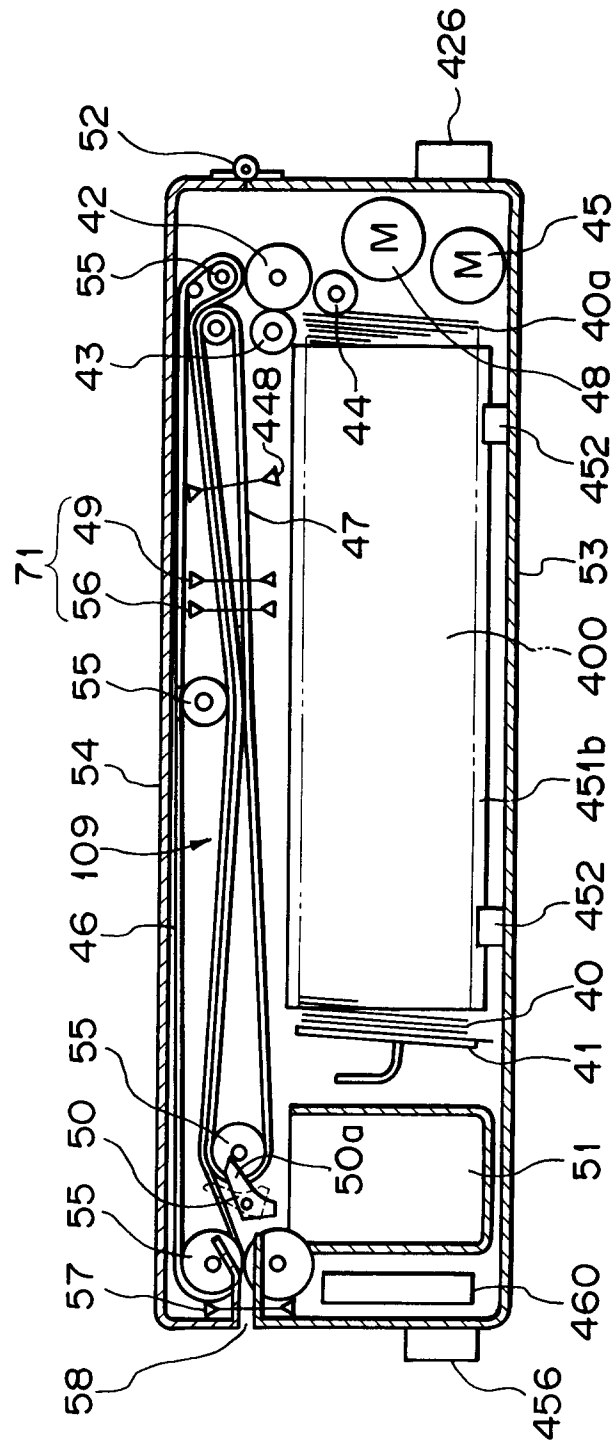


Fig. 41

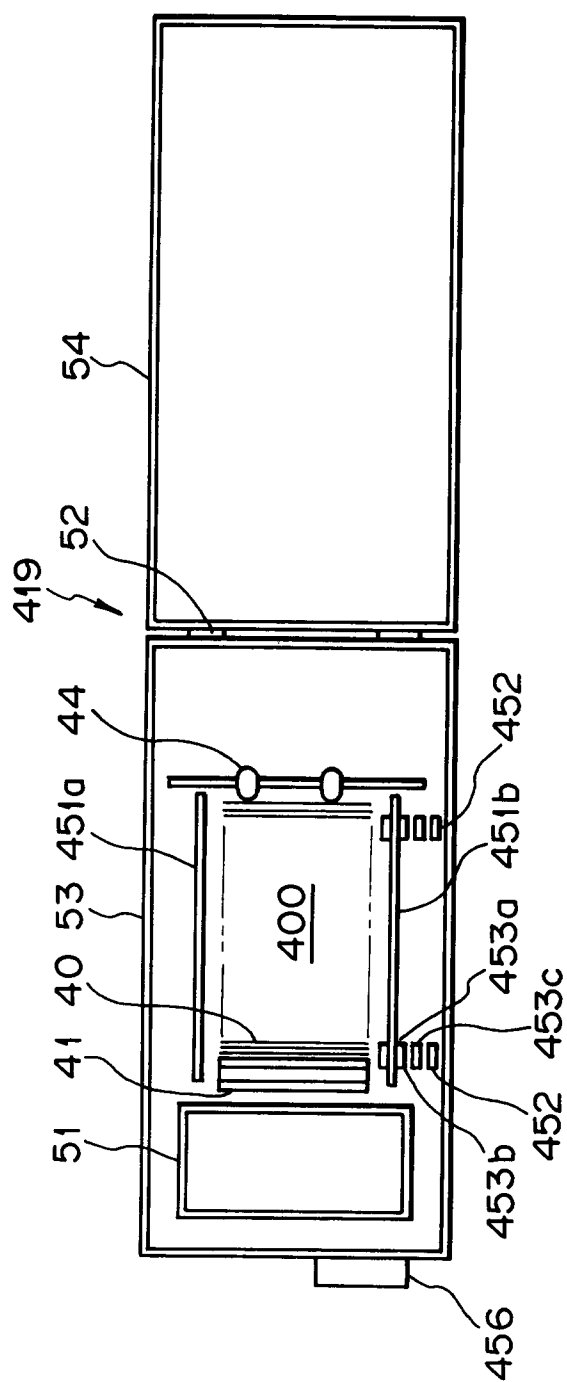


Fig. 42

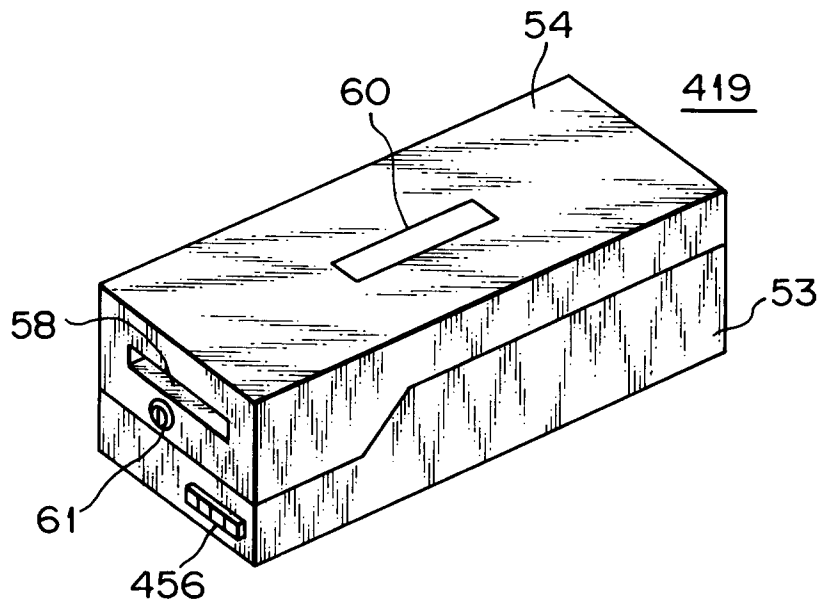


Fig. 43

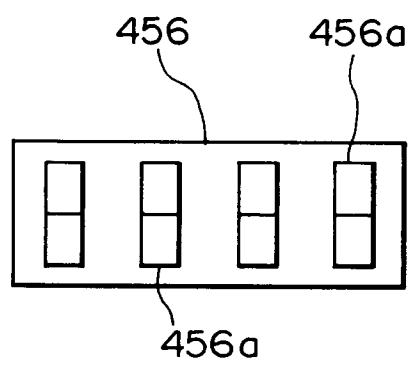


Fig. 44

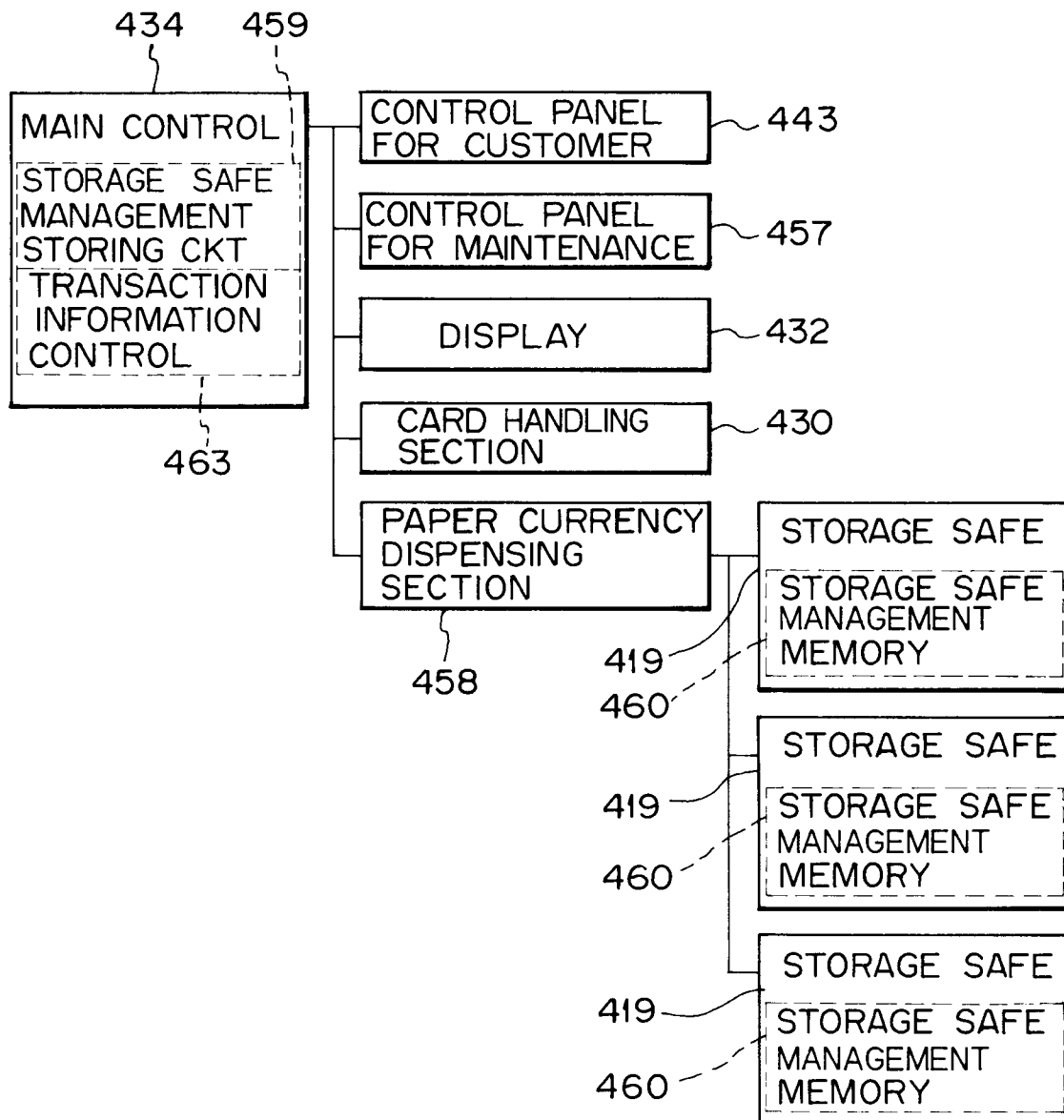


Fig. 45

ADDRESS	MEMORY CONTENTS
n	TRANSACTION COUNTS OF THE ONE-THOUSAND YEN NOTE
n + 1	DISCHARGE COUNTS OF THE ONE-THOUSAND YEN NOTE
n + 2	TRANSACTION COUNTS OF THE FIVE-THOUSAND YEN NOTE
n + 3	DISCHARGE COUNTS OF THE FIVE-THOUSAND YEN NOTE
n + 4	TRANSACTION COUNTS OF THE TEN-THOUSAND YEN NOTE
n + 5	DISCHARGE COUNTS OF THE TEN-THOUSAND YEN NOTE
n + 6	TOTAL TRANSACTION COUNTS
n + 7	TOTAL DISCHARGE COUNTS
n + 8	FIRST SENSOR OUTPUT VALUE
n + 9	SECOND SENSOR OUTPUT VALUE
n + 10	MOTOR 42 DRIVING TIME
