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(54) **Automated transaction machine**

(57) An automated transaction machine (10) includes a note receiving and dispensing mechanism (77). The mechanism includes a storage reel (66), a take-up reel (68) and a flexible web (70) extending between the reels. The note receiving and dispensing mechanism is housed within a note storage module (44). Notes are selectively passed into and out of the storage module to a passage area (92). The machine further includes a note inlet opening (30) and a note outlet (28). A note outlet transport (96) extends between the passage area and the note outlet opening. A note inlet transport (98) extends between the passage area and the note inlet opening. A note validator (58) extends adjacent to the note inlet transport for purposes of sensing the validity of notes inserted in the machine. The machine is selectively operative responsive to inputs to receive and deliver notes.

The machine is further operative to enable replenishment of notes therein without accessing the interior of the housing.

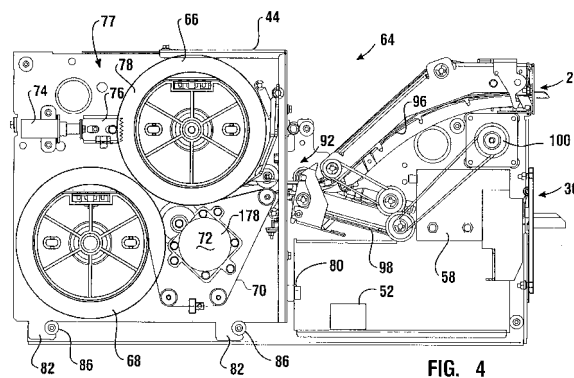


FIG. 4

Description

TECHNICAL FIELD

[0001] This invention relates to automated transaction machines. Specifically this invention relates to an automated transaction machine that dispenses notes to users and which has an internal note storage area which may be replenished without accessing the interior of the machine.

BACKGROUND ART

[0002] Automated transaction machines are known in the prior art. A common type of automated transaction machine is an automated teller machine (ATM). ATMs have been developed which are capable of performing a variety of transactions including the dispensing of currency notes. Other types of transaction machines dispense notes and other types of sheets to users such as bank tellers, cashiers and other service providers. Other types of automated transaction machines dispense items such as tickets, travelers checks, scrip, vouchers or gaming materials. Automated transaction machines generally dispense such materials while assessing appropriate charges and credits to the respective accounts of the user, the machine owner and the provider of the dispensed materials. For purposes of this description an automated transaction machine will be considered as any machine that is capable of carrying out transactions including transfers of value.

[0003] Automated transaction machines that dispense notes or other types of sheets representative of value are generally constructed to prevent access to the supply of sheets within the machine by unauthorized persons. In most cases such automated transaction machines include a secure chest or other secure enclosure. Access to the enclosure is controlled by a lock or other security device so that the interior thereof may only be accessed by appropriate personnel. The interior of the secure enclosure generally includes storage areas for currency notes and other types of sheets which are valuable. The storage areas are often inside removable canisters or other types of enclosures that may be readily installed in and removed from the machine when the secure area is accessed. Sheets are dispensed by the machine to users from the sheet storage areas. When the storage areas require replenishment a service person opens the secure chest and replenishes the supplies. In some cases this is done by removing the depleted or partially depleted canisters and replacing those canisters with filled canisters. In other situations it may involve inserting a "brick" of currency or sheets into the canisters or other sheet storage areas to replenish the sheet supplies.

[0004] A drawback associated with the construction of such conventional automated transaction machines is that replenishing the sheet supplies requires opening the secure area of the machine. This provides the service

person with access to all the valuable sheets as well as the sensitive electronic equipment within the machine. This presents opportunities for theft and tampering. When canisters are changed several individuals may have access to the canister during the times when it is being loaded, transported and installed in the machine. Likewise partially depleted canisters returning from machines for replenishment may pass through several hands. This may present opportunities for pilferage for which responsibility cannot be readily documented. Tamper resistant and tamper indicating sheet holding canisters have been developed. However such containers are not failsafe and may still be subject to compromise by skilled thieves. Sheet holding canisters may also be stolen in their entirety when in transit to and from machines. The use of currency canisters is also expensive. The use of such canisters adds to the cost of the automated transaction machines by requiring the inclusion of mechanisms that can open, close and work in conjunction with sheet containing canisters. The handling and transport of canisters also adds to the cost of machine operation.

[0005] Lower cost automated transaction machines are often installed in gas stations, convenience stores and other merchandising facilities. Such automated transaction machines often carry out only cash dispensing transactions. While the reduced capabilities of such machines results in a lower machine acquisition cost, the problems of handling sheets still exists. Because the security in such merchandising facilities is often not as high as that found in banking environments, it is not uncommon to use armored car type courier services to carry out cash replenishment transactions in such machines. This adds to the cost of machine operation.

[0006] Operators of automated transaction machines in merchandising facilities would desire to replenish the note supplies in such machines with cash that is available within the establishment. Doing this can avoid the cost of having to pay a third party to carry out cash replenishment, which reduces operating costs. However in many merchandise transaction environments the trustworthiness of the personnel may not be verifiable. As a result the machine operator may not want to give their personnel access to the large amounts of cash which are available within the interior of an automated transaction machine. Replenishing the currency supplies within such machines may be an activity limited to supervisory level personnel. However, despite such precautions shortages and discrepancies can occur. This is particularly true when several individuals have the capability of accessing the interior of a machine.

[0007] Recently automated transaction machines have been developed that are capable of "recycling" currency. Such machines are capable of accepting currency notes from a user or operator, and determining the genuineness and particular type of each note. Such machines selectively store the deposited notes in locations within the machine. At a later time when the same or

another user requests a dispense of notes, the machine dispenses the previously deposited notes to the user. While such machines have the capability of having the note supplies replenished without accessing the interior of the machine, such machines are generally complex and expensive. The installation of such a machine would generally not be cost justified in situations where relatively low cost, cash dispense only type machines are currently used.

[0008] There are also many other types of self service and vending machines that users operate which could be improved by adding the capability to such machines of accepting and dispensing currency notes. Common examples of such machines include motor fuel dispensing pumps, vending machines, automated ticketing machines and automated gaming machines. Often such machines already have a user interface that is capable of reading a user's credit card. Such machines also have the capability of assessing a charge to a user's account in exchange for merchandise or services provided. Increasingly self service machines are being provided with the capability of accepting a user's smart card. Smart cards include a memory thereon which has data representative of monetary value. Instead of assessing a charge to a user's account, such machines also have the capability of deducting the monetary value from the value represented by data in the memory of the user's smart card.

[0009] Cash receiving and dispensing capability has generally not been provided in most self service and vending machines for several reasons. First, cash dispensing and accepting mechanisms have in the past generally been , expensive and would render such machines cost prohibitive to acquire and operate. Second, such machines generally do not include the security features included in automated teller machines or cash dispensers, because the items generally dispensed by such machines are not readily disposed of for cash value. Another reason such machines have not been provided with cash accepting and/or dispensing capability is that to do so would require the machine operators to incur the additional costs associated with cash handling previously discussed, that are often encountered in the use of operating ATMs and cash dispensers. A further drawback has been that making cash acceptance and dispensing an integral part of such machines may limit their operation to selected hours and locations where greater security may be maintained. Thus, while users may benefit from having machines such as motor fuel dispensing pumps and vending machines accept and receive cash, providing such machines with these capabilities has been cost prohibitive.

[0010] Thus there exists a need for an automated transaction machine that is inexpensive to produce and operate, but that is also highly reliable. There further exists a need for an automated transaction machine that is capable of being replenished with currency notes or other sheets of value without having to access the note storage

areas in the interior of the machine. There further exists a need for an automated transaction machine which includes a note receiving and dispensing component that adds only limited cost to the production and operation of the machine.

DISCLOSURE OF INVENTION

[0011] It is an object of the present invention to provide an automated transaction machine.

[0012] It is a further object of the present invention to provide an automated transaction machine which is capable of dispensing sheets having value, such as currency notes.

[0013] It is a further object of the present invention to provide an automated transaction machine which dispenses currency notes from a note storage area within the machine and which is capable of having the note storage area replenished without accessing an interior of the machine.

[0014] It is a further object of the present invention to provide an automated transaction machine which includes a note supply that can be replenished without accessing an interior area of the machine and which is configurable to be replenished from either the front or the rear side of the machine.

[0015] It is a further object of the present invention to provide an automated transaction machine that is economical to produce and to operate.

[0016] It is a further object of the present invention to provide an automated transaction machine that is capable of receiving, validating and dispensing sheets such as currency notes.

[0017] It is a further object of the present invention to provide an automated transaction machine which provides for the receiving and dispensing of currency notes as a supplementary function to a primary vending or self service function that is carried out by the machine.

[0018] It is a further object of the present invention to provide an automated transaction machine which is capable of dispensing notes from a note storage area within the machine and which is capable of having a note supply readily removed from the machine by authorized personnel.

[0019] It is a further object of the present invention to provide an automated transaction machine that is easy for users to operate and which provides timely promotional and other messages to users of the machine.

[0020] Further objects of the present invention will be made apparent in the following Best Modes For Carrying Out Invention and the appended claims.

[0021] The foregoing objects are accomplished in an exemplary embodiment by an automated transaction machine. The automated transaction machine may be a machine whose primary function is the receipt and/or dispensing of sheets such as currency notes. Alternatively the automated transaction machine may be associated with a primary function such as the vending of motor fuel,

lottery tickets, transit tokens or other transactions and may include the dispensing and/or receipt of sheets having value, such as currency.

[0022] The automated transaction machine in one exemplary embodiment includes a machine housing. The housing includes a user interface area including at least one input device through which the machine may receive at least one input from a user of the machine. A sheet inlet opening extends through the housing as does a sheet outlet opening.

[0023] Within the housing of the machine is a note receiving and dispensing mechanism. The note receiving and dispensing mechanism is operatively connected to a sheet storage area which in the described embodiment is used for holding currency notes. The sheet receiving and dispensing mechanism includes a passage area through which sheets are passed when they are being received by the mechanism for storage in the storage area. Sheets also pass through the passage area when they are being dispensed by the mechanism from the storage area.

[0024] The described embodiment further includes a note inlet transport which extends between the note inlet opening and the passage. A note validator is positioned adjacent the note inlet transport. The note validator is operative to sense notes which are inserted through the inlet opening for purposes of determining whether the notes are valid. The machine further includes a note outlet transport. The note outlet transport extends between the passage and the outlet opening through the housing. The machine further includes one or more drive mechanisms that are operatively connected to the inlet and outlet transports and which enable the selective movement of notes or other sheets therein.

[0025] The automated transaction machine of the described embodiment further includes a controller. The controller is in operative connection with the validator and the drive for the inlet and outlet transports. The controller is also in operative connection with the input devices as well as the validator. The controller is operative to control the machine such that in response to at least one input to the input device, notes or other sheets stored in the storage area are dispensed by the mechanism and moved through the outlet transport to the outlet opening. The controller is further operative responsive to insertion of a note or other sheet to the inlet opening to have the validator determine if the inserted note is valid. If so, the note is accepted by the receiving and dispensing mechanism and stored in the storage area.

[0026] Configurations of the automated transaction machine of the present invention may provide for both receiving notes from and dispensing notes to customers while charging and crediting appropriate accounts. Alternatively embodiments of the invention may be configured for only dispensing notes to customers who operate the machine. In such embodiments acceptance of notes is limited to personnel who are authorized to replenish the machine on behalf of the machine owner or operator.

Alternative configurations of the machine may provide for the note inlet and outlet openings to be positioned on generally one side of the machine, while alternative forms of the invention may provide for such openings to be on generally opposed sides of the machine. Some forms of the invention may provide for accepting sheets into the note inlet opening one sheet at a time while others may be configured for accepting stacks of sheets which are then separated, authenticated and stored within the machine.

[0027] In some exemplary forms of the invention the note receiving and dispensing mechanism may include a roll storage type mechanism. The roll storage mechanism includes a flexible web that extends between a storage reel and a take-up reel. The storage reel and take-up reel are moved by a reel drive mechanism that enables selectively moving the reels to deliver sheets to and to receive sheets from the passage area. The storage and take-up reels in some embodiments are contained within a note storage module that is readily installed in and removed from the machine housing by authorized personnel. Certain preferred forms of the invention are highly reliable and yet relatively lower in cost to produce and operate.

[0028] Other preferred forms of the invention include a user interface with a display. The display is used for presenting promotional or other messages to users of the machine. These messages may be time sensitive and/or of limited duration. In preferred forms of the invention such messages are provided by interaction of the controller with a replaceable plug-in memory of a smart card or similar device. Various forms of user interfaces may also be provided to simplify and facilitate operation of automated transaction machines.

BRIEF DESCRIPTION OF DRAWINGS

[0029]

Figure 1 is an isometric view of one exemplary embodiment of an automated transaction machine of the present invention.

Figure 2 is a rear plan view of the machine shown in Figure 1 with an access door in an open position.

Figure 3 is a schematic view showing a controller of the automated transaction machine and transaction function devices and other devices in operative connection therewith.

Figure 4 is a transparent side view of the mechanisms for handling sheets such as currency notes in the automated transaction machine shown in Figure 1.

Figure 5 is a schematic view showing the components included in the sheet paths of the automated transaction machine shown in Figure 1.

Figure 6 is a schematic view of a reel drive mechanism operating to move the storage and take-up reels in a sheet dispensing direction.

Figure 7 is a schematic view of the first and second drive members of the reel drive mechanism, along with the transmission member which interconnects the drive members.

Figure 8 is a schematic view similar to Figure 7 with the reel drive mechanism operating to move the storage and take-up reels in a sheet receiving direction. Figure 9 is a simplified side view of the sheet handling components in the passage area of the machine.

Figure 10 is an enlarged view of the passage area including the first and second sheet separating members for separating sheets from the sheet supporting web.

Figure 11 is a side schematic view of the gate member which serves to direct sheets between the inlet and outlet transports in the passage area.

Figure 12 is a side schematic view of the secondary separating member and its suspension on the note storage module.

Figure 13 is a side schematic view of the directional drag applying members used in connection with the storage and take-up reels.

Figure 14 shows a tab portion on the note storage module engaged with a cylindrical support member.

Figure 15 is an isometric view of the cylindrical support member shown in Figure 14.

Figure 16 is an isometric view of a flexible note supporting web with machine readable indicia thereon, the web being shown in supporting connection with currency notes.

Figure 17 is a side schematic view indicating movement of parts of sheet handling mechanisms when dispensing sheets.

Figure 18 is a side schematic view showing movement of sheet handling mechanisms when the note validator is operating to determine if an inserted note is valid.

Figure 19 is a schematic view showing a note that has passed from the note validator to the passage area.

Figure 20 is a schematic view indicating operation of sheet handling mechanisms in moving a note through the passage area and into supporting connection with the web and sheet storage reel.

Figure 21 is a schematic view of an alternative embodiment of an automated transaction machine which includes a common note inlet and outlet transport in connection with a note validator.

Figure 22 is a schematic view of a further alternative embodiment which has a note inlet opening on an opposed side of the machine from the note outlet opening.

Figure 23 is a schematic view of an automated transaction machine which is capable of receiving and separating a stack of notes.

Figure 24 is a schematic view of a mechanism used for separating notes individually from the stack in the embodiment shown in Figure 23.

Figures 25-30 are schematic views of a user interface and the operation thereof which may be used in connection with embodiments of the invention.

5 BEST MODES FOR CARRYING OUT INVENTION

[0030] Referring now to the drawings and particularly Figure 1 as shown therein an automated transaction machine of a first exemplary embodiment of the present invention generally indicated 10. Machine 10 is an automated teller machine whose primary functions are to dispense and receive currency notes. It should be understood however that other embodiments of the invention may be machines whose primary functions include conducting other types of transactions. These may include for example the dispense of motor fuel, the dispense of tickets, the dispense of vouchers, the dispense of gaming materials or other functions that a user may carry out using the machine.