n + 11	MOTOR 46 DRIVING TIME
-	-
-	-
-	-
-	-

Fig. 46

ADDRESS	MEMORY CONTENTS
m	TRANSACTION COUNTS OF THE ONE-THOUSAND YEN NOTE
m + 1	DISCHARGE COUNTS OF THE ONE-THOUSAND YEN NOTE
m + 2	TRANSACTION COUNTS OF THE FIVE-THOUSAND YEN NOTE
m + 3	DISCHARGE COUNTS OF THE FIVE-THOUSAND YEN NOTE
m + 4	TRANSACTION COUNTS OF THE TEN-THOUSAND YEN NOTE
m + 5	DISCHARGE COUNTS OF THE TEN-THOUSAND YEN NOTE
m + 6	TOTAL TRANSACTION COUNTS
m + 7	TOTAL DISCHARGE COUNTS
m + 8	TOTAL REJECT COUNTS OF THE ONE-THOUSAND YEN NOTE
m + 9	SKEW REJECT COUNTS OF THE ONE-THOUSAND YEN NOTE
m + 10	DOUBLE CONVEYANCE REJECT COUNTS OF THE ONE-THOUSAND YEN NOTE
m + 11	JAM COUNTS OF THE ONE-THOUSAND YEN NOTE
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Fig. 47