[0031] Machine 10 includes a housing 12. As used herein housing 12 refers to the external enclosure of the machine as well as the internal structures which support components of the machine therein. A user interface generally indicated 14 is supported on the housing and is accessible by a user. In the embodiment shown the user interface includes input devices and output devices. One of the input devices is a card reader 16. Card reader 16 in the machine shown is a swipe type card reader which is operative to read magnetic stripe cards 18 which are passed through the reader by customers. Cards 18 may be various types of cards such as credit or debit cards which include information for identifying the user and/or their accounts.

[0032] User interface 14 of the described embodiment also includes other input devices. These include a keypad 20 and function keys 22. Users are enabled to input data and instructions to the machine by selectively pressing the keys which make up the keypad as well as the function keys 22.

[0033] The user interface 14 further includes an output device which includes a display 24. Display 24 of the described embodiment may be a CRT or LCD type display that is operative to display messages to a user, including messages which instruct the user in operation of the machine.

[0034] It should be understood that the input devices and output device shown are exemplary and that other embodiments of the invention may employ other types of input and output devices. These include for example other types of card readers for reading magnetic stripe or other types of cards. These may include for example motorized readers or dip readers. Other types of cards may also be employed with the machine. Such cards include so called "smart cards" which include a programmable memory with data thereon. Such data may include information about the user and their accounts. It may also include information representative of monetary value. Such value may be deducted from the memory as the

card is used to make purchases. Some cards may have the value thereon periodically replenished. Other types of input devices may be used which read articles such as articles encoded with optical indicia which can be used to identify the user or their accounts. Other types of input devices may include biometric type reading devices such as fingerprint readers, retina scan devices, iris scan devices, speech recognition devices or other types of input devices which are capable of providing an input which can identify a particular user and/or their accounts.

[0035] The keypad and function keys which serve as input devices in the described exemplary embodiment may be replaced in other embodiments by other types of devices which are capable of selectively receiving data or instructions from a user. Other types of output devices may also be used. These may include other types of visual and nonvisual output devices which are capable of communicating a message to a user and which can instruct the user in the operation of the machine. Of course when automated transaction machines of the invention are incorporated with other devices which carry out other functions, other types of input devices associated with carrying out those other functions may also be included. These may include for example switching and control devices for controlling the dispense of motor fuel when the machine of the invention is incorporated with a motor fuel dispensing device. The particular additional devices will depend on the environment in which the invention is used.

[0036] Returning to the description of the machine 10 shown in Figure 1, the housing includes therethrough a receipt opening 26. The receipt opening is used to provide the user with printed receipts for the transactions conducted at the machine. The housing further includes a note outlet opening 28. The note outlet opening 28 is used to deliver notes dispensed from the machine to a user. It should be understood that the note outlet opening may also be referred to herein as a sheet outlet opening, and that in embodiments of the invention sheets other than notes may be received and dispensed from the machine.

[0037] The machine 10 further includes a note inlet opening 30. Note inlet 30 is used for inserting notes or other types of sheets into the machine for storage. As indicated in phantom, in some embodiments the note inlet opening 30 may be rendered inaccessible by a movable cover 32. The cover 32 is selectively secured by a suitable locking mechanism 34. The cover may be used in circumstances where the machine operator only wants selected authorized personnel to be able to insert notes for storage in the machine. This may be the case when the machine operator wants users to use the machine only as a cash dispenser. In some embodiments the cover may provide a note supporting surface or include a note holding structure such as a pocket to facilitate holding dispensed notes for the user of the machine when the cover is in position.

[0038] As shown in Figure 1 the housing of the machine

further includes a connector 36. The connector 36 is operative to releasibly receive a plug in memory element 38. The plug in memory element in the embodiment shown is used for holding messages that are to be provided to users of the machine through the display 24. As later discussed, the plug in memory 38 may hold promotional messages which are displayed to users of the machine on a timely basis. Such promotional messages may include for example discounts on certain merchandise or special offers which expire on a certain date. In one preferred embodiment the plug in memory 38 may be supported on a smart card. The memory may include one or more promotional items which are promoted only during certain times of day, on certain days of the week or during particular time periods. The use of this feature is later discussed in detail.

[0039] Figure 2 shows the rear of the machine 10. The housing 12 of the machine includes an access door 40 which is shown in the open position in Figure 2. The access door 40 includes a locking mechanism 42. The locking mechanism 42 is normally used to secure the access door 40 in the closed position. The locking mechanism 42 may be opened by authorized personnel to enable them to access an interior area of the machine.

[0040] The interior area of the machine includes various components which are shown schematically. Such components may include for example a note storage module 44. As later described in detail the note storage module 44 includes a note storage area for holding notes within the machine. The note storage module 44 is readily removable and installed in the machine once the access door 40 is in the open position. Other components within the housing of the machine may include a journal device 46. The journal device 46 may be for example a journal printer which makes a permanent hard copy record of transactions which are carried out by the machine. Other devices within the interior of the machine may include a communications device 48. The communications device may be for example a modem, wireless transmitter, lease line interface connection or other suitable device for communicating with other computers to carry out transactions with the machine. These other computers may include for example computers in credit and/or debit card networks which are capable of handling transaction messages and settling accounts between users, sources of monetary value and the operator of the machine. Another device shown schematically in the interior of the machine in Figure 2 is a receipt printer 50. The receipt printer 50 is operative to produce printed receipts that are dispensed to customers through receipt opening 26.

[0041] Figure 3 shows schematically the electrically controlled devices which are included in the described embodiment of the machine 10. A controller 52 serves as a control device for controlling the electrical devices within the machine. The controller 52 includes an internal clock device schematically indicated 54. The controller is in operative communication with a memory 56 which is also referred to herein as a data store. The controller

52 may in various embodiments include one or more processors or operatively connected computers which serve as an electrical signal source for devices which are in operative connection with the controller.

[0042] As shown in Figure 3 the controller is operative to communicate with the transaction function devices previously described. These include the card reader 16, the keypad and function keys 20 and 22 and the display 24. The controller is also operative to communicate and control operation of the receipt printer 30 and the journal device 46, which in this case is a journal printer. The controller is also in operative communication with the plug in memory 38 and the communication device 48 which is used to communicate with other devices. In the described embodiment the controller 52 is also operative to communicate with other devices. These include for example a note validator 58 which will later be discussed in detail. The note validator is operative to sense notes to determine their validity and to distinguish between valid and invalid notes inserted into the machine. The controller 52 is also operatively connected to a module drive 60 and a transport drive 62 which are control circuits for controlling motors which operate to move notes within the machine. These are later discussed in detail. It should be understood that these transaction function devices are exemplary and that other embodiments of the invention may include different and/or additional types of transaction function devices.

[0043] Figure 4 is a view of the sheet handling mechanism that is used for storing and dispensing notes within the machine. The sheet handling mechanism generally indicated 64, includes the note storage module 44 previously discussed which is removably mounted on the housing of the machine. The note storage module includes a storage reel 66 which is rotatably mounted in supporting connection with the housing of the machine in the storage module. A take-up reel 68 which in the preferred embodiment is identical to the storage reel, is also rotatably mounted in the machine. A flexible web 70 extends between the storage reel and the take-up reel.

[0044] The note storage module of the described embodiment includes thereon a reel drive mechanism 72. The reel drive mechanism is operative in a manner later discussed to selectively drive the storage reel 66 or the take-up reel 68.

[0045] The note storage module 44 also includes therein an actuator 74. The actuator is in operative connection with a movable locking member 76. The locking member 76 is movable by the actuator 74 between a position in which rotational movement of the storage reel is enabled and a position in which the locking member holds the rotatable storage reel in relatively fixed position with respect to the note storage module 44. This is accomplished in the locking position of the locking member by engaging cooperating projections and recesses schematically indicated 78 on the locking member and the storage reel.

[0046] The actuator 74 is electrically connected with

the controller 52 through a releasible connector 80. The controller 52 serves as an electrical signal source which operates the actuator generally to enable the storage reel 66 to move when it is properly positioned within the machine. When the note storage module is positioned in the machine and the releasible connector 80 connects the actuator 74 to the electrical signal source, the projections and recesses of the locking member and reel are disengaged enabling the reel to move. This feature aids in securing the note storage reel which serves as a note storage area, in fixed position relative to the module when the note storage module is removed from the machine. This makes it more difficult for unauthorized persons to extract the note from the note storage module after it has been removed from the machine.

[0047] The note storage module 44 is supported in the machine by tab portions 82. Tab portions 82 include semicircular openings or slots 84 (see Figure 14). Axially elongated cylindrical support members 86 are accepted into the openings 84 when the note storage module 44 is in the operative position within the machine.

[0048] The openings 84 in the tab portions 82 extend in generally planar members and are bounded by a surface 88 which serves as an arcuately shaped generally u-shaped projection. The u-shaped projecting surface 88 is positioned to extend in generally annular recesses or slots 90 which extend about the cylindrical support members 86. The interfitting engagement of the u-shaped projections and the annular recesses enables positioning the note storage module 44 in the proper position within the housing of the machine. It further enables engaging and disengaging the tab portions and the cylindrical support members from the engaged and disengaged positions by moving the note storage module along the direction of arrow I shown in Figure 14.

[0049] In the described form of the invention the cylindrical support members 86 also serve as supporting members for the construction of the structure surrounding the note storage module within the machine. Members 86 include threaded openings in each end to facilitate their engagement to other components. The positioning of the annular recesses 90 in the cylindrical support members are also asymmetrical to facilitate the proper positioning of the note storage module. During assembly of the machine the proper positioning of the cylindrical support members is assured by having the threaded openings in each end of the support members of a different size and/or thread configuration. This construction along with the mating fasteners which are used to hold the machine components together assure that the cylindrical support members are installed properly during assembly. Of course the construction of the supporting structure and removable note storage module is exemplary and in other embodiments other suitable structures and assembly methods may be used. This includes using a configuration for positioning the storage module which is generally the reverse of that shown in Figure 14 as well as other arrangements of interengaging projections

and slots.

[0050] The note handling mechanism shown in Figure 4 further includes a passage area 92. The passage area 92 extends through an opening 94 in the front wall of the note storage module (see Figure 10). Notes passing between the note receiving and dispensing mechanism of the note storage module pass through the passage area 92.

[0051] As shown in Figure 4 a note outlet transport 96 extends between the passage area and the note outlet opening 28. Note outlet transport 96 is operative to move notes in connection therewith. A note inlet transport 98 is operative to move notes between the note inlet opening 30 and the passage area 92. Note inlet transport 98 includes a portion which extends through the note validator 58. As previously discussed the note validator is operative to sense notes which pass through the note inlet transport. The note validator is operative to sense notes which move in the note inlet transport. The note validator is operative to determine if the sensed notes are valid for purposes of acceptance in the machine and to discriminate between valid and invalid notes.

[0052] A transport drive 100 is operatively connected to the inlet and outlet transports 96 and 98 respectively. The note inlet and outlet transports are shown in further detail in Figure 5. The note outlet transport 96 includes a belt 102 and a plurality of note engaging idler rolls 104. The belt and idler rolls engage notes therebetween such that the notes move with movement of the belt between the passage area and the note outlet opening 28. It should be understood that while a belt and roll transport is used for the note outlet transport in the described embodiment, in other embodiments other configurations of cooperating belts, rollers or other moving members suitable for engaging and moving notes may be used.

[0053] The note inlet transport in the described embodiment includes note validator 58. In the described embodiment note validator 58 is a standard commercially available note acceptor which is operative to sense and determine the validity of certain types of bills. In the case of a machine which is configured to receive and dispense twenty dollar bills, the validator may be a device for sensing whether an inserted note is a valid twenty dollar bill. The validator 58 includes therein or has adjacent thereto a generally nonslip portion 106 of the note inlet transport 98. Portion 106 is operative to engage and move notes inserted through the note inlet opening 30 past the validator. The generally nonslip portion 106 is operative to move notes past the sensing mechanisms within the validator 58 as required for sensing the note and determining its validity for purposes of receipt within the machine. If an inserted note is determined not to be valid or otherwise not suitable for acceptance within the machine, the nonslip portion 106 after moving the note inward into the validator is operative to move it outward back through the note inlet opening 30. This is done by the validator operating based on its internal programming or in alternative embodiments operating in cooperating relation

with the controller 52.

[0054] If a note inserted through the note inlet opening 30 is sensed as valid and acceptable by the validator 58, the nonslip portion 106 of note inlet transport 98 is operative to release the note to a limited slip portion 108 of the note transport 98. Limited slip portion 108 includes a belt 110 and idler rolls 112. The belt 110 and idler rolls 112 serve as limited slip engaging members which engage notes passing inward from the validator 58. However, the limited slip portion 108 is not operative to apply sufficient force to a note to remove it from engagement with the nonslip portion 106, until the nonslip portion disengages the note. This enables the validator 58 of the described embodiment to move the note sufficiently rearward so that it can engage the limited slip engaging members 110, 112 and still enable the nonslip portion to reverse the direction of the note so that it can be delivered back out through the note inlet opening in the event that the note is determined to be invalid. This feature enables standard commercially available, compact size note validators to be used in the embodiment shown.

[0055] While the note inlet transport 98 is shown in the described embodiment has a generally nonslip portion and a limited slip portion, other embodiments of the invention may not include such portions depending on the type of validator used. An example of such an embodiment is later described in detail. In addition although the generally nonslip portion is shown as a plurality of cooperating rolls and the limited slip portion 108 is shown as a belt and roll transport, other embodiments of the invention may include other types of cooperating moving members that are operative to move sheets in the desired fashion.

[0056] A gate 114 is positioned adjacent to the passage area 92. Gate 114 is operative to selectively direct sheets and enable the passage of sheets relative to the note inlet transport and note outlet transport. As shown in greater detail in Figures 9 and 11, gate 114 includes a rotatably mounted gate member 116. Gate member 116 includes a curved lead surface 118 which is disposed adjacent to the passage area. When the lead surface 98 is disposed downward relative to the position shown in Figure 9 and the mechanism is operated to move sheets outward through the passage area 92, the outward moving notes are engaged with the lead surface and are directed to engage the belt 102 and idler rolls 104 of the note outlet transport 96. In this position the notes are carried in an outward direction by the note outlet transport to the note outlet opening 28. Likewise when notes are moved by the note inlet transport towards the passage area 92, the lead surface 118 is moved upward to an accepting position relative to Figure 9. In this position notes carried by the inlet transport 98 are enabled to pass into the passage area 92.

[0057] A guide 120 extends adjacent to the gate 114 generally between the note inlet and outlet transports. The guide includes rotatable guide rolls 122 in supporting connection therewith. Guide roll 122 is generally en-

gaged with belt 110 and rotates therewith. The guide 120 and guide rolls 122 further aid in guiding sheets through the passage area in a manner later discussed. The passage area is also bounded on an opposed side of the guide by a separating member 124. The separating member also later described in detail, engages the surface of belt 110 which serves as an arcuately shaped moving member in an area overlying belt supporting roll 126. The separating member 124 also engages on an opposed side, the web 70 in an area overlying a supporting roll 128 which is supported on the note storage module 44. The web 70 serves as a arcuately shaped moving member when it moves over the roll 28 in engagement with the separating member 124.

[0058] As shown in Figure 11, gate 114 is moved between the accepting position which is the position wherein notes are accepted into the passage area from the note inlet transport, and the directing position in which notes passing outward through the passage are directed to the outlet transport, by a limited slip transmission mechanism generally indicated 130. The limited slip transmission mechanism of the described embodiment includes a slipping member 132. Slipping member 132 is a small relatively slippery belt or similar force transmission member, which can be used to translate the gate member 116 to a desired position and thereafter a slip in response to driving motion without causing damage to itself or other connected components. In the described embodiment the slipping member 132 is connected to a pulley portion 134 which is operatively connected to the gate member 116. The slipping member 132 is also connected to a pulley portion 136 which is connected to a roll 138 which supports belt 102 of the outlet transport. Stops schematically indicated 140 limit the rotation of the gate member 116.