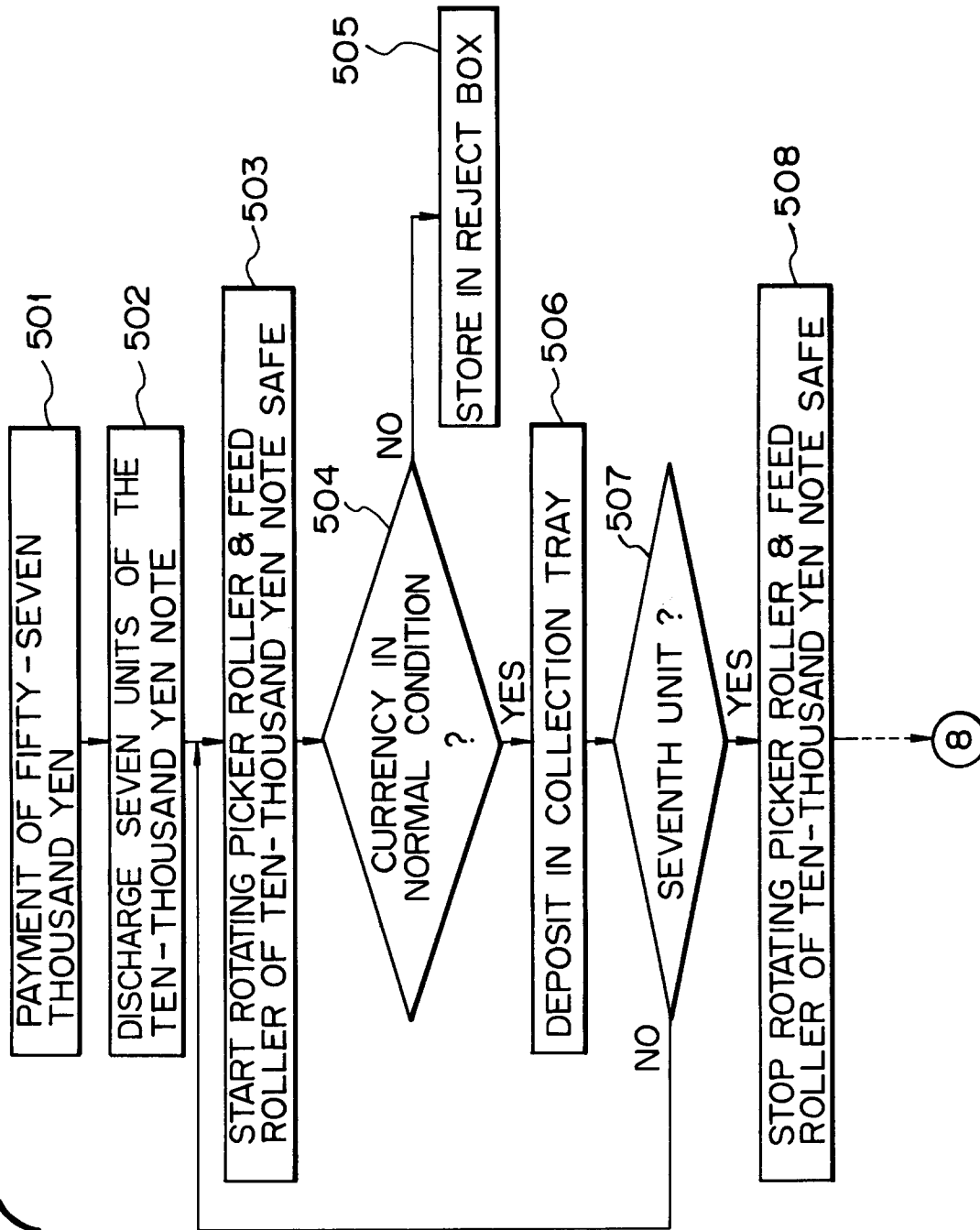


Fig. 48

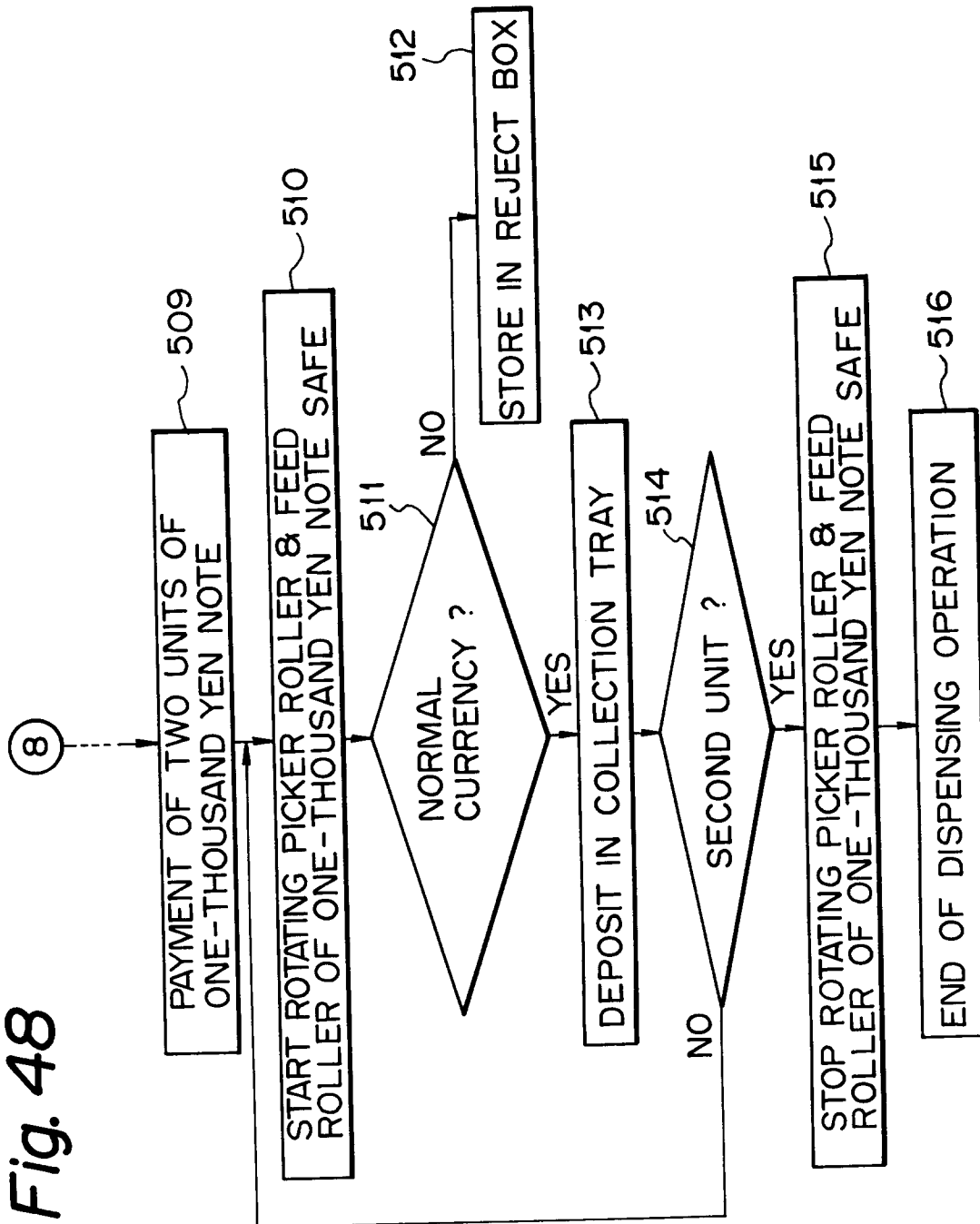


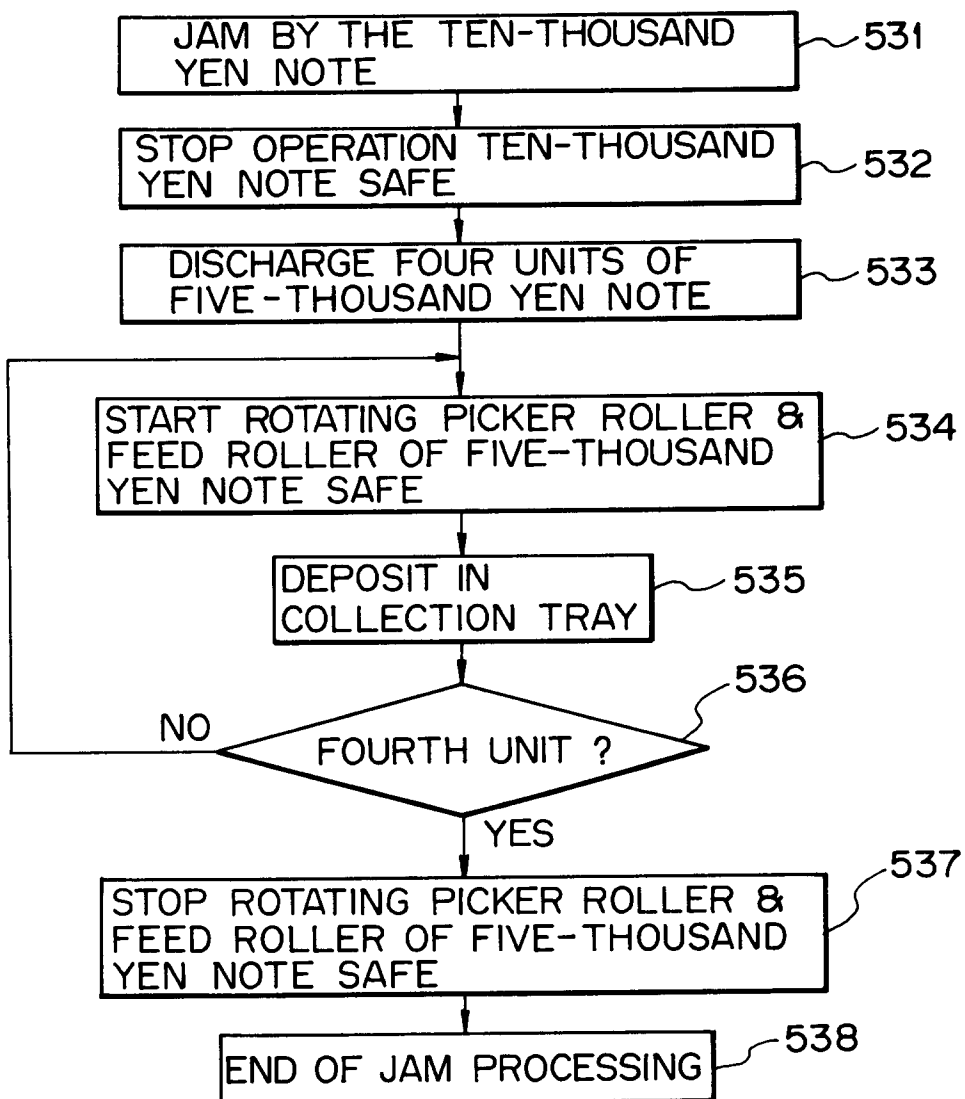
Fig. 49