[0059] When the note outlet transport is driven to move notes outwardly from the passage area 92, belt 102 is driven in the direction indicated by the Arrow O. This causes the lead surface 118 of the gate member 116 to move downward until the gate member is engaged with the stop 140 which limits its counterclockwise rotation. Because in this position belt 110 is moved in the direction of Arrow N, notes moving through the passage area 92 are engaged by the lead surface 118 in the directing position and moved in connection therewith to engage the outward moving belt 102. The outward moving belt continues to run for as long as it is controlled to do so in response to the controller. However once the gate member 116 is against the stop the slipping member 132 slips relative to at least one of the pulley portions 134 and 136. This causes the gate member to be held in the directing position but does not result in further movement nor damage to any of the components.

[0060] As can be appreciated from Figure 11, when the note inlet transport 98 moves belt 110 in a direction opposite to that indicated by Arrow N to deliver notes toward the passage area 92, belt 102 moves in a direction opposite to Arrow O. This movement causes roll 138 to

rotate the pulley portions 136 and 134 to rotate the gate member 116. The gate member 116 rotates in a clockwise position in the orientation shown to the accepting position where clockwise rotation of the gate member is stopped by engagement with one of the stops 140. Once the gate member has moved to the accepting position the slipping member 132 slips relative to at least one of the pulley portions without causing damage to any of the components. In this position notes are enabled to pass the gate member moving inward in supporting connection with belt 110 to reach the passage area.

[0061] While in this described embodiment of the invention the gate 114 includes a gate member that is moved by the same drive mechanism as the belt, in other embodiments other gate moving mechanisms including separate actuators may be used. Alternatively embodiments of the invention may employ passive gate members which enable passage of the notes inwardly by deflection or translation a movement of the gate member in connection with the notes. Such passive gate members may through their configuration engage outwardly moving notes and direct them to engage appropriate mechanisms for moving the notes outward. Various arrangements of gate members and sheet moving members may be used in embodiments of the invention. It should further be understood that while single belts have been described herein as moving sheets in the inlet and outlet transports, preferred embodiments of the invention may include a plurality of parallel moving belts, rolls or other note moving mechanisms which are operative to move the notes in the described directions.

[0062] Figure 12 shows in greater detail the operation of the separating member 124 which bounds a first side of the passage area where notes move to and from the note storage module 44. Notes moving through the passage area generally move in a note plane schematically indicated 142 in Figure 12. The note plane extends generally along an inner surface 144 of the separating member 124. The inner surface 144 of the exemplary embodiment includes a plurality of projections as shown. The projections serve to minimize surface tension so that notes will move more easily over the inner surface 144.

[0063] The note storage module 44 includes an inner wall 146. The opening 94 extends through the inner wall. The opening is bounded on each transverse side by an ear portion 148. Each ear portion 148 includes a generally vertically extending slot 150. A cutout portion 152 extends through the ear portion to the slot. The separating member 124 includes a pair of outward extending projections 154 which are sized to be movable in the slot 150. The projections 154 also enable the separating member 124 to be rotatably movable relative to the note storage module 44. The separating member also includes an eye 156. Eye 156 is engaged by a biasing member 158. The biasing member operates to bias the separating member 124 generally in a downward direction as shown.

[0064] When the note storage module 44 is installed

in the housing of the machine, the separating member 124 is moved to a position in which a first end of the separating member engages belts 110 overlying roll 126. Also in the operative position, the opposed end of separating member 124 engages the web 70 overlying roll 128. In this way the separating member 124 engages at its opposed ends arcuately shaped moving members which move sheets in supporting connection therewith. The separating member of the exemplary embodiment is configured to ride on the moving members and to engage sheets which are supported thereon. The engagement of the separating member with the sheets on the moving members serves to separate the sheets and direct them generally along the note plane 142 through the note passage. The separating member 124 minimizes the risks that notes will be carried by the supporting belt or web underneath the separating member where they may jam or otherwise disrupt the operation of the mechanism. The floating character of the separating member facilitates its ability to properly position itself both vertically and rotationally in the mechanism when the note storage module is in its operative position. Thus the separating member is enabled to correct for minor misalignments and still perform its function by engaging the arcuately shaped moving members on either side. In addition the configuration of the slot 150 and cutout area 152 facilitate the ready replacement of the separating member. This is accomplished because the projections 154 may be moved through the cutout area. Also the biasing member 158 may be readily disconnected from the eye 156. Thus the removal of an existing separating member and installation of a new one is readily accomplished.

[0065] It should be understood that while in the described embodiment the projections are associated with the separating member and the slots are associated with the supporting housing structure, other embodiments may have these features reversed such that the projections are associated with the supporting housing and the slots associated with the separating member. Also in other embodiments intermediate or additional structures may be used.

[0066] As best shown in Figure 10 the note storage module of the exemplary embodiment further includes a separating member 160. Separating member 160 engages an opposed side of the web from that engaged by separating member 124. Separating member 160 minimizes the risk that notes supported by the web 70 on the storage reel will remain with the web when the web moves in a sheet dispensing direction. The deflector 160 aids in separating sheets from the web and directs them toward the passage area when the storage reel rotates in the direction indicated in Figure 10.

[0067] The separating member includes an edge portion 162. The edge portion 162 engages the web at a location indicated 164. A deflector surface 166 extends from location 164 toward the passage. The deflector surface is positioned to extend generally parallel to the web

70 in the area between the location where the web joins the storage reel and the passage area.

[0068] A movable member 168 engages the web 70 in generally overlying relation of the roll 128. The movable member 168 engages inward moving notes so that they can be guided by the deflector surface into a nip 170 generally in the area where the web joins the stored web material on the storage reel 66. Likewise the movable member 168 serves to engage sheets that are separated from the web by the separating member 160 and to move the sheets outward through the passage area.

[0069] The separating member 160 is rotatable relative to the housing about an axis generally indicated 172. The separating member 160 is biased to rotate in a clockwise direction as shown about the axis 172 by a biasing member 174. The reel 66 rotates relative to the housing and note storage module about an axis of rotation indicated 176. In the described form of the invention the axis 172 about which the separating member rotates, is angularly disposed relative to the axis 176 about which the storage reel rotates from the nip at a substantial angle of generally about at least 90 degrees. This configuration enables providing relatively controlled angular movement of the edge portion at the location as the amount of web material stored on the storage reel changes during operation of the machine. This relatively limited movement assures more reliable separation and guidance of notes from and onto supporting connection with the storage reel. The configuration further minimizes the wearing of the web material by maintaining desirable relative positions of the edge portion 162 and to the web.

[0070] As shown in Figure 10 the deflector surface 166 is generally located such that it extends on opposed sides of the movable member 168. In certain preferred embodiments of the invention the movable member 168 may include a plurality of transversely disposed movable members across the web. The deflector surface may be configured to extend in the intermediate spaces between the movable members. In addition the guide surface 120 also extends into the areas intermediate of the deflector surfaces. The positioning of the deflector surfaces transversely intermediate of the movable member 168 as well as the guide surfaces 120 provides a relatively movable interfitted relation of surfaces which facilitates guiding sheets through the passage area. It should also be noted that the use of the separating members 172 and 124 which engage opposed sides of the web generally help to avoid uneven wearing of the web and the buildup of stresses unevenly along the surfaces thereof. This along with the configuration and orientation of the separating members helps to prolong the life of the web.

[0071] As later discussed in detail the note storage module 44 of the described embodiment includes a note receiving and dispensing mechanism generally referred to as 77 in Figure 4. This note receiving and dispensing mechanism includes the storage and take-up reels 66 and 68 respectively. The web 70 which extends between the reels, the roll 128 and movable member 168 which

engage the web in the passage area, and the separating member 160, serve to assure that notes are separated from the web and directed to and from the passage area. In the operation of this described embodiment, the reel drive mechanism 72 operates to move the reels so that notes can be delivered to and dispensed from the passage area. It should be noted that in alternative embodiments a number of different types of note handling mechanisms may be positioned adjacent to the passage area to accomplish the dispense of notes to or the receipt of notes from customers.

[0072] The transport mechanisms described herein while useful are exemplary of but one of many types of mechanisms that may be used. The note storage module 44 of the described embodiment is useful because the module construction may be used with many types of such transport mechanisms including very low cost mechanisms that are suited for installations in machines that perform other types of primary functions. This includes the ability to retrofit cash dispensing capability to such machines by providing suitable mechanisms to connect the passage area and one or more outlets which may be accessed by a customer. In addition the note storage module 44 may be readily removed by authorized personnel from an interior area of the machine. Thus for example in a motor fuel dispensing application, a system operator may readily remove the module 44 from the fuel dispensing pumps during off hours and store such items in a secure location. The removal and reinstallation of such items can be accomplished quickly to minimize the actions required to be taken by personnel in the facility.

[0073] The operation of the note receiving and dispensing mechanism within the note storage module 44 is controlled through operation of the reel drive mechanism 72. The reel drive mechanism is operative to control selectively the rotation of the note storage reel 66 and the take-up reel 68. By controlling the rotation of the reels notes may be brought into supporting connection with the web 70 and stored on the note storage reel. Likewise by controlling the rotation of the reels notes stored on the storage reel may be delivered to the passage area.

[0074] The reel drive mechanism 72 of the exemplary embodiment includes a motor or other drive indicated 178. The operation of the drive and its direction of rotation is controllable in response to signals from the controller 52 when the note storage module 44 is installed in the machine. The drive 178 is operative as shown in Figure 6 to rotate a first drive member 180 about an axis of rotation 179. The first drive member 180 in the described embodiment is a gear. However in other embodiments rollers, belts or other force transmission members may be used.

[0075] The first drive member is operative to rotate a second drive member 182. In the described embodiment the second drive member is rotatably connected to the transmission member 184, and the transmission member is rotatable about the axis of rotation 179 of the first drive member 180. The second drive member rotates about

an axis of rotation 185 which is movable with the transmission member. Of course in other embodiments other drive arrangements may be used.

[0076] As schematically indicated in Figure 7 a first drag member 186 is in operative connection with the second drive member 182. First drag member 186 is operative to apply a force resisting movement of the second drive member thereon. The first drag member preferably applies a resistance to movement in either rotational direction of the second drive member. The first drag member may include a thrust washer, friction disk, bushing or other suitable member for providing a limited and controlled degree of resistance to movement of the second drive member. The first drag member 186 is operative so that when the first drive member 180 rotates in a clockwise direction as indicated in Figure 7, the resistance force applied by the first drag member 186 will also tend to cause the transmission member 184 to rotate with the second drive member in a clockwise position. However when the clockwise rotation of the transmission member is stopped such as due to engagement of the second drive member with a further drive surface, the second drive member will rotate in a counterclockwise direction responsive to rotation of the first drive member. Likewise the counterclockwise rotation of the first drive member will move the transmission member and the second drive member counterclockwise until the second drive member engages a drive surface, in which case the second drive member will rotate clockwise. It should be kept in mind that these structures are exemplary and that intermediate drive members and other mechanisms may be included while still achieving the similar results.

[0077] As shown in Figure 7 the reel drive mechanism 72 further includes a transmission drag member 188. The transmission drag member 188 is operative to apply a limited resistance to rotation of the transmission member 184. This limited resistance to rotation is operative to provide a limited and controlled resistance to movement of the transmission member 184. It is also operative to generally hold the transmission member 184 in its then current position until it is deliberately moved responsive to rotation of the first drive member 180. The transmission drag member may include a thrust washer, friction disk, bushing or other suitable device for applying resistance to movement of the transmission member.

[0078] As shown in Figure 6 rotation of the first drive member 180 in a counterclockwise direction is operative to move the transmission member and the second drive member 182 counterclockwise to a position where the second drive member 182 engages a drive surface 190 of the take-up reel. Drive surface 190 of the take-up reel is preferably a surface including gear teeth adapted for meshing engagement with gear teeth on the second drive member 182. However it should be understood that in other embodiments other drive surfaces suitable for receiving power transmitted by the reel drive mechanism may be used. As shown in Figure 6 the second drive member operates to rotate the take-up reel 168 in a coun-

terclockwise direction. This causes the web 70 to move in a sheet dispensing direction as indicated by the arrows shown superimposed on web 70. As the reel drive mechanism operates to move the take-up reel the sheet storage reel 66 moves in a counterclockwise direction as shown so as to unwind the web 70 therefrom and to deliver notes in supporting connection therewith to the passage area.

[0079] Figure 8 shows the operation of the reel drive mechanism 72 when the web 70 is moved in a sheet receiving direction. The sheet receiving direction is the direction that the web moves when notes in supporting connection therewith are wound into the note storage area supported on storage reel 66. Rotation of the first drive member 180 in the clockwise direction shown in Figure 8 is operative to rotate the second drive member 182 in the clockwise direction relative to the first drive member until the second drive member engages a drive surface 192 on storage reel 66. When the second drive member 182 engages the drive surface 192 the second drive member rotates in a counterclockwise direction which rotates reel 66 in a clockwise direction. The clockwise rotation of reel 66 causes the web 70 and notes supported thereon to be wound into the web for storage on the storage reel. As the storage reel pulls the web thereon the web 70 unwinds from the take-up reel 68.

[0080] The operation of the drag mechanisms on the transmission member as well as on the second drive member help to assure that the first drive member remains in positive engagement with the desired drive surface of the reels during movement thereof. Also referring to Figure 4 it should be noted that the drive surface 192 of the storage reel 66 preferably includes mating gear teeth to engage the second drive member 182. These mating gear teeth may also make up the interengaging projections and recesses 78 which enable the locking member 76 to hold the storage reel in position when the note storage module 44 is removed from the housing.

[0081] To facilitate the controlled rotational movement of the storage reel 66 and the take-up reel 68, a controlled drag applying mechanism is included in the note storage module 44. An exemplary form of this drag applying mechanism is schematically shown in Figure 13. The storage reel 66 has thereon an annular brake surface 194. A directional drag applying member 196 extends about the annular brake surface through an angle greater than 180 degrees as shown. The directional drag applying member 196 includes a first end 198 and a second end 200 which are generally fixed relative to the housing through the note storage module.

[0082] The directional drag applying member 196 includes a band portion 202. The band portion 202 extends generally in engagement with the annular brake surface 194 of the storage reel. The directional drag applying member 196 further includes an extendable portion schematically indicated 204. Extendable portion 204 includes a resilient biasing portion that is extendable in the direction of Arrow E as shown in Figure 13.

[0083] During operation of the reel drive mechanism 72, the storage reel 66 is rotated in a clockwise direction when it is desired to move the web 70 in a sheet receiving direction such that the web and notes supported thereon are wound onto the storage reel. When the storage reel 66 is moved in a clockwise direction the extendable portion 204 tends to expand in the direction of Arrow E responsive to the force applied to the band portion 202 by the relative movement of the annular brake surface 194. This enables the storage reel 66 to rotate in a clockwise direction relatively easily responsive to the force applied by the extendable portion 204. However when the storage reel 66 is rotated responsive to movement of the web 70 in a counterclockwise direction which corresponds to the web moving in a sheet dispensing direction, the resistance to movement of the storage reel is relatively higher. This is because the tension in the band portion 202 is higher due to a lack of an extendable portion between the band portion and the first end 198. As a result the tension in the band portion is maintained relatively higher as the storage reel is moved in the counterclockwise direction. This provides a relatively higher drag force on the storage reel which minimizes the risk of overrunning.

[0084] A similar but oppositely disposed structure is used for applying drag force to take-up reel 68 in this exemplary embodiment. The take-up reel, which as previously discussed in this embodiment is identical to the storage reel, includes an annular brake surface 206 thereon. A directional drag applying member 208 includes a band portion 210 that engages the annular brake surface 206 about an angle of generally more than 180 degrees. The directional drag applying member is generally fixed relative to the housing at a first end 212 and a second end 214. The directional drag applying member 208 includes an extendable portion 216 adjacent the second end 214. Extendable portion 216 is expandable in an extendable direction generally indicated by Arrow X.

[0085] In operation of the reel drive mechanism 72 when the take-up reel 68 is rotated in a counterclockwise direction which moves the web 70 in a sheet dispensing direction, the extendable portion 216 of the drag applying member 248 expands to apply relatively lower resistance to movement of the take-up reel 68. However when the take-up reel 68 is moved in a clockwise direction responsive to the web moving in a sheet receiving direction, a relatively higher drag force is applied to the take-up reel.

[0086] As a result of the directional drag applying mechanism of the described embodiment, the drag force on the reel being driven by the second drive member 182 is relatively lower. This reduces the amount of force that the reel drive mechanism must produce to move the take-up and storage reels. This is useful compared to systems where drag applying members act equally on storage reels regardless of the direction in which they are moved.

[0087] Referring again to Figure 5, web 70 extends between the storage reel and the take-up reel along a web path. The web path extends adjacent to the passage

area in which the web is supported by roll 128. The web path further includes a pair of guiding rolls 218, 220 which guide the web 70 along the web path to the take-up reel 68. A sensor 222 is disposed adjacent to the web path between the guide rolls. Sensor 222 is in operative connection with the controller and is operable to sense machine readable indicia in supporting connection with the web.

[0088] Figure 16 shows a section of web 70 of an exemplary embodiment of the invention. The web includes a transversely central sheet engaging area generally indicated 224. The sheet engaging area 224 operatively engages sheets therewith in the passage area and holds sheets in supporting connection with the storage roll 66.

[0089] Transversely outward of the sheet engaging area 224 are a pair of peripheral areas 226 and 228. The peripheral areas extend transversely on either side of the web adjacent the transverse edges thereof. The peripheral areas 226 and 228 include machine readable indicia 230 thereon. In the described form of the invention the machine readable indicia is indicia on the web that serves to block the transmission of radiation therethrough. This blocking of radiation is sensed by the sensor 222. Of course in other embodiments other types of indicia which can be sensed or read by a sensing device may be used.

[0090] As previously discussed, the opposed ends of the web are connected to the take-up reel and the storage reel respectively. In the described embodiment the machine readable indicia are configured so as to correspond to a location on the web relative to an end. In the described embodiment the machine readable indicia are symmetrical on the web and are configured such that the spacing between adjacent indicia decreases with proximity to each end. This construction in the described embodiment enables the installation of the web in any of four possible orientations. Thus a person replacing the web need not be concerned that it could be installed improperly. This is because of the symmetry of the machine readable indicia in the peripheral areas as well as the decreasing spacing between the machine readable indicia with proximity to the end.

[0091] In operation of the machine, the sensor 222 is operative to cause the controller to include data in the data store representative of the location for the machine readable indicia which is in proximity to the sensor 222. In the described embodiment this data may include data corresponding to a count of a number of machine readable indicia which have moved past the sensor from a reference position located adjacent to a first end of the web at a first end area adjacent to the take-up reel. By holding this data which corresponds to a count, the controller may be operative to determine the relative position of the web with respect to the ends thereof. In addition or in the alternative, the controller may also hold data representative of a count of the sheets which are currently stored in supporting connection with the storage reel. This number of sheets may be correlated with the location indicia such that the controller coordinates the location

information, provided by the indicia with data corresponding to the number of notes in storage.

[0092] Alternatively, the decrease in spacing of the indicia with proximity to the ends of the web enables the controller in the described embodiment to detect a condition which suggests that the web is approaching the first end or the second end. This enables the controller to provide a signal through the communications device or through another output device to indicate that the machine is either reaching a condition where it can hold no further notes or is approaching a condition where it is running out of notes. For example the web must move at least a distance somewhat greater than the length of a note in the dispense of one sheet. If in moving the web this distance during the dispensing of a sheet the sensor 222 senses passage of more than a set number of indicia on the web, the controller may determine that the web is approaching the second end which means that few notes are left on the storage reel. By the number of machine readable indicia which pass the sensor in the dispense of one note or sheet the controller knows generally accurately how close the web now is to reaching the end area when no further notes are stored on the storage reel.

[0093] Likewise when operating to receive a note, the reel drive mechanism moves the web a length that is generally slightly greater than the length of one note. If in the process of accepting a note the sensor 222 senses more than a set number of machine readable indicia passing the sensor, the controller may determine that the web is approaching the first end at which point no further web material is stored on the take-up reel. By the number of machine readable indicia passing the sensor with the receipt of a note, the controller is operative to determine relatively accurately the position of the web. This enables the controller and its operatively connected memory to determine and indicate quantity condition data which is indicative of a need to replenish the machine, that the machine is full and/or some notes will need to be removed from the machine within a given time period. The machine is still capable of accomplishing this even if the portion of the memory which may be holding information corresponding to an exact location of the web should be lost or corrupted.

[0094] An example of how one exemplary embodiment of the invention may operate to dispense sheets and to maintain a count of the number of sheets remaining is discussed in connection with Figure 17. In the described embodiment sheets are dispensed responsive to a user inputting an input through one or more of the input devices. This may include for example a customer passing a card through the card reader which includes account data corresponding to the customer. If the card is a debit card the customer may also input a personal identification number (PIN) through the keys of the keypad. The customer may thereafter indicate that they wish to withdraw notes and the value of the notes to be withdrawn through inputs through the function keys and/or the keypad keys. In response to these inputs the controller 52 is operative

in the described embodiment to operate the communications device 48 to determine through communication with another computer system whether the customer is authorized to withdraw the funds requested. Assuming that the customer is authorized to withdraw the funds the communication device 48 receives back from a host computer or other connected system a message indicating that the requested withdrawal by the customer is permissible. The controller then operates the reel drive mechanism to rotate the take-up reel 68 in the direction indicated. This causes the storage reel to rotate in the direction shown. Rotation of the storage reel causes notes to be separated from the web 70 and moved into the note passage area 92.

[0095] As shown in Figure 17 in the described embodiment a passage sensor 232 is positioned adjacent to the passage area 92. Passage sensor 232 is operatively connected to the controller 52 and is operative to sense sheets therein. The passage sensor 232 is operative to sense the leading edge of the note entering the passage area. In response to the passage sensor the controller 52 is operative to operate the transport drive which operates the outlet transport 96. The outlet transport runs so that notes in connection therewith move toward the note outlet opening 28. This motion of the outlet transport also causes the gate 114 to move to the directing position to engage notes with the outlet transport. In the described configuration of the invention the outlet transport and the limited slip portion 108 of the inlet transport 98 move in cooperating relation so as to move notes from the passage area into engagement with the outlet transport.

[0096] The reel drive mechanism moves the web 70 in the note dispensing direction until the end of the sheet is sensed passing the passage sensor 232. The sheet passing the passage sensor is carried by the outlet transport 96 to the outlet opening 28 where it is delivered to the customer. This is represented by a note 234. The note at the outlet opening may be held in a tray or by other suitable holding devices until taken by the customer. Alternatively a suitable sensor adjacent to the outlet which is connected to the controller may operate to hold the sheet in connection with the outlet transport in a stopped relation until the customer physically pulls it from the opening. Various approaches to delivering the sheets may be used depending on the nature and character of the transaction machine.

[0097] Additional sheets beyond one may be delivered. The controller 52 operates the reel drive mechanism to dispense additional sheets through the passage area and to deliver them through the outlet transport to the customer. When the desired number of sheets has been dispensed which corresponds to the input from the user, the controller operates to stop both the reel drive mechanism and the outlet transport.

[0098] In the course of dispensing sheets from the storage reel the passage sensor senses each sheet. The passage sensor may be a radiation type sensor that is capable of sensing both the leading and trailing edges

of the sheet. Of course in other embodiments of the invention other types of passage sensors may be used. As the web 70 moves to deliver one or more sheets to the passage area the web sensor 222 provides signals to the controller 52. In response to the sensing of the machine readable indicia by the sensor 222 the controller generates signals. These signals include data representative of sheet quantities. This may include for example in some embodiments a simple count which corresponds to a length of web remaining on the storage reel. Because the notes are generally spaced at a uniform spacing this count data is representative of a quantity of sheets remaining. This data can be stored in the memory 56 as a quantity condition which corresponds to the number of sheets remaining.

[0099] Alternatively in embodiments of the invention the sensor 222 may be operative to sense the number of indicia which pass the sensor as a sheet is moved through the passage area as sensed by the sensor 232. The number of indicia which pass the sensor 222 as a single note is dispensed can be correlated with the distance of the location adjacent the sensor to the end of the web. The controller is operative responsive to the sensor sensing more than a determined number of such indicia during the dispense of a single note may be programmed to store and provide an indication of a quantity condition which indicates that the machine is in need of note replenishment.

[0100] In addition to using the machine readable indicia on the web to provide data representative of the quantity of notes remaining, the controller 52 may also be operative to cause actual count data or data representative of a value to be stored in memory 56. In this way the controller may be operative to maintain information on how many notes remain stored in the machine at any time. This may enable a user to query the controller to determine the number of remaining notes.

[0101] In the event that the described form of the controller should experience a failure of the volatile memory data concerning the number of notes remaining, the controller may operate the machine to execute a recovery operation to determine how many notes are remaining. The executable steps necessary to perform this recovery operation may be stored in nonvolatile memory so that the machine can almost always execute the recovery operation no matter what conditions are experienced. In the recovery operation the controller responds to a loss of available memory data by operating the reel drive mechanism to wind the web 70 onto the storage reel 66. The reel drive mechanism continues to wind the web onto the storage reel until a first end area adjacent the end of the web attached to the take-up reel is sensed. This may be done a number of ways, for example by the sensor 222 sensing a set number of machine readable indicia on the web within a given time period which the controller determines through use of the clock device 54.

[0102] Once the controller has determined that the web has been wound onto the storage reel to generally the

full extent, the controller operates the reel drive mechanism to begin moving the web from the storage reel to the take-up reel. As the reel drive mechanism is operated by the controller to do this the controller generates signals responsive to indicia sensed by the web sensor 222. These signals are indicative of how far the web has moved at any given time. The process of winding the web onto the take-up reel is stopped when the passage sensor 232 senses the first note entering the first passage 92. At this point the controller 52 is operative to generate a further signal which corresponds to the location on the web where first sheet is sensed. Because the sheets are generally stored in relatively uniformly spaced relation, the further signal generated is indicative of a number of sheets that remain in supporting connection with the web on the storage reel. This enables the controller to closely determine how many sheets remain in storage. Further operation of the machine dispensing and receiving sheets may thereafter be continued using the data corresponding to the sheet quantity determined through the recovery operation. Of course this is but one example of operation of the machine used in connection with a described embodiment. In other embodiments other approaches to calculating and determining the number of sheets in storage at any given time may be used.

[0103] The operation of the machine to receive a note is now explained with reference to Figures 18-20. To insert notes into the machine may require an appropriate input by an authorized user through the input devices. This may include special cards or codes which are used by servicing personnel to replenish notes in the machine. Alternatively as was discussed in connection with Figure 1, the housing of the machine may include a physical security device which can be accessed by authorized personnel and which only enables such personnel to input notes into the inlet opening. Alternatively the inlet opening may be positioned relative to the housing in such a way that it is generally only accessible by authorized personnel. Finally in some embodiments of the invention users may both insert cash into the inlet opening as well as receive cash through the outlet opening. The particular activities that a user may go through in order to enable the machine to operate to accept notes through the note inlet opening will depend on the particular machine and the programming by the operator of the controller 52.

[0104] When notes are to be accepted a note is inserted through the inlet opening 30 to the inlet transport 98. In the inlet transport 98 the note first extends in the nonslip portion 106 of the inlet transport which extends adjacent to the validator 58. The validator includes sensors therein for sensing if the inserted note is a note that is valid for acceptance by the machine. For example in this embodiment the validator may be configured to accept only US twenty dollar bills and to reject all other inserted sheets as invalid for this machine. The controller 52 operates in connection with the validator 58, and a sheet schematically represented 236 is moved therein by the nonslip portion 106. As represented in Figure 18 the sheet 236

may be extended from the nonslip portion into the limited slip portion 108 which is driven by the transport drive to move in the direction indicated. The limited slip portion engages the sheet but allows it to be moved back and forth by the portion 106. In the event that the note is determined to be invalid the nonslip portion may disengage the note from the limited slip portion 108 and move it back outwards through the opening 30. If the note is determined to be valid however the portion 106 releases the note 236 into the limited slip portion 108 which moves the note in connection therewith towards the passage area 92.

[0105] Because in the described embodiment the limited slip portion 108 and the outlet transport 96 are operated by a common drive mechanism, movement of the limited slip portion in the direction indicated also causes the outlet transport to move in a manner which causes the gate 114 to be rotated to the note accepting position. As a result the note 236 is moved to the passage area 92 as shown in Figure 19. When the note reaches the passage area it is sensed by the passage sensor 232.

[0106] The controller is operative responsive to the note being sensed by the passage sensor to operate the reel drive mechanism. The controller is operative to cause the web 70 to move in the note accepting direction as shown in Figure 20. The reel drive mechanism moves the web so that the note comes into supporting connection therewith and is wound onto the note storage reel 66. The controller continues to operate the reel drive mechanism until the trailing edge of the note is sensed as passing the passage sensor 232. Thereafter the controller may operate the reel drive mechanism to move the note a sufficient distance so as to provide spacing from the next note which is inserted. Once the controller has moved the inserted note a sufficient distance onto the note storage reel the reel drive mechanism stops until instructed to move further by the controller.

[0107] While in this first described embodiment the nonslip drive portion adjacent the validator sensors 58 is operative to immediately push out notes that are sensed as not valid, alternative forms of the invention may be programmed to operate differently. For example a controller 52 may be programmed to move a note in the inlet transport past the validator. If the validator senses an invalid note, the note may be stopped at the passage area once the trailing edge of the note has passed the gate 114. The controller may thereafter operate to reverse the direction of the transports 96 and 98 which causes the gate to direct the note outward through the outlet opening. The controller 52 may operate both the inlet and outlet transports as well as the roll storage mechanism to accomplish this. This may include for example causing the invalid note to be stored partially or temporarily in supporting connection with the web 70 before the direction of the note is reversed to deliver the note outward. These are examples and other embodiments of the invention may operate differently to reject notes.

[0108] Alternative forms of the invention may be produced to accommodate other types of validating mechanisms. Figure 21 shows an alternative form of a note handling mechanism generally indicated 238. Mechanism 238 is generally similar to that previously described except as otherwise indicated. It includes a note receiving and dispensing mechanism 240 similar to mechanism 77 previously discussed. Mechanism 238 further includes a combined inlet and outlet transport 242. Inlet and outlet transport 242 is selectively operative to both move sheets into and out from a passage area 244. Note sensors 246 are positioned adjacent to the transport 242. Note sensors 246 may be operative to sense that the note is valid, such as for example whether a note which is passing through the transport 242 is a valid US twenty dollar bill. An example of a suitable note sensing device for this purpose is described in U.S. Patent Application Serial No. 09/749,260 which is owned by the Assignee of the present invention and incorporated by reference as if fully rewritten herein.

[0109] If the note is sensed as valid it may be moved by a transport 242 past a gate 248 and into a storage location on the storage reel 250. Likewise when the note is to be dispensed from the storage reel, a web 254 which holds the notes in supporting connection with the storage reel may move the note into the passage area 244. The gate 248 is moved by an actuator (not shown) to direct the note to engage the transport 242. The transport 242 then operates in a direction to carry the note from the passage area to a note outlet adjacent the end of the transport 242.

[0110] If the controller of the mechanism 238 is operating to sense notes being input into the machine and the sensors 246 operate to sense an invalid note, the transport 242 may be reversed immediately to reject the note. Alternatively if it is not desired to reject the note through the exterior of the machine, the note may be moved by the transport 242 into the passage area 244. The note may also be moved partially onto the web 254 as is necessary in the operation of the machine. Thereafter, after the note has been moved to the storage area, the position of the gate 248 may be changed and the controller may operate a reject transport 256. The reject transport is operated to move the note inward to a storage area 258 inside the housing of the machine. As a result suspect notes are held within the housing of the machine until they can be removed by authorized personnel.