Fig. 50

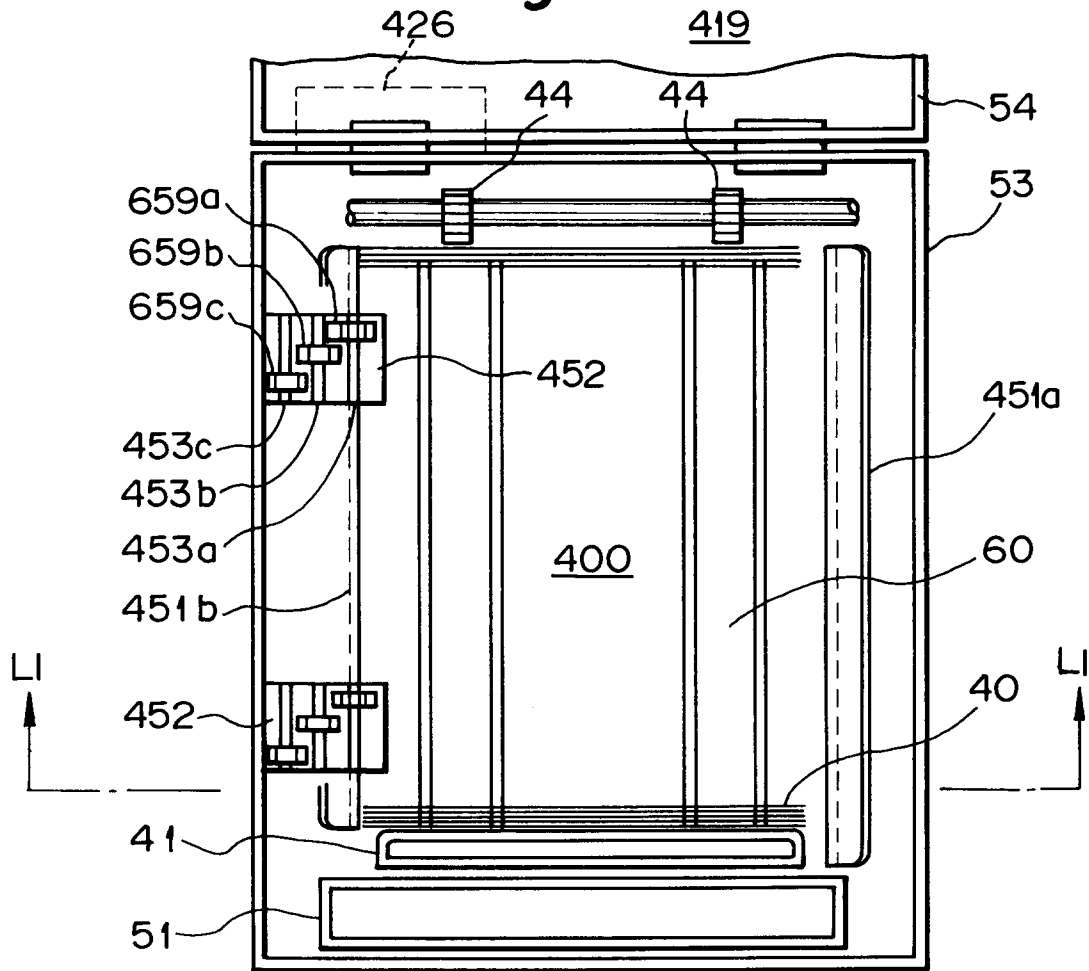


Fig. 51

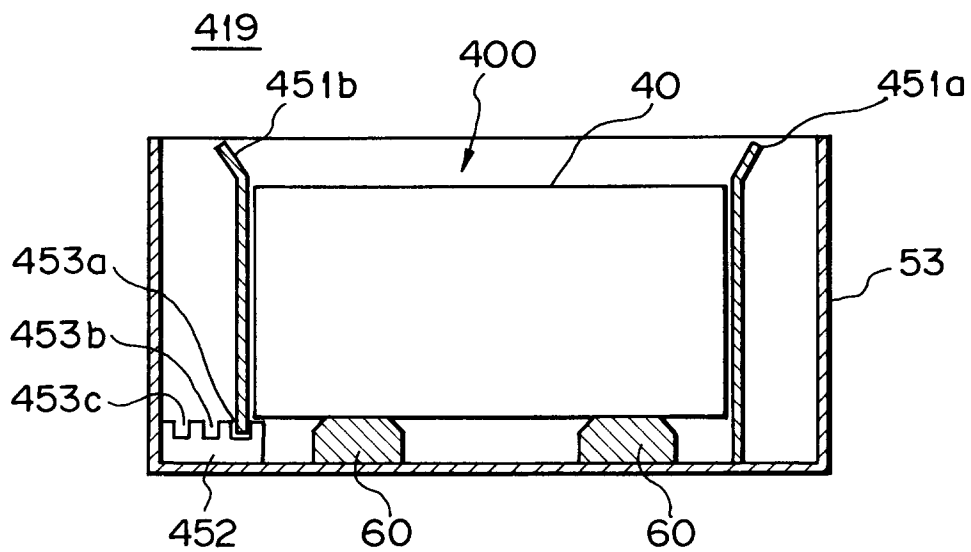


Fig. 52

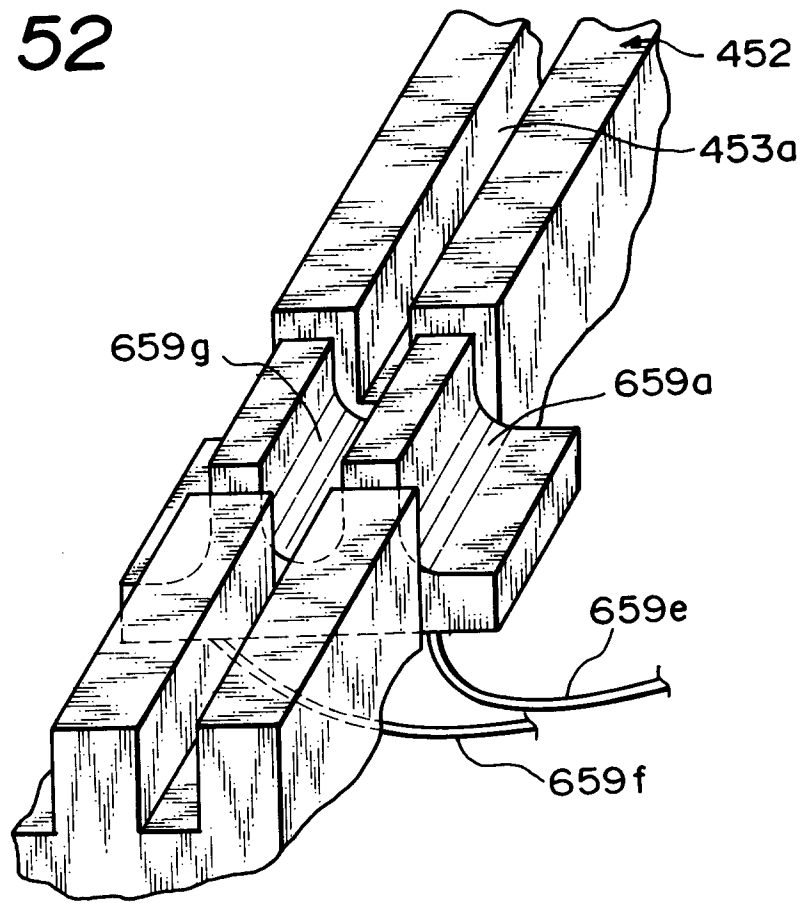