[0111] An advantage of the described embodiment of the invention shown in connection with mechanism 238 is that a single transport can be used as both the inlet and the outlet transport for notes. This may have advantages in some embodiments in which the validity of notes may be determined within a single note path which moves selectively in opposed directions.

[0112] An alternative note handling mechanism generally indicated 260 is shown in Figure 22. The note handling mechanism 260 is similar to the first note handling mechanism described except where otherwise indicated.

Note handling mechanism 260 includes an outlet transport 262 that extends between a passage area 264 and a note outlet opening 266. Mechanism 260 further includes a note inlet opening 268. The note inlet opening extends in a housing wall of the machine which is generally opposed of a housing wall in which the outlet opening extends. Inlet opening 268 is operatively connected to a note validator 270 which may be of a type previously described. The note validator 270 is connected to a first Limited slip transport section 272 and a second transport section 274. Transport sections 272 and 274 are operative to carry notes that have passed the validator 270 to the passage area 264.

[0113] The operation of the mechanism 260 is generally similar to the first described embodiment of the invention. However an advantage of the construction shown in Figure 22 is that an operator of the machine is enabled to load currency into the machine from the rear. Certain preferred forms of the invention are sufficiently small such that they may be supported on a counter top or on a standard interior building wall. This enables the machine operator to feed notes into the machine from behind the counter or from within an interior room within a building. This may facilitate loading of notes in the machine as the machine operator does not have personnel blocking access to the machine as notes are being loaded, which may discourage customers from using the machine. In addition this configuration may eliminate the need for covers or other devices over the note inlet opening to prevent confused customers from attempting to insert things into the inlet opening. Further advantages of this alternative structure shown in Figure 22 will be apparent to those skilled in the art.

[0114] Yet another embodiment of a note handling mechanism generally designated 276 is shown in Figure 23. This alternative note handling mechanism 276 is operative in the described embodiment to work in connection with the note receiving and dispensing mechanism 77 of the first embodiment including the note storage module 44 which has been previously described. The alternative note handling mechanism 276 is operative to avoid the need for a user to insert notes generally one at a time for storage within the machine.

[0115] The note handling mechanism includes an outlet transport 278 which extends between a passage area 280 and a note outlet opening 282. A gate 284 is positioned adjacent to the passage area 280 and operates in the manner previously described. An inlet transport 286 includes a first portion 288 which extends adjacent to a validator 290. A second transport portion 292 extends between the validator and the passage area 280.

[0116] The note separating mechanism generally indicated 294 is positioned generally adjacent to the validator. The note separating mechanism is operative to separate notes individually from a stack 296 and deliver the individual notes to the validator 290. A note thickness sensor 298 is positioned adjacent to the unstack mechanism. The note thickness sensor 298 operates to sense

if more than one note has been removed from the stack. In the event that more than one note is sensed as passing from the stack toward the validator, the controller is operative to cause the note separating mechanism 294 to reverse the movement of the note. The note is moved back into the stack and another attempt made until a single note is separated as sensed by the thickness sensors and delivered to the validator.

[0117] An exemplary separating mechanism is shown schematically in Figure 24. The arrangement includes a central feed roll 300 which is flanked by two supplementary belt supporting feed rolls 302. The feed rolls 300 and 302 are rotated by a drive schematically indicated 304. The drive is selectively operated responsive to signals from a controller.

[0118] A contact stripper roll 306 and a pair of non-contact stripper rolls 308 are positioned in generally opposed abutting arrangement with feed rolls 300 and 302. Rolls 306 and 308 are connected on a common shaft to a one-way clutch 310. The one-way clutch is operative to resist rotation of rolls 306 and 308 in a direction which would facilitate the movement of sheets from the stack towards the validator. However the clutch 310 readily enables the rolls 306 and 308 to rotate in a direction generally moving sheets away from the validator towards the stack. When the drive 304 moves rolls 300 and 302 to move a sheet at the bottom of the stack 296 towards the validator, both rolls 306 and 308 resist motion of the sheet. This generally prevents all but the first sheet at the bottom of the stack from moving past the sensors 298 to the drive portion 288 adjacent the validator 290. If however multiple sheets are sensed by the sensors 298 as being passed out of the stack, the controller operates to reverse the direction of drive 304. In this situation rolls 306, 308, 300 and 302 cooperate to readily help move the sheets back into the stack.

[0119] As shown in Figure 23 in the described form of the invention the stack 296 may be inserted in an unstack area 312 within the housing of the machine. Access to the unstack area may be controlled by a door schematically indicated 314. In the described form of the mechanism shown in Figure 23, the machine operator is enabled to place a stack of notes in the unstack area 312 and then close and secure the door 314. The machine may thereafter operate to separate the notes in the stack to validate them as proper and to store the notes in the storage reel of a connected note storage module. If in the course of sensing the sheets invalid sheets are found, the invalid sheets may be diverted through operation of the gate 284 into the transport 278 which can deposit the sheets in the area adjacent to the note outlet opening 282. Alternative forms of the invention may provide other storage areas for holding invalid sheets. Further alternative forms of the invention may provide for interrupting the note validating and stacking operation of the machine for a user who wishes to operate the machine for dispensing purposes. Of course other alternative arrangements and configurations utilizing the principles of the

invention may be devised by those skilled in the art.

[0120] Alternative forms of user interfaces may be provided for use in connection with embodiments of the invention. Such an alternative embodiment is shown in Figures 25-30. The alternative embodiment includes a display 316 which in various embodiments may be an LCD, CRT or other type of visual or nonvisual output device. The interface further includes an input device in the form of a dip card reader for reading magnetic stripe cards generally indicated 318. The interface further includes a cancel button indicated 320. In this simplified user interface the controller operates to display messages which can be observed by the user on the display 316. These various displays which include preprogrammed text and/or graphics are referred to as screens herein. When the machine is waiting for a customer to begin operating the machine an initial screen indicated 320 and shown in Figure 25 is output on the display. The initial screen 320 instructs a user to insert their card into the dip reader and to withdraw the card therefrom when the amount that they desire is displayed on the screen.

[0121] Figure 26 shows a card schematically indicated 322 of the magnetic stripe variety being inserted into the reader 318. In response to the card being inserted and held therein a first amount screen indicated 324 is displayed. The first amount screen which is generated responsive to the controller advises the customer of an amount and to withdraw their card from the dip reader when the amount shown on the screen corresponds to a desired amount that they wish to receive. In the described embodiment within approximately five seconds after the first screen is displayed a second account screen indicated 326 and shown in Figure 27 is displayed. The second amount screen shows a different amount and again instructs the user to remove the card from the dip reader when the amount that they desire is shown. Assuming that the user does not withdraw the card from the reader when the second amount screen 326 is shown. A short time later (about five seconds in this exemplary embodiment) a third amount screen is displayed. Because the described embodiment dispenses twenty dollar bills each sequential display screen increases the amount by twenty dollars. This sequence is continued until a maximum amount screen is reached or until the customer presses the cancel button 320.

[0122] Assuming that the customer removes their card from the reader 318 when a sixty dollar amount is displayed, a withdrawal screen generally indicated 328 and shown in Figure 28 will be displayed. The withdrawal screen 328 advises the customer of the amount that will be charged to their account. Again assuming that the customer does not promptly hit the cancel button 320 the controller operates to communicate through its associated communication device with an appropriate host computer or other system to determine whether the customer is authorized to charge the amount requested. During this time period a wait screen 330 shown in Figure 29 is displayed. When the machine receives authorization in-

dicating that the customer is authorized to receive the amount requested, the controller operates the components of the machine to cause the requested amount to be delivered to the customer through the outlet opening in the housing. The controller also operates to have a transaction receipt printed. After this is done a completion screen generally indicated 332 and shown in Figure 30 is displayed. The completion screen advises the customer to take their cash and their receipt. Of course if for some reason the transaction is not authorized, an alternative screen advising the customer of this is displayed to the customer. Thereafter the controller is operative to return to the initial screen 320.

[0123] An advantage of this exemplary user interface is that it can be used with machines that dispense cash in response to credit card inputs and requires no further input devices other than a cancel button and a dip reader. Such components are very common on many types of transaction machines whose primary function is not the dispensing of cash. This interface facilitates incorporating the note dispensing mechanism of the present invention into other types of transaction machines. In addition other embodiments may eliminate the cancel button by enabling the customer to cancel the transaction by removing the card at a time when a particular screen is displayed. Many alternative embodiments employing these principles may be devised.

[0124] A further novel aspect of the described embodiment of the invention is the ability of the machine to display selected promotional messages to the customer on a timely basis. Such a promotional message is shown in screen 330 and indicates a sale on a beverage item. In an exemplary embodiment of the invention this promotional message is generated in response to the data stored on the plug in memory 38 which is connected to the connector 36 on the housing. The data stored in the plug in memory which in the described form of the invention is a smart card, includes a promotional message as well as time parameters associated with the promotional message. Thus for example if the special offer represented in screen 330 is to extend only until a certain date, the controller and its associated clock device are operative to sense the passage of this date and to no longer display the particular promotional message once this date has passed. For example if the operator of the machine fails to remove the plug in memory and the controller determines that the message is no longer timely, screen 330 may include only a blank space or a blank area below the "please wait" notice on the screen while the machine is operating to obtain verification and to dispense the user's cash.

[0125] Likewise other data may be stored in the plug in memory module so that particular promotional messages are displayed at particular times of day or within particular time periods. The plug in memory module may also include several promotional messages which are designed to be displayed at various times or sequentially to users of the machine. Alternatively the data stored in

the plug in memory module may include public service messages such as promoting various charitable organizations and events. The data stored in the plug in memory may also be operative to generate graphical presentations as well as other types of video and audio presentations that may be of interest to a user. Other data stored in the memory module may include for example logos or other advertising for the establishment where the automated transaction machine is operated.

[0126] Because the exemplary form of the invention enables the presentation of promotional messages selectively by simply plugging a smart card into an associated connector, the promotional messages may be changed readily from outside the machine and very cheaply. For example the merchandising establishment or entities sponsoring promotional events may provide promotional messages on smart cards to operators of the machine. The operators of the machines may plug the cards into the machine and during the selected time windows for presentations of the messages, the messages will be displayed. At times when the memory indicates that such messages are not to be displayed, screens including the messages are not provided to users of the machine. Thus the providers of promotional messages are able to avoid their promotions being presented beyond the expiration date or at other times when it is not appropriate.

[0127] Of course the automated transaction machine may be operative to output such promotional messages at other times during its operation. This may include for example periodically displaying promotional messages in place of the initial screen. This may include for example alternating a promotional message with the initial screen 316 during relatively brief time periods such as a period of five seconds. In this way a user walking up to the machine will be advised in a very brief period of time how to operate the machine. However such a user will also receive at least one and perhaps several promotional messages before they proceed to insert their card into the reader 318. In this way the described form of the invention enables operators of the machines to conduct additional marketing relatively simply and reliably and at a minimum cost.

[0128] It should be understood that while in the exemplary embodiment the plug in memory element includes a smart card, other embodiments may include other types of plug in memory devices. These may include for example floppy disks, PROMS, CD-ROMs or other devices. It should further be understood that access to such replaceable memory items may be limited by a cover, such as for example the cover for the note inlet opening previously discussed. In this way access to the connector or reader for the plug in memory is limited to persons who are authorized to change the plug in memory. However, such persons do not need to have access to the note storage area inside the machine to change the plug in memory.

[0129] Thus the preferred embodiment of the automated transaction machine of the present invention achieves

the above stated objectives, eliminates difficulties encountered in the use of prior devices and systems, solves problems and attains the desirable results described herein.

[0130] In the foregoing description certain terms have been used for brevity, clarity and understanding, however no unnecessary limitations are to be implied therefrom because such terms are used for descriptive purposes and are intended to be broadly construed. Moreover, the descriptions and illustrations herein are by way of examples and the invention is not limited to the exact details shown and described.

[0131] Aspects of the invention are defined in the following series of numbered clauses.

1. Apparatus comprising:

a machine housing;

a note inlet opening through the housing;

a note outlet opening through the housing;

a note receiving and dispensing mechanism in operative connection with a note storage area, wherein the mechanism includes a passage area through which pass notes being received by the mechanism for storage in the storage area and notes being dispensed by the mechanism from the storage area;

a note inlet transport extending between the note inlet opening and the passage area, wherein notes are movable in the inlet transport;

a note outlet transport extending between the passage area and the note outlet opening;

a note validator, wherein the note validator is operative to sense whether notes are valid, wherein the note validator is operative to sense notes in the inlet transport;

at least one drive in operative connection with the inlet transport and the outlet transport, wherein the drive is selectively operative to move notes in the inlet transport and the outlet transport; and

a controller in operative connection with the validator and the drive, wherein the controller is operative to cause notes inserted through the note inlet opening and sensed as valid by the validator to be moved by the inlet transport to the passage area, and is operative to cause notes dispensed by the mechanism to be moved through the outlet transport to the outlet opening.

2. The apparatus according to clause 1 wherein the housing includes a first side, and wherein both the note outlet opening and the note inlet opening extend through the first side of the housing.

3. The apparatus according to clause 1 wherein the housing includes a first side and a generally opposed second side, and wherein the note outlet opening extends through the first side and the note inlet opening extends through the second side.

4. The apparatus according to clause 1 and further comprising a gate movably mounted in supporting connection with the housing extending adjacent the passage area, wherein the gate is in operative connection with the drive, and wherein when the drive operates the note outlet transport to move notes towards the note outlet opening the gate is moved to a directing position, wherein notes passing outward through the passage area are directed outward by the gate in the directing position to engage the note outlet transport.

5. The apparatus according to clause 1 and further comprising a gate movably mounted in supporting connection with the housing and extending adjacent the passage area, and wherein when the drive operates the note inlet transport to move notes toward the passage area the gate is positioned in an accepting position, wherein notes from the note inlet transport are directed by the gate to move inward through the passage area, and wherein when notes move outward from the passage area the gate is positioned in a directing position wherein notes passing outward through the passage area are directed by the gate to engage the note outlet transport.

6. The apparatus according to clause 4 wherein the gate is operatively connected to the drive by a limited slip transmission mechanism.

7. The apparatus according to clause 4 wherein the note outlet transport includes a rotating member, and wherein the limited slip transmission mechanism includes a slipping member in operative engagement with the rotating member wherein the slipping member slips relative to the rotating member when the gate is in the directing position.

8. The apparatus according to clause 7 wherein the note inlet transport, note outlet transport, gate and drive are operatively interconnected, wherein when the drive rotates in a first rotational direction the note outlet transport moves such that notes in connection therewith move in a direction from the passage area toward the outlet opening and the gate moves to the directing position, and wherein when the drive moves in a second rotational direction opposed of the first

direction the note inlet transport moves such that notes in connection therewith move in a direction away from the note inlet opening towards the passage area and the gate moves to the accepting position.

9. The apparatus according to clause 1 and further comprising a first arcuately shaped moving member operatively connected with the note receiving and dispensing mechanism, and a first separating member engaged with the first arcuately shaped moving member, wherein the first separating member is operative to separate sheets from the first arcuately shaped moving member.

10. The apparatus according to clause 9 wherein the first arcuately shaped moving member includes a movable sheet supporting web.

11. The apparatus according to clause 9 and further comprising a second arcuately shaped moving member adjacent the passage area, the second arcuately shaped moving member in operative connection with the drive, and wherein the first separating member is engaged with the second arcuately shaped moving member.

12. The apparatus according to clause 11 wherein in cross section the first separating member has a first end and an opposed end, wherein the first end engages the first arcuately shaped moving member and the second end engages the second arcuately shaped moving member.

13. The apparatus according to clause 12 and further comprising a biasing member in operative connection with the first separating member, wherein the biasing member is operative to bias the first separating member to engage both the first arcuately shaped moving member and the second arcuately shaped moving member.

14. The apparatus according to clause 12 wherein in cross section the first separating member bounds the passage on a first transverse side and further comprising a guide, wherein the guide is in supporting connection with the housing and bounds the passage on a transverse side generally opposed of the first transverse side.

15. The apparatus according to clause 1 and further comprising a storage module, wherein the storage module includes the note storage area, and wherein the storage module is removably mounted in supporting connection with the housing, and wherein the storage module includes a module opening, and wherein the passage area extends through the module opening.

16. The apparatus according to clause 15 and further comprising a first separating member extending through the module opening and in cross section bounding a first transverse side of the passage area, and a first arcuately shaped moving member in supporting connection with the note storage module, wherein the first separating member engages the first arcuately shaped moving member and is operative to separate notes therefrom.

17. The apparatus according to clause 1 and further comprising a passage sensor adjacent the passage area, wherein the passage sensor is in operative connection with the controller, and wherein the controller is operative responsive to sensing a note discharged by said note receiving and dispensing mechanism with the sensor to operate the note outlet transport to move the note in a direction from the passage area toward the note outlet opening.

18. The apparatus according to clause 1 and further comprising a passage sensor adjacent the passage area, wherein the passage sensor is in operative connection with the controller, and wherein the controller is operative responsive to the passage sensor sensing a note in the inlet transport adjacent the passage area to operate the note receiving and dispensing mechanism to accept the note into the note storage area.

19. The apparatus according to clause 1 wherein the note inlet transport includes a first portion and a second portion, wherein the first portion is adjacent the note validator, and wherein the second portion includes a limited slip engaging member, and wherein the first portion holds a note in generally nonslip engagement therewith, wherein when a note is passed towards the passage area from the first portion to the second portion the note is in slipping engagement with the engaging member until the note disengages from the first portion.

20. The apparatus according to clause 19 wherein the controller is operative to move the first portion and the second portion in a first direction as the validator senses the note, wherein notes are urged to move towards the passage area when moved in the first direction, and responsive to the validator sensing an invalid note the first portion is operative to move the note in an opposed direction toward the note inlet opening.

21. The apparatus according to clause 20 wherein as a note in the first portion is moved in the opposed direction the controller is operative to cause the second portion to run in the first direction, wherein the note in engagement with the limited slip engaging member moves in the opposed direction in generally

nonslip engagement with the first portion.

22. The apparatus according to clause 1 and further comprising a user interface, wherein the interface includes at least one input device in operative connection with the controller, wherein the controller is operative responsive to an input to the input device to cause a note to be delivered from the note storage area to the note outlet opening.

23. The apparatus according to clause 1 and further comprising a user interface, wherein the user interface comprises at least one input device, wherein the controller is operative responsive to an input to the input device to accept a note inserted in the note inlet opening and to place the note in the note storage area.

24. The apparatus according to clause 1 and further comprising a note separating mechanism in operative connection with the controller, wherein the note separating mechanism is positioned intermediate of the note inlet opening and the validator, wherein the controller is operative to cause the note separating mechanism to deliver individual notes from a stack of notes inserted through a note inlet opening.

25. The apparatus according to clause 24 and further comprising a note thickness sensor in operative connection with a controller, wherein the note thickness sensor is positioned intermediate of the note separating mechanism and the validator, and wherein the controller is operative to cause the note separating mechanism to return a note to the stack responsive to the note thickness sensor sensing a multiple note being delivered by the note separating mechanism from the stack.

26. The apparatus according to clause 24 and further comprising a gate adjacent the passage area, and wherein the controller is operative responsive to sensing an invalid note in the note inlet transport to move the invalid note to the passage area, and thereafter the controller is operative to cause the invalid note to be engaged with the gate and the note outlet transport and moved by the note outlet transport toward the note outlet opening.

27. A method of operating the apparatus recited in clause 23 comprising the steps of:

(a) inputting an input to the input device;

(b) delivering a note from the note storage area to the passage area with the note receiving and dispensing mechanism; and

(c) moving the note from the passage area to

the note outlet opening with the note outlet transport.

28. A method of operating the apparatus recited in clause 1 comprising the steps of:

(a) inserting a note into the note inlet opening;

(b) sensing the note as valid with the note validator;

(c) moving the note to the passage area with the note inlet transport; and

(d) moving the note from the passage area to the note storage area with the note receiving and dispensing mechanism.

29. The method according to clause 28 and subsequent step (d) further comprising the steps of:

(e) moving the note from the note storage area to the passage area with the note receiving and dispensing mechanism;

(f) moving the note from the passage area to the note outlet opening with the note outlet transport; and

(g) extending the note from the note outlet opening.

30. The method according to clause 29 wherein the note inlet opening and the note outlet opening extend on generally opposed sides of the housing, wherein step (a) is performed on a first side of the housing and step (g) is performed on an opposed side of the housing.

31. The method of operating the apparatus recited in clause 24 comprising the steps of:

(a) inserting a stack of notes in the note inlet opening;

(b) delivering notes from the stack generally one at a time from the stack with the note separating mechanism to the note inlet transport;

(c) sensing each of the notes for validity with the note validator;

(d) moving valid notes to the passage area with the inlet note transport;

(e) moving the valid notes from the passage area to the note storage area with the note receiving and dispensing device.

32. Apparatus comprising:

a housing including at least one sheet opening for passing sheets therethrough;

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a user interface in supporting connection with the housing, the user interface including at least one input device;

a sheet storage reel movably mounted in supporting connection with the housing;

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a take-up reel movably mounted in supporting connection with the housing;

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a flexible web extending between the storage reel and the take-up reel, the web extending adjacent to a sheet passage area intermediate of the storage reel and take-up reel;

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a reel drive mechanism in operative connection with the storage reel and take-up reel, wherein the reel drive mechanism is selectively operative to move sheets in supporting connection with the web between the sheet storage reel and the passage area;

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a sheet transport mechanism, wherein the sheet transport mechanism is selectively operative to move sheets between the sheet passage area and the sheet opening;

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a sheet validator in operative connection with the sheet transport mechanism, wherein the sheet validator is operative to distinguish acceptable sheets from unacceptable sheets;

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a controller in operative connection with the input device, the reel drive mechanism, sheet transport mechanism and sheet validator, wherein the controller is operative responsive to the sheet validator sensing a valid sheet inserted into a sheet opening to cause the valid sheet to be stored in supporting connection with the web on the storage reel, and the controller is further operative responsive to at least one input to the input device to cause the valid sheet to be moved from the storage reel to the sheet opening.

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33. The apparatus according to clause 32 wherein the housing includes a sheet inlet opening and a sheet outlet opening disposed from the sheet inlet opening, and wherein sheets are accepted into the apparatus through the sheet inlet opening and sheets are delivered from the apparatus through the sheet outlet opening.

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34. The apparatus according to clause 32 wherein

the sheets are both accepted into the housing and delivered from the housing through a single sheet opening.

35. The apparatus according to clause 32 wherein the input device includes a card reader, and wherein an input operative to cause sheets to be delivered from the sheet opening includes reading a card with the card reader.

36. In a cash dispensing machine including:

a housing;

a note outlet opening extending through the housing;

a passage area within the housing;

a note outlet transport extending in the housing between the passage area and the note outlet opening, the note outlet transport including a separating member engaging surface, apparatus comprising:

a note storage module removably mounted in supporting connection with the housing, the note storage module including a note storage area therein, wherein the note storage module includes a module first wall including a module opening therein, wherein the module opening is adjacent the passage area when the note storage module is in an operative position, wherein notes from the note storage area are selectively delivered from the note storage module through a module opening;

a first separating member movably mounted in supporting connection with the note storage module, wherein in the operative position of the note storage module the separating member extends through the module opening and operatively engages the separator engaging surface.

37. The apparatus according to clause 35 wherein the note storage module includes a first arcuately shaped moving member, wherein notes moving towards a module opening are passed in supporting connection with the first arcuately shaped moving member, wherein in the operative position of the note storage module the separating member operatively engages the first arcuately shaped moving member, wherein notes moving in supporting connection with the first arcuately shaped moving member are caused to engage the separating member.

38. The apparatus according to clause 37 wherein the note storage module includes a movable web, wherein notes moving between the note storage area and the passage area are moved in supporting connection with the web, and wherein the first arcuately shaped moving member includes a surface of the web.

39. The apparatus according to clause 36 and further comprising a biasing member in supporting connection with the note storage module and in operative connection with the separating member, wherein in the operative position of the note storage module the biasing member is operative to bias the separating member toward engagement with the separator engaging surface.

40. The apparatus according to clause 39, wherein the note storage module includes a first arcuately shaped moving member, wherein notes moving toward the module opening are moved in supporting connection with the first arcuately shaped moving member, and wherein in the operative position of the note storage module the separating member operatively engages the first arcuately shaped moving member, and wherein the biasing member is further operative to bias the separating member toward engagement with the first arcuately shaped moving member.

41. The apparatus according to clause 36 wherein the first separating member is movably mounted in supporting connection with the module first wall.

42. The apparatus according to clause 36 wherein the notes moving through the module opening extend generally in a note plane, and wherein the separating member is mounted to move relative to the note storage module in a direction generally transverse to the note plane.

43. The apparatus according to clause 42 wherein the separating member is movably mounted to further move rotationally relative to the note plane.

44. The apparatus according to clause 43 and further comprising an interengaging projection and slot, wherein the slot extends along the direction generally transverse to the note plane, and wherein the projection is rotatably movable relative to the slot, and wherein one of the separating member where the module first wall is operatively connected to the projection and the other of the separating member where the module first wall is operatively connected to the slot.

45. The apparatus according to clause 44 wherein the slot is bounded by an ear portion in supporting

connection with the module front wall, and wherein the note storage module includes a pair of ear portions disposed adjacent opposed transverse sides of the module opening, and further comprising a pair of generally opposed projections in operative connection with the separating member, wherein each projection is movable in a corresponding slot in an ear portion.

46. The apparatus according to clause 36 wherein at least one ear portion includes a cutout area extending through the ear portion of the slot, wherein the cutout area is configured such that a projection is enabled to pass through the cutout area.

47. The apparatus according to clause 36 and further comprising an interengaging projection and slot wherein when the note storage module is aligned in the operative position in supporting connection with the housing, the projection and slot are in engaged relation, and wherein one of either the projection or slot is operatively connected with the housing and the other of the projection or slot is operatively connected with the note storage module.

48. The apparatus according to clause 47 wherein the housing includes a generally cylindrical support member having a circumferential recess, and wherein the note storage module includes an arcuately shaped projection engageable in the recess.

49. The apparatus according to clause 48 wherein the cylindrical support member includes a pair of axially disposed circumferential recesses, and wherein the note storage module includes a pair of disposed arcuately shaped projections, wherein each projection is engageable in a corresponding recess.

50. The apparatus according to clause 48 wherein the projection includes a generally u-shaped portion.

51. The apparatus according to clause 50 wherein the note storage module is in operative connection with a tab, and wherein the u-shaped projection bounds an opening in the tab.

52. The apparatus according to clause 51 wherein the housing is in operative connection with a pair of disposed cylindrical support members, and wherein the note storage module includes a pair of disposed tabs, wherein in the operative position of the note storage module a generally u-shaped portion of a projection in supporting connection with each tab engages a recess in supporting connection with a corresponding cylindrical support member.

53. The apparatus according to clause 36 wherein the housing includes in supporting connection there-

with a support member, and wherein the note storage module includes a tab in supporting connection therewith, wherein the tab includes an opening, wherein in the operative position of the note storage module the opening accepts the support member therein. 5

54. The apparatus according to clause 53 wherein the support member is an axially elongated member, and wherein the note storage module includes at least one tab portion engaging the support member at a plurality of axially disposed locations. 10

55. The apparatus according to clause 54 wherein the note storage module includes a plurality of tab portions, wherein the tabs are axially disposed from one another relative to the supporting member in the operative position of the note storage module. 15

56. The apparatus according to clause 54 wherein the housing is in operative connection with a further support member, wherein the further support member is disposed transversely relative to the support member, and wherein the note storage module further includes a further tab portion, wherein the further tab portion engages the further support member in the operative position of the note storage module. 20 25

57. The apparatus according to clause 36 wherein the note storage module includes a plurality of tab portions, wherein each tab portion includes an opening therein, and wherein the openings are generally aligned and elongated along a first direction, and wherein the housing includes a pair of disposed support members, and wherein movement of the note storage module along the direction from an inoperative position is operative to move the openings in the tab portions to engage the support members, whereby the note storage module is moved to the operative position. 30 35 40

58. The apparatus according to clause 36 wherein the note storage area in the note storage module includes a rotatable member, and wherein the note storage module further includes a locking member, wherein the locking member selectively operatively engages the rotatable member to hold the rotatable member in fixed rotational position relative to the note storage module. 45 50

59. The apparatus according to clause 58 wherein the locking member and the rotatable member include an interengaging projection and recess, and wherein when the projection and recess are engaged the rotatable member is held rotationally fixed relative to the note storage module. 55

60. The apparatus according to clause 59 and further

comprising an actuator in supporting connection with the note storage module, wherein the actuator is operative to move the locking member to hold the rotatable member fixed responsive to disengagement of the note storage module from the housing.

61. The apparatus according to clause 60 wherein the cash dispensing machine includes an electrical signal source in the housing, and further comprising an electrical connector releasibly connecting the actuator with the electrical signal source, wherein the connector electrically disconnects the actuator responsive to removal of the module from supporting connection with the housing, and wherein the actuator is operative to cause the locking member to hold the rotatable member responsive to disconnection of the electrical connector.

62. The apparatus according to clause 47 wherein the note storage area in the note storage module includes a rotatable member, and wherein the note storage module further includes a locking member, wherein the locking member selectively operatively engages the rotatable member to hold the rotatable member in fixed rotational position relative to the note storage module.

63. Apparatus comprising:

a housing;

a sheet storage reel rotatably mounted in supporting connection with the housing;

a take-up reel rotatably mounted in supporting connection with the housing;

a flexible web extending between the storage reel and the take-up reel, the web extending adjacent a sheet passage area intermediate of the storage and take-up reels;

a first drive member selectively movable relative to the housing in a first direction and an opposed second direction;

a transmission member operatively connected to the first drive member, wherein responsive to movement of the first drive member in the first direction the transmission member is moved to a first position, and wherein responsive to movement of the first drive member in the second direction the transmission member is moved to a second position;

wherein when the transmission member is in the first position the first drive member is caused to be operatively engaged with the take-up reel,

wherein responsive to movement of the first drive member in the first direction the take-up reel is operative to move the web in a sheet dispensing direction such that sheets in supporting connection with the web on the storage reel are moved adjacent the passage area, and wherein in the second position of the transmission member the first drive member is caused to be operatively engaged with the take-up reel, wherein responsive to movement of the first drive member in the second direction the storage reel is operative to move the web in a sheet receiving direction such that sheets in supporting connection with the web adjacent the passage area are moved with the web toward the storage reel.

64. The apparatus according to clause 63 and further comprising:

a second drive member operatively connected to the first drive member and the transmission member, wherein the second drive member is operatively intermediate of the first drive member and the reels, wherein movement of the second drive member responsive to movement of the first drive member is operative to move both the transmission member and the reels.

65. The apparatus according to clause 64 and further comprising a first drag member operatively connected to the second drive member wherein the first drag member is operative to resist movement of the second drive member in transmitting motion between the first drive member and the reels, wherein the first drag member is operative to cause the transmission member to move to the first and second positions responsive to movement of the first drive member in the first and second directions respectively.

66. The apparatus according to clause 63 and further comprising a transmission drag member in operative connection with the transmission member, wherein the transmission drag member is operative to urge the transmission member to remain in its then current first or second position.

67. The apparatus according to clause 63 wherein the first drive member is a rotatable member, and wherein the first drive member rotates about a first axis of rotation, and wherein the transmission member rotates generally about the first axis of rotation when the transmission member moves between the first and second positions.

68. The apparatus according to clause 67 and further comprising a second drive member operatively connected with the first drive member, wherein the second drive member rotates relative to the transmis-

sion member about a second axis of rotation, wherein the second axis of rotation rotates about the first axis of rotation as the transmission member moves between the first and second positions.

69. The apparatus according to clause 68 wherein the storage reel includes a generally annular storage reel drive surface, and the take-up reel includes a generally annular take-up reel drive surface, wherein in the first position of the transmission member the second drive member operatively engages the take-up reel drive surface, and in the second position the second drive member operatively engages the storage reel drive surface.