Fig. 53

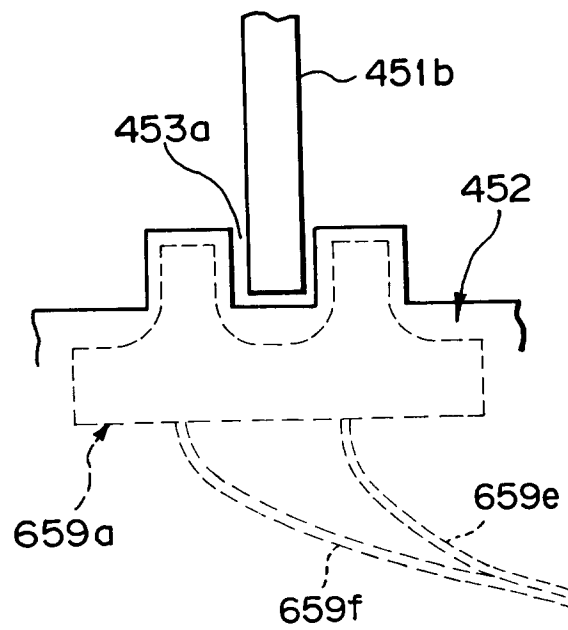


Fig. 54

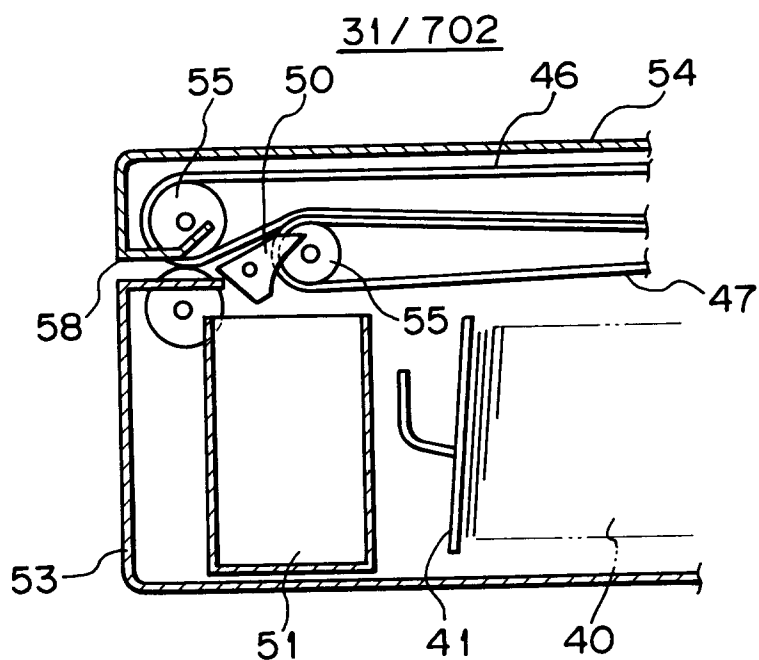


Fig. 55

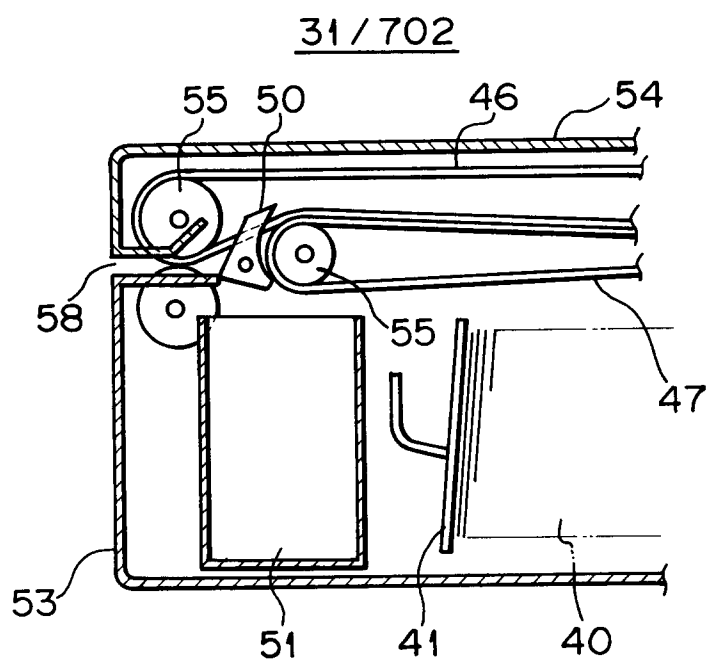