70. The apparatus according to clause 69 wherein the storage reel and the take-up reel are identical.

71. The apparatus according to clause 69 and further comprising a locking member in supporting connection with the housing, and further comprising an actuator, wherein the actuator is selectively operative to hold the storage reel in relatively fixed rotational relation.

72. The apparatus according to clause 71 wherein the storage reel and the locking member are housed within a storage module, and wherein the storage module is removably mounted relative to the housing, and wherein the locking member is operative to hold the storage reel in fixed relative relation relative to the storage module responsive to removal of the module from the housing.

73. The apparatus according to clause 72 and further comprising an electrical signal source located in the housing and external of the module, and wherein the actuator is housed in the module, and further comprising a releasible electrical connector electrically connecting the actuator and the electrical signal source, wherein the electrical connector is disconnected when the module is removed from the housing, and wherein the actuator is operative to cause the locking member to hold the storage reel responsive to the connector electrically disconnecting the actuator from the electrical signal source.

74. The apparatus according to clause 63 and further comprising a user interface in supporting connection with the housing, the user interface including an input device, and further comprising a drive in operative connection with the first drive member and a controller in operative connection with the input device and the drive, and wherein the controller is operative responsive to at least one input to the input device to operate the drive to cause the web to move in a sheet dispensing direction, wherein sheets in supporting connection with the storage reel are moved toward

the passage area.

75. The apparatus according to clause 74 wherein the housing further includes an outlet opening and a sheet transport for moving sheets from the passage area to the outlet opening, whereby sheets from the storage reel are delivered to the outlet opening responsive to an input to the input device.

76. The apparatus according to clause 63 and further comprising a storage reel directional drag applying member in operative connection with the sheet storage reel, wherein the storage reel directional drag applying member is operative to apply relatively higher resistance to movement of the sheet storage reel when the web moves in the sheet dispensing direction compared to resistance to movement when the web moves in the sheet receiving direction.

77. The apparatus according to clause 76 wherein the storage reel directional drag applying member includes an extendable portion, wherein the extendable portion is configured to be extendable generally in only an extendable direction, wherein during movement of the web in a sheet receiving direction the extendable portion is extended in the extendable direction.

78. The apparatus according to clause 76 wherein the storage reel drag applying member includes a band portion extending in engagement with a generally annular brake surface in operative connection with the storage reel.

79. The apparatus according to clause 78 wherein the band portion includes a first end and a second end, wherein the first end and the second end are operatively connected to the housing, and wherein the second end is operatively connected to the housing through an extendable portion, wherein the extendable portion is operative to extend the effective length of the band portion when the web moves in a sheet receiving direction.

80. The apparatus according to clause 63 and further comprising a storage reel directional drag applying member in operative connection with the take-up reel, wherein the take-up reel directional drag applying member is operative to apply relatively higher resistance to movement of the take-up reel when the web moves in a sheet receiving direction compared to resistance to movement when the web moves in a sheet dispensing direction.

81. The apparatus according to clause 80 wherein the storage reel directional drag applying member includes an extendable portion, wherein the extendable portion is configured to be extendable in gen-

erally an extendable direction, wherein during movement of the web in a sheet dispensing direction the extendable portion is extended in the extendable direction.

82. The apparatus according to clause 80 wherein the take-up reel drag applying member includes a band portion extending in engagement with a generally annular brake surface in operative connection with the take-up reel.

83. The apparatus according to clause 82 wherein the take-up reel drag applying member includes a first end and a second end, wherein the first end and the second end are operatively connected with the housing, and wherein the second end is operatively connected to the housing through an extendable portion, wherein the extendable portion is operative to extend the effective length of the band when the web moves in the sheet dispensing direction.

84. The apparatus according to clause 63 and further comprising a note inlet opening in the housing, a note validator in operative connection with the note inlet opening, and a drive in operative connection with the first drive member and the note validator, wherein the drive is operative responsive to the note validator sensing a valid note passed into the note inlet opening to cause the drive to move the web in the sheet receiving direction, wherein the valid note is stored in supporting connection with the sheet storage reel.

85. The apparatus according to clause 84 and further comprising a sheet inlet transport, wherein the sheet inlet transport is operative to move notes from the note validator to the note passage area responsive to the validator sensing a valid note.

86. A method of operating the apparatus recited in clause 75 comprising the steps of:

- (a) storing at least one note in supporting connection with the web on the sheet storage reel;
- (b) receiving an input to the input device; and
- (c) operating the drive and the sheet transport responsive to the controller to deliver the note to the outlet opening.

87. A method of operating the apparatus recited in clause 85 comprising the steps of:

- (a) inserting a valid note in the note inlet opening;
- (b) sensing the note with the note validator, and

(c) operating the drive and the sheet transport responsive to the note validator sensing the valid note, to store the note in supporting connection with the web on the storage reel.

88. Apparatus comprising:

a housing;

a sheet storage reel rotatably mounted in supporting connection with the housing;

a take-up reel rotatably mounted in supporting connection with the housing;

a flexible web extending between the storage reel and the take-up reel, the web extending adjacent a sheet passage area intermediate of the storage and take-up reels;

a reel drive mechanism operatively connected to the storage and take-up reels, wherein the reel drive mechanism is selectively operative to move the web wherein sheets are moved in supporting connection with the web between the storage reel and the sheet passage area; and

a storage reel directional drag applying member in operative connection with at least one of the reels, wherein the directional reel drag applying member is operative to apply relatively higher resistance to movement of the one reel in a first direction than in a second direction opposed of the first direction.

89. The apparatus according to clause 88 wherein when the web moves in a sheet dispensing direction sheets are moved in supporting connection with the web from the storage reel to the passage area, and wherein the directional drag applying member is in operative connection with the storage reel and is operative to apply the relatively higher resistance to movement of the storage reel when the web moves in the sheet dispensing direction.

90. The apparatus according to clause 88 wherein when the web moves in a sheet receiving direction sheets are moved in supporting connection with the web from the passage area to the storage reel, and wherein the directional drag applying member is in operative connection with the take-up reel and is operative to apply the relatively higher resistance to movement of the take-up reel when the web moves in the sheet receiving direction.

91. The apparatus according to clause 88 and further comprising a storage reel directional drag applying member in operative connection with the storage

reel, and a take-up reel directional drag applying member in operative connection with the take-up reel, and wherein when the web moves in a sheet dispensing direction sheets in supporting connection with the storage reel are moved in supporting connection with the web to the passage area, and when the web is moved in a sheet receiving direction sheets in supporting connection with the web are moved in supporting connection with the web from the passage area to the storage reel, and wherein the storage reel directional drag applying member is operative to apply relatively higher drag to the storage reel as the web moves in the sheet dispensing direction, and the take-up reel directional drag applying member is operative to apply relatively higher drag to the take-up reel when the web moves in the sheet receiving direction.

92. The apparatus according to clause 91 and further comprising a storage module, wherein the storage module is removably mounted on the housing, and wherein the storage reel take-up reel, storage reel directional drag applying member, and take-up reel directional drag applying member are in supporting connection with the module.

93. The apparatus according to clause 88 wherein the directional drag applying member includes an extendable portion, wherein the extendable portion is extendable in an extendable direction, wherein the extendable portion extends in the extendable direction responsive to the associated reel rotating in the second direction.

94. The apparatus according to clause 88 wherein the one reel in operative connection with the directional drag applying member has a generally annular brake surface in operative connection therewith, and wherein the directional drag applying member includes a band portion extending in engagement with the annular brake surface.

95. The apparatus according to clause 94 wherein the directional drag applying member includes a first end and a second end, and wherein the first end and the second end are operatively connected to the housing, and wherein the second end is operatively connected to the housing through an extendable portion, wherein the extendable portion is operative to extend the effective length of the band portion when the reel operatively connected to the directional drag applying member rotates in the second direction.

96. The apparatus according to clause 94 wherein the band portion extends in engagement with the brake surface generally at least about 180 degrees.

97. The apparatus according to clause. 88 and further comprising a user interface including an input device in operative connection with the housing, and a controller in operative connection with the input device and the reel drive mechanism, wherein the controller is operative responsive to an input to the input device to operate the reel drive mechanism to move the web such that sheets in supporting connection with the web on the storage reel are moved to the passage area.

98. The apparatus according to clause 97 and further comprising an outlet opening in the housing, and an outlet transport extending between the passage area and the outlet opening, and wherein the outlet transport is in operative connection with the controller, and the controller is further operative responsive to the input to move at least one sheet from the passage area to the outlet opening.

99. The apparatus according to clause 88 and further comprising an inlet opening in the housing, and a note validator in operative connection with the inlet opening, wherein the note validator is operative to sense a valid note inserted through said inlet opening, and wherein the note validator is operatively connected to the reel drive mechanism, wherein responsive to the note validator sensing a valid note inserted through the inlet opening the note validator is operative to cause the reel drive mechanism to move the valid note from the passage area into supporting connection with the web.

100. The apparatus according to clause 98 and further comprising a note inlet opening in the housing, a note validator in operative connection with the note inlet opening, wherein the note validator is operative to sense if a note inserted through the inlet opening is a valid note, an inlet note transport extending between the note validator and the passage area, wherein the note validator and the inlet transport are in operative connection with the controller, wherein the controller is operative responsive to the note validator sensing a valid note inserted through the inlet opening to transport the note in connection with the inlet transport from the validator to the passage area and to operate the reel drive mechanism to move the valid note from the passage area to the storage area

101. A method of operating the apparatus recited in clause 98 comprising the steps of:

(a) storing at least one note in supporting connection with the web on the storage reel;

(b) receiving an input through the input device; and

(c) operating the reel drive mechanism and note outlet transport with the controller responsive to the input, to deliver the note to the outlet opening.

102. Apparatus comprising:

a housing;

a sheet storage reel rotatably mounted in supporting connection with the housing, the storage reel rotatable relative to the housing about a first axis;

a take-up reel rotatably mounted in supporting connection with the housing;

a flexible web extending between the storage reel and the take-up reel, the web extending adjacent a sheet passage area intermediate of the storage and take-up reels, and wherein the web joins the storage area adjacent a nip;

a reel drive mechanism in operative connection with the storage and take-up reels, wherein the reel drive mechanism is selectively operative to move sheets in supporting connection with the web between the storage reel and the passage area;

a separating member movably mounted in supporting connection with the housing, wherein the separating member includes an edge portion, wherein the edge portion engages the web and is operative to disengage sheets therefrom, wherein the edge portion engages the web at a location disposed in a direction from the nip toward the passage area, and wherein the separating member is rotatably mounted relative to the housing about a second axis, wherein relative to the first axis the second axis is angularly disposed from the nip generally at least 90 degrees.

103. The apparatus according to clause 102 and further comprising a biasing member, wherein the biasing member is operative to bias the edge portion to engage the web.

104. The apparatus according to clause 102 wherein the separating member includes a deflector surface, wherein the deflector surface extends from the edge portion in generally facing relation and generally parallel to the web.

105. The apparatus according to clause 104 and further comprising at least one movable member, wherein the movable member is operative to move

in engagement with sheets supported on the web, and wherein the deflector surface is operative to extend on at least one transverse side of the movable member.

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106. The apparatus according to clause 105 wherein the deflector surface extends on two transverse sides of the movable member.

107. The apparatus according to clause 105 and further comprising a guide surface, wherein the guide surface is disposed in facing relation relative to the web in the passage area, and wherein the deflector surface extends on at least one transverse side of the guide surface.

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108. The apparatus according to clause 102 and further comprising an arcuately shaped web supporting member supporting the web adjacent the passage area, and a secondary separating member engaging a portion of the web overlying the arcuately shaped web supporting member, wherein the secondary separating member is operative to engage an opposed side of the web from a side of the web engaged by the separating member.

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109. The apparatus according to clause 108 and further comprising a biasing member wherein the biasing member is operative to bias the secondary separating member to engage the web.

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110. The apparatus according to clause 102 and further comprising a user interface in supporting connection with the housing, the user interface including an input device, and further comprising an outlet opening in the housing, an outlet transport extending between the passage area and the outlet opening, and a controller in operative connection with the input device, the reel drive mechanism and the note outlet transport, wherein the controller is operative responsive to an input to the input device to cause sheets stored in supporting connection with the storage reel to be moved to the outlet opening.

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111. The apparatus according to clause 110 and further comprising a note validator in supporting connection with the housing, wherein the note validator is operative to sense the validity of notes adjacent thereto, and wherein the note validator is in operative connection with the controller, and wherein the controller is operative responsive to the validator sensing a valid note to move the note to the storage reel.

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112. Apparatus comprising:

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a housing including at least one sheet opening, wherein the sheet opening is adapted for pass-

ing sheets therethrough;

a user interface in supporting connection with the housing, the user interface including at least one input device;

a sheet storage reel movably mounted in supporting connection with the housing;

a take-up reel movably mounted in supporting connection with the housing;

a flexible web extending between the storage reel and the take-up reel, the web extending adjacent to a sheet passage area intermediate of the storage and take-up reels;

a reel drive mechanism in operative connection with the storage and take-up reels, wherein the reel drive mechanism is selectively operative to move sheets in supporting connection with the web between the sheet storage reel and the passage area;

a sheet transport mechanism wherein the sheet transport mechanism is selectively operative to move sheets between the sheet passage area and the sheet opening;

a controller, wherein the controller is in operative connection with the input device, the reel drive mechanism and the sheet transport mechanism, and wherein the controller is operative responsive to at least one input to the input device to cause sheets to be moved between the storage reel and the sheet opening;

wherein the web includes a plurality of machine readable indicia thereon, wherein each of the indicia corresponds to a location relative to an end of the web;

a sensor in operative connection with the controller, wherein the controller is operative to generate at least one signal responsive to sensing the indicia with the sensor.

113. The apparatus according to clause 112 wherein spacing between adjacent machine readable indicia varies responsive to the distance of the location from the end, and wherein the signal is generated by the controller responsive to adjacent machine readable indicia having a predetermined spaced relationship.

114. The apparatus according to clause 112 wherein the web includes a first end operatively connected to the take-up reel and a second end operatively con-

nected to the storage reel, and wherein the spacing between adjacent machine readable indicia varies responsive to a distance of the location from each respective end.

115. The apparatus according to clause 112 wherein the spacing between adjacent indicia decreases with proximity of the location to the end of the web.

116. The apparatus according to clause 114 wherein the spacing between adjacent indicia decreases with proximity of the location to each of the first end and the second end of the web.

117. The apparatus according to clause 112 wherein the web includes a transfer sheet engaging area, wherein sheets in supporting connection with the web are engaged with the sheet engaging area, and wherein the web further includes a peripheral area, wherein the peripheral area is transversely disposed from the sheet engaging area, and wherein the indicia are in supporting connection with the peripheral area of the web.

118. The apparatus according to clause 117 wherein the web includes a peripheral area on each transverse side of the sheet supporting area, wherein each transverse side includes the indicia

119. The apparatus according to clause 118 wherein the web includes a first end in operative connection with the take-up reel and a second end in operative connection with the storage reel, and wherein the indicia in each peripheral area is indicative of the distance of the location relative to at least one of the ends.

120. The apparatus according to clause 118 wherein the spacing between adjacent indicia varies with proximity to the end.

121. The apparatus according to clause 120 wherein the spacing between adjacent indicia decreases with proximity to the end.

122. The apparatus according to clause 119 wherein the spacing between adjacent indicia decreases with proximity to the each of the first end and the second end.

123. The apparatus according to clause 112 and further comprising a passage sensor, wherein the passage sensor is adjacent the passage area, and wherein the passage sensor is in operative connection with the controller, and wherein the passage sensor is operative to sense sheets adjacent the passage area, and wherein the controller is operative to cause further sheets to cease to be stored on the

storage wheel responsive to sensing indicia corresponding to a location adjacent the end of the web.