Fig. 56

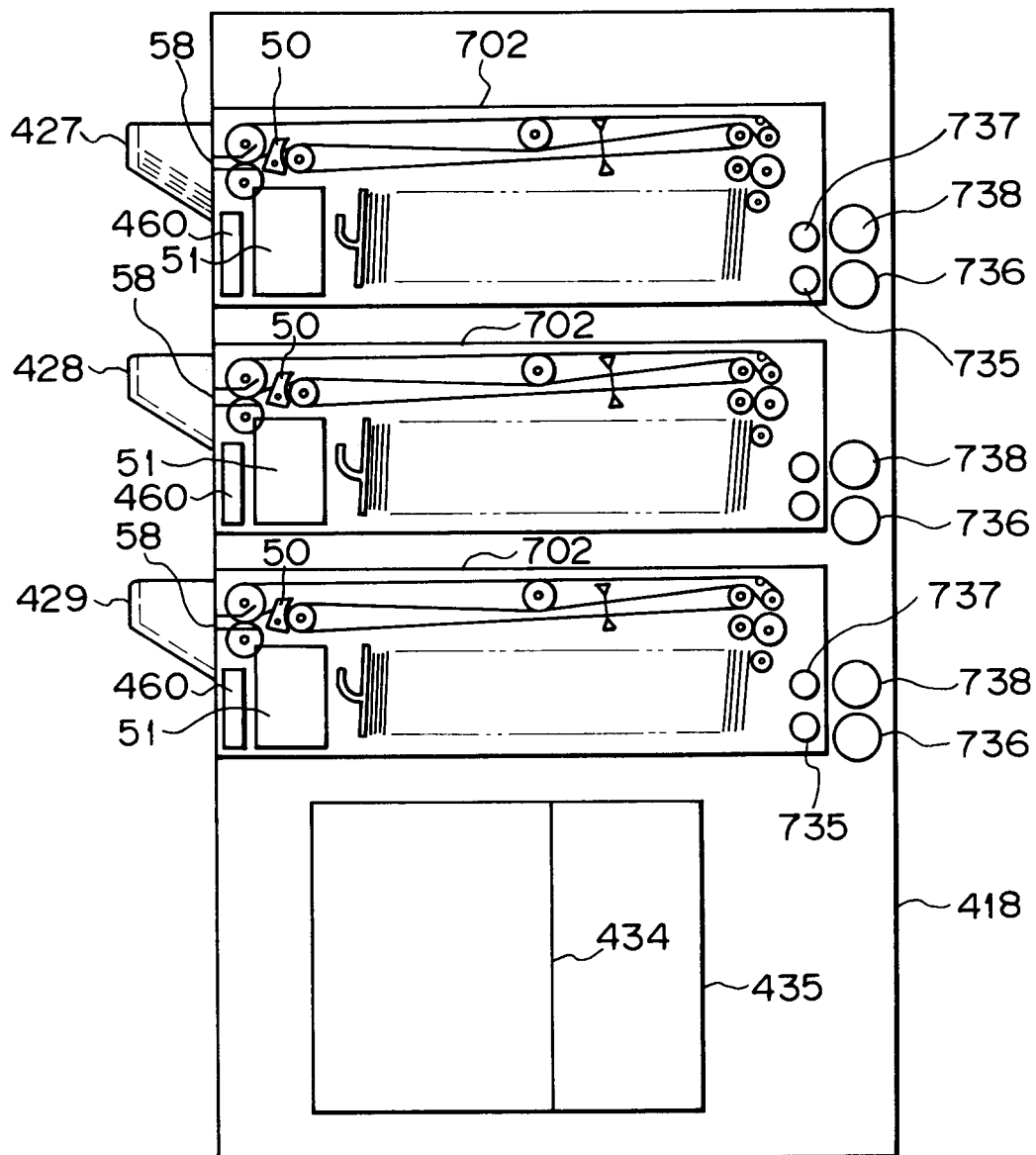


Fig. 57

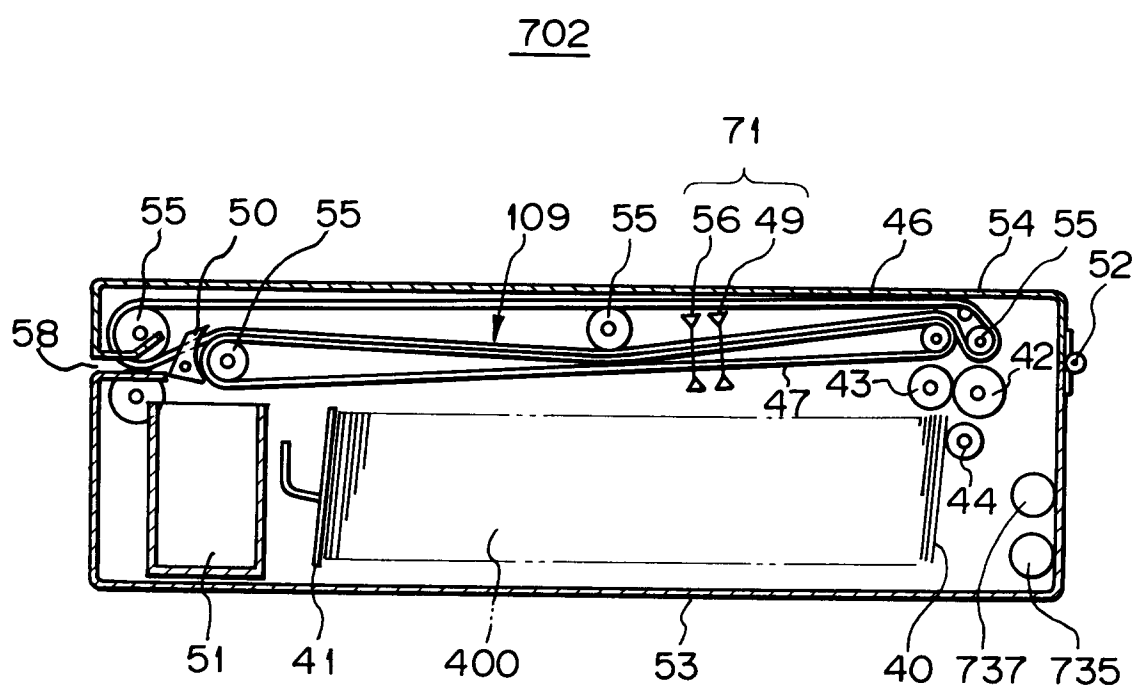


Fig. 58

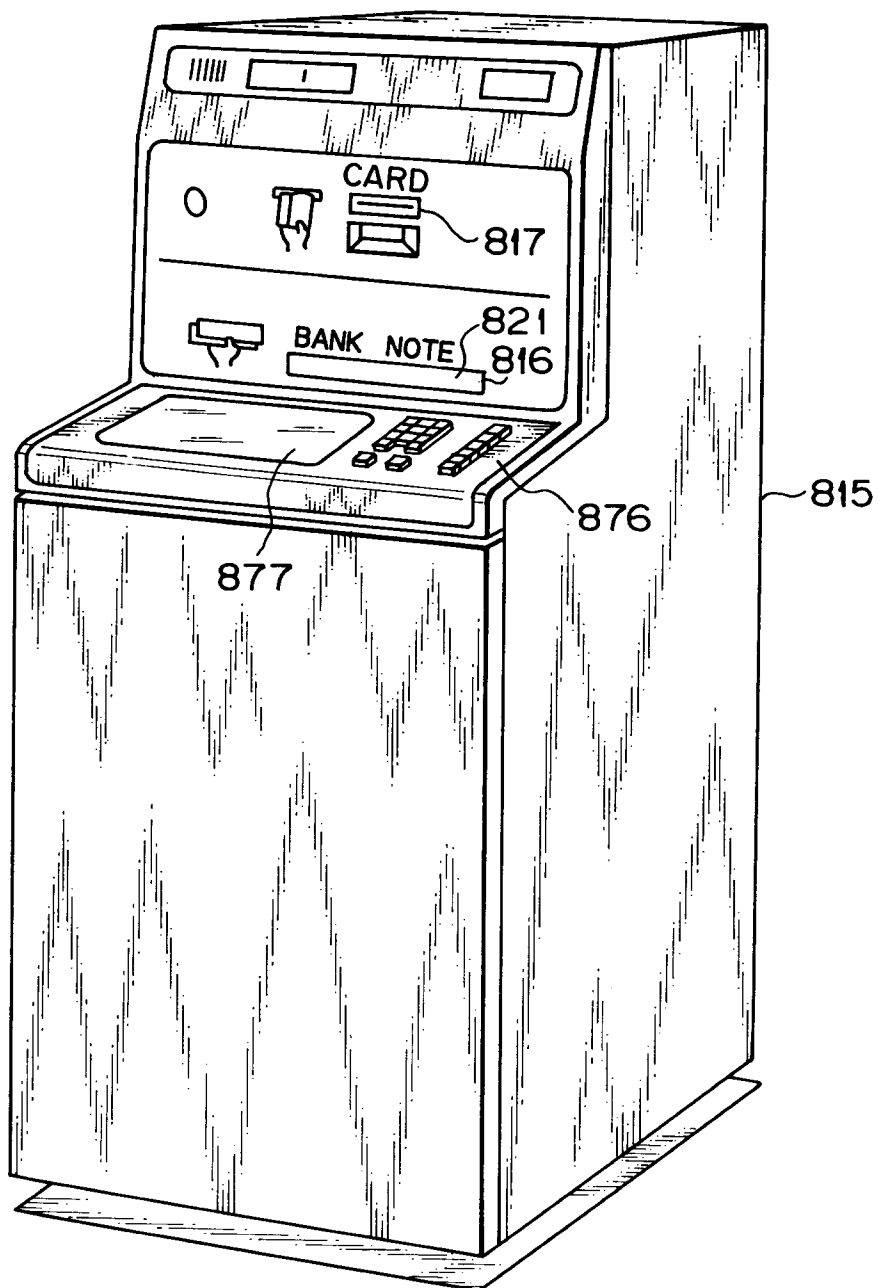


Fig. 59

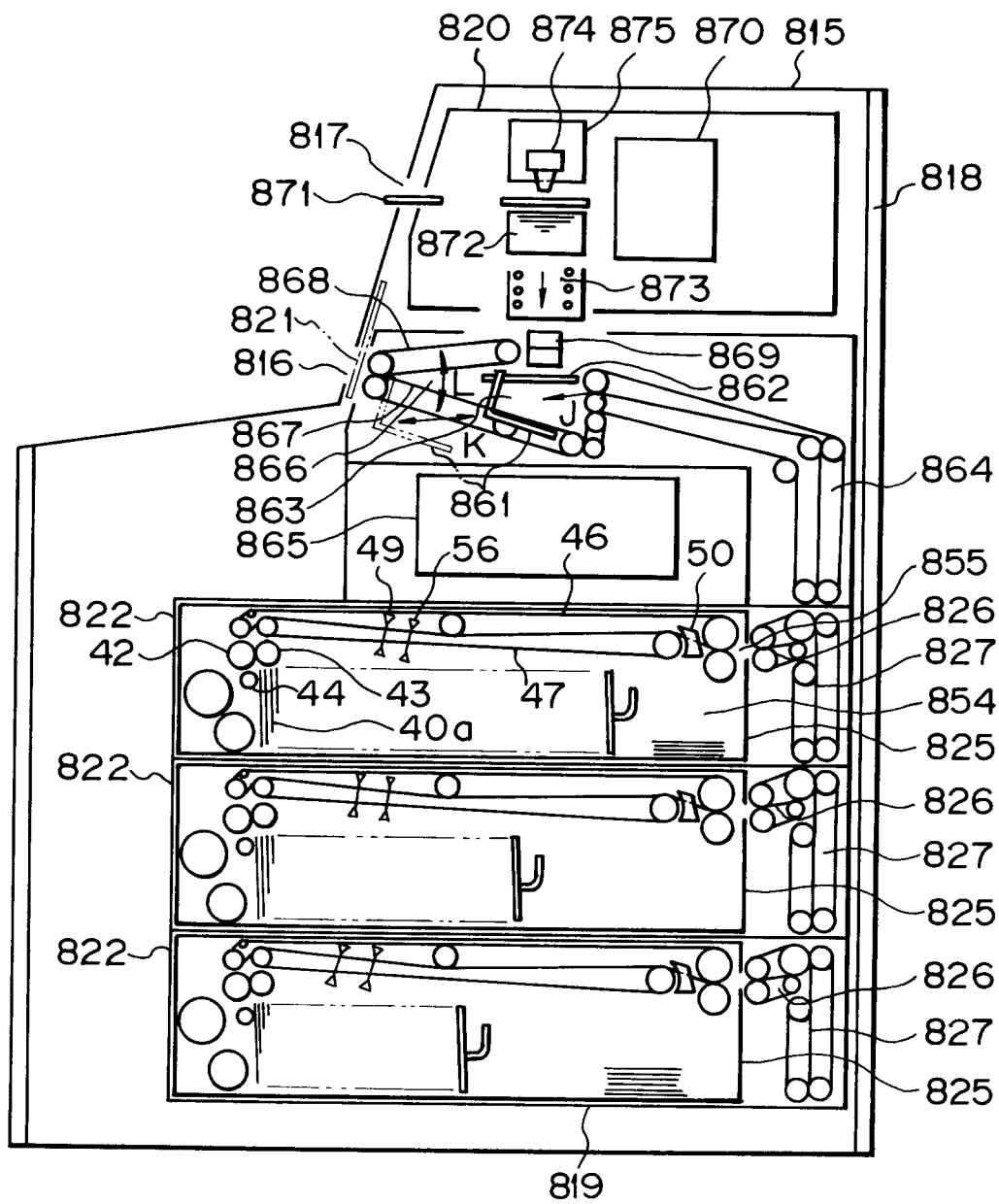


Fig. 60

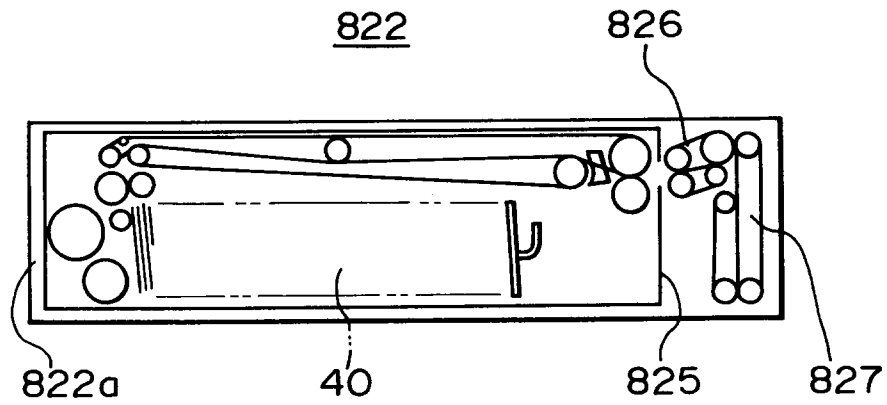


Fig. 61