124. The apparatus according to clause 112 and further comprising a passage sensor in operative connection with the controller, wherein the passage sensor is operative to sense sheets adjacent the passage area, and wherein the web includes a first end in operative connection with the take-up reel and a second end in operative connection with the storage reel, and wherein the controller is operative to operate the reel drive mechanism to transfer the web into supporting connection with the note storage reel such that the portion of the web in engagement with the take-up reel is reduced to a first area of the web adjacent the first end, and the controller is further operative thereafter to operate the reel drive mechanism to place increasing amounts of the web in supporting connection with the take-up reel until a sheet is sensed in the passage area by the passage sensor, and wherein the controller is operative to generate a further signal indicative of a location wherein a sheet is sensed by the passage sensor.

125. The apparatus according to clause 124 wherein the further signal includes data representative of a number of sheets currently stored in supporting connection with the web.

126. The apparatus according to clause 112 wherein the web includes a first end in operative connection with the take-up reel and a second end in operative connection with the storage reel, and wherein the signal is generated responsive to the sensor sensing indicia corresponding to a distance from the second end.

127. The apparatus according to clause 126 wherein the signal includes data representative of a quantity of sheets remaining in supporting connection with the web.

128. A method of operating the apparatus recited in clause 112 comprising the steps of:

(a) storing a plurality of sheets on the storage reel in supporting connection with the web;

(b) operating the reel drive mechanism and the sheet transport with the controller responsive to inputs to the input device to move sheets from the storage reel to the sheet opening;

(c) sensing indicia associated with the web with the sensor; and

(d) generating a signal with the controller responsive to the indicia sensed corresponding to

a particular location.

129. A method of operating the apparatus recited in clause 124 comprising the steps of:

(a) storing a plurality of sheets on the storage reel in supporting connection with the web;

(b) operating the reel drive mechanism with the controller to remove portions of the web from the take-up reel until indicia corresponding to the first end area is sensed by the sensor as being disposed from the take-up reel;

(c) operating the reel drive mechanism to include increasing portions of the web on the take-up reel until a sheet is sensed adjacent the passage sensor;

(d) sensing with the sensor an indicia corresponding to a location where the sheet is sensed by the passage sensor;

(e) generating with the controller the further signal indicative of the location.

130. The method according to clause 129 and prior to step (b) further comprising the steps of:

(f) storing data corresponding to a quantity condition in a memory in operative connection with the controller, wherein the quantity condition corresponds to a quantity of sheets stored in supporting connection with the web;

(g) adjusting the quantity condition responsive to the delivery of sheets towards the sheet opening;

(h) sensing loss of the data corresponding to the quantity condition wherein step (b) is carried out responsive to sensing loss of the quantity condition data.

131. In a apparatus including:

a housing;

a sheet storage reel movably mounted in supporting connection with the housing;

a take-up reel movably mounted in supporting connection with the housing;

a reel drive mechanism in operative connection with the storage reel and the take-up reel, wherein the reel drive mechanism is selectively

operative to move the storage reel and the take-up reel;

a sensor for sensing indicia along a web path intermediate of the storage reel and the take-up reel, the web path including a passage area; and

a web extending between the storage and take-up reels along the web path, the web comprising:

a central sheet engaging area and a pair of peripheral areas, each peripheral area disposed on an opposed side of the sheet engaging area, wherein sheets are generally engaged with the web in the sheet engaging area and not the peripheral areas, and wherein each peripheral area includes machine readable indicia which are detectable by the sensor, wherein the web includes a first end and a second end, and wherein the first end and the second end are operatively attached respectively to one of the take-up reel and the storage reel, and wherein the machine readable indicia are spaced from one another, and wherein spacing between adjacent machine readable indicia decreases with proximity to each end.

132. The apparatus according to clause 131 and further comprising:

a user interface in supporting connection with the housing, the user interface including at least one input device;

a sheet transport mechanism wherein the sheet transport mechanism is selectively operative to move sheets between the sheet passage area and the sheet opening; and

a controller in operative connection with the reel drive mechanism, the sensor, the sheet transport mechanism and the input device, and wherein the controller is operative responsive to at least one input to the input device to cause sheets to move from the storage reel to the sheet opening, and wherein the controller is further operative to generate at least one signal responsive to the sensor sensing indicia having a particular relation to an end of the web.

[0132] In the following claims any feature described as a means for performing a function shall be construed as encompassing any means known to those skilled in the art to be capable of performing the recited function, and shall not be limited to the structures shown herein or mere equivalents thereof.

[0133] Having described the features, discoveries and

principles of the invention, the manner in which it is constructed and operated, and the advantages and useful results attained; the new and useful structures, devices, elements, arrangements, parts, combinations, systems, equipment, operations, methods and relationships are set forth in the appended claims.

Claims

1. Apparatus comprising:

a housing including at least one sheet opening, wherein the sheet opening is adapted for passing sheets therethrough;
 a user interface in supporting connection with the housing, the user interface including at least one input device;
 a sheet storage reel movably mounted in supporting connection with the housing;
 a take-up reel movably mounted in supporting connection with the housing;
 a flexible web extending between the storage reel and the take-up reel, the web extending adjacent to a sheet passage area intermediate of the storage and take-up reels;
 a reel drive mechanism in operative connection with the storage and take-up reels, wherein the reel drive mechanism is selectively operative to move sheets in supporting connection with the web between the sheet storage reel and the passage area;
 a sheet transport mechanism wherein the sheet transport mechanism is selectively operative to move sheets between the sheet passage area and the sheet opening;
 a controller, wherein the controller is in operative connection with the input device, the reel drive mechanism and the sheet transport mechanism, and wherein the controller is operative responsive to at least one input to the input device to cause sheets to be moved between the storage reel and the sheet opening;
 wherein the web includes a plurality of machine readable indicia thereon, wherein each of the indicia corresponds to a location relative to an end of the web;
 a sensor in operative connection with the controller, wherein the controller is operative to generate at least one signal responsive to sensing the indicia with the sensor.

2. The apparatus according to claim 1 wherein spacing between adjacent machine readable indicia varies responsive to the distance of the location from the end, and wherein the signal is generated by the controller responsive to adjacent machine readable indicia having a predetermined spaced relationship.

3. The apparatus according to claim 1 wherein the web includes a first end operatively connected to the take-up reel and a second end operatively connected to the storage reel, and wherein the spacing between adjacent machine readable indicia varies responsive to a distance of the location from each respective end.

4. The apparatus according to claim 1 wherein the spacing between adjacent indicia decreases with proximity of the location to the end of the web.

5. The apparatus according to claim 3 wherein the spacing between adjacent indicia decreases with proximity of the location to each of the first end and the second end of the web.

6. The apparatus according to claim 1 wherein the web includes a transfer sheet engaging area, wherein sheets in supporting connection with the web are engaged with the sheet engaging area, and wherein the web further includes a peripheral area, wherein the peripheral area is transversely disposed from the sheet engaging area, and wherein the indicia are in supporting connection with the peripheral area of the web.

7. The apparatus according to claim 6 wherein the web includes a peripheral area on each transverse side of the sheet supporting area, wherein each transverse side includes the indicia.

8. The apparatus according to claim 7 wherein the web includes a first end in operative connection with the take-up reel and a second end in operative connection with the storage reel, and wherein the indicia in each peripheral area is indicative of the distance of the location relative to at least one of the ends.

9. The apparatus according to claim 7 wherein the spacing between adjacent indicia varies with proximity to the end.

10. The apparatus according to claim 9 wherein the spacing between adjacent indicia decreases with proximity to the end.

11. The apparatus according to claim 8 wherein the spacing between adjacent indicia decreases with proximity to the each of the first end and the second end.

12. The apparatus according to claim 1 and further comprising a passage sensor, wherein the passage sensor is adjacent the passage area, and wherein the passage sensor is in operative connection with the controller, and wherein the passage sensor is operative to sense sheets adjacent the passage area,

and wherein the controller is operative to cause further sheets to cease to be stored on the storage wheel responsive to sensing indicia corresponding to a location adjacent the end of the web.

13. The apparatus according to claim 1 and further comprising a passage sensor in operative connection with the controller, wherein the passage sensor is operative to sense sheets adjacent the passage area, and wherein the web includes a first end in operative connection with the take-up reel and a second end in operative connection with the storage reel, and wherein the controller is operative to operate the reel drive mechanism to transfer the web into supporting connection with the note storage reel such that the portion of the web in engagement with the take-up reel is reduced to a first area of the web adjacent the first end, and the controller is further operative thereafter to operate the reel drive mechanism to place increasing amounts of the web in supporting connection with the take-up reel until a sheet is sensed in the passage area by the passage sensor, and wherein the controller is operative to generate a further signal indicative of a location wherein a sheet is sensed by the passage sensor.
14. The apparatus according to claim 13 wherein the further signal includes data representative of a number of sheets currently stored in supporting connection with the web.
15. The apparatus according to claim 1 wherein the web includes a first end in operative connection with the take-up reel and a second end in operative connection with the storage reel, and wherein the signal is generated responsive to the sensor sensing indicia corresponding to a distance from the second end.
16. The apparatus according to claim 15 wherein the signal includes data representative of a quantity of sheets remaining in supporting connection with the web.
17. A method of operating the apparatus recited in claim 1 comprising the steps of:
 - (a) storing a plurality of sheets on the storage reel in supporting connection with the web;
 - (b) operating the reel drive mechanism and the sheet transport with the controller responsive to inputs to the input device to move sheets from the storage reel to the sheet opening;
 - (c) sensing indicia associated with the web with the sensor; and
 - (d) generating a signal with the controller responsive to the indicia sensed corresponding to a particular location.

18. A method of operating the apparatus recited in claim 13 comprising the steps of:

- (a) storing a plurality of sheets on the storage reel in supporting connection with the web;
- (b) operating the reel drive mechanism with the controller to remove portions of the web from the take-up reel until indicia corresponding to the first end area is sensed by the sensor as being disposed from the take-up reel;
- (c) operating the reel drive mechanism to include increasing portions of the web on the take-up reel until a sheet is sensed adjacent the passage sensor;
- (d) sensing with the sensor an indicia corresponding to a location where the sheet is sensed by the passage sensor;
- (e) generating with the controller the further signal indicative of the location.

19. The method according to claim 18 and prior to step (b) further comprising the steps of:

- (f) storing data corresponding to a quantity condition in a memory in operative connection with the controller, wherein the quantity condition corresponds to a quantity of sheets stored in supporting connection with the web;
- (g) adjusting the quantity condition responsive to the delivery of sheets towards the sheet opening;
- (h) sensing loss of the data corresponding to the quantity condition wherein step (b) is carried out responsive to sensing loss of the quantity condition data.

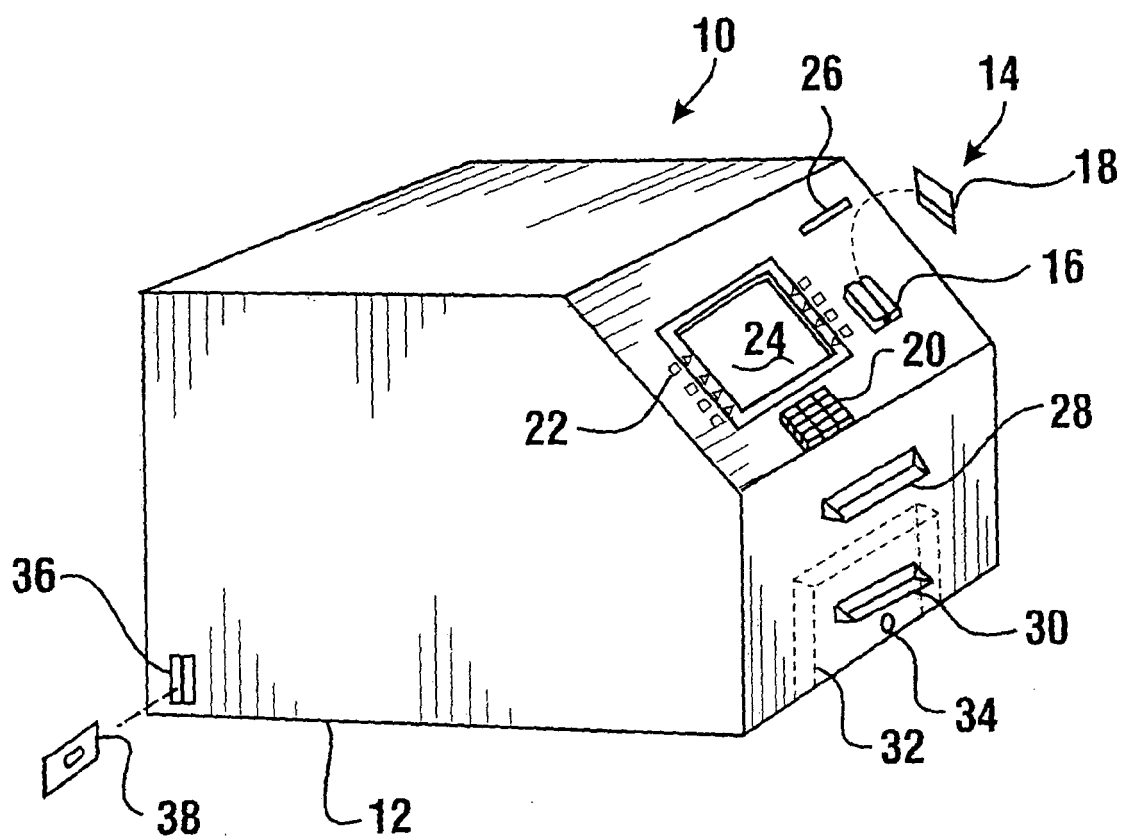


FIG. 1

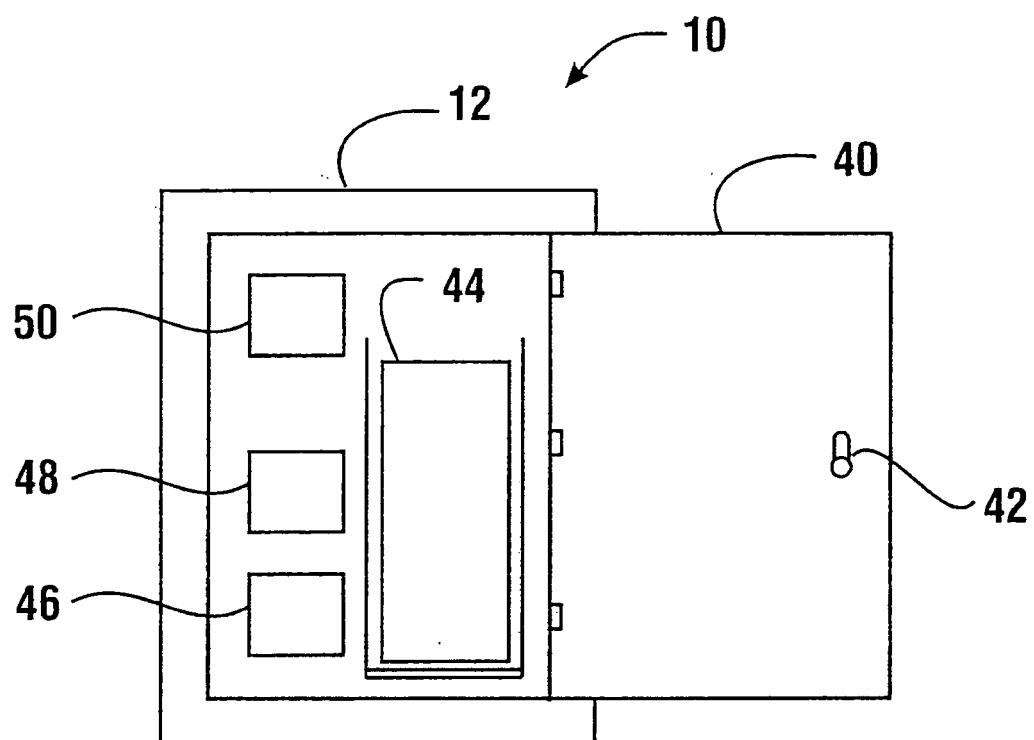