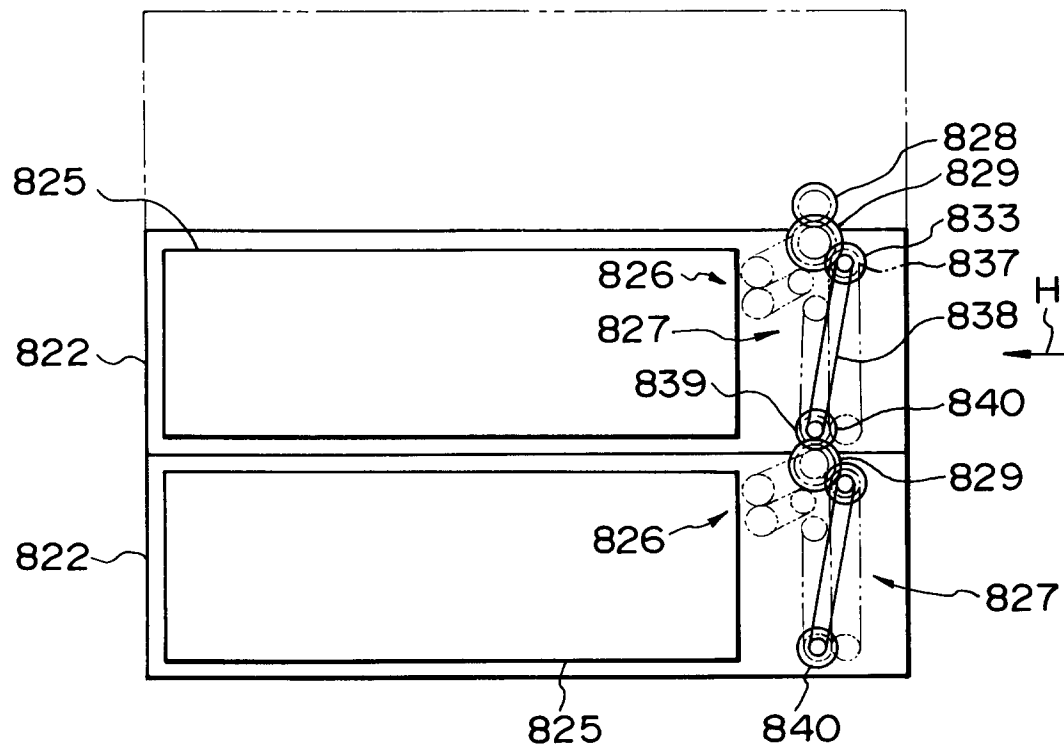


Fig. 62

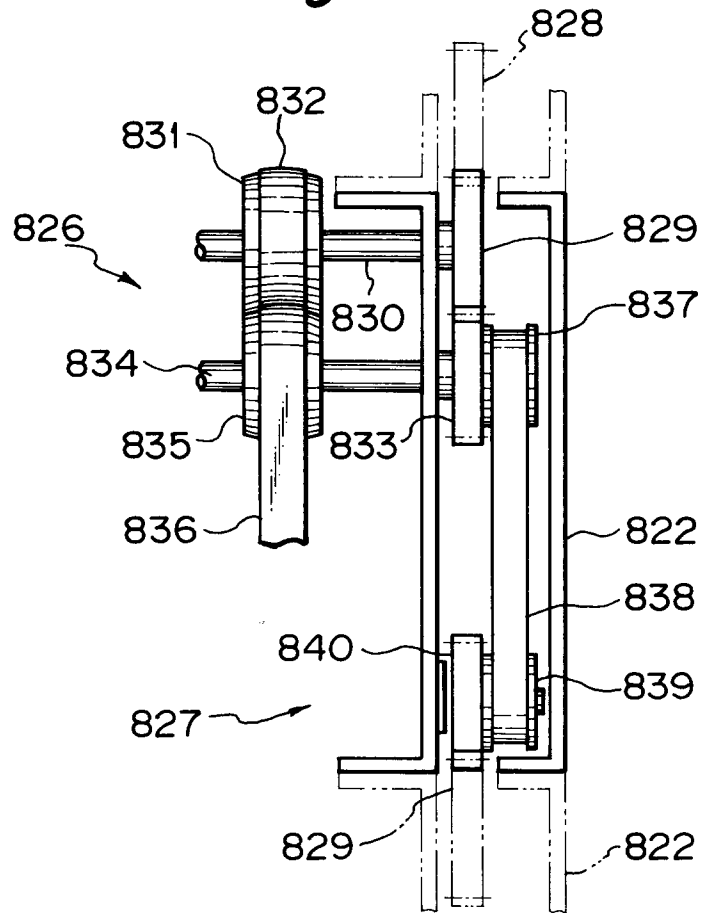


Fig. 63

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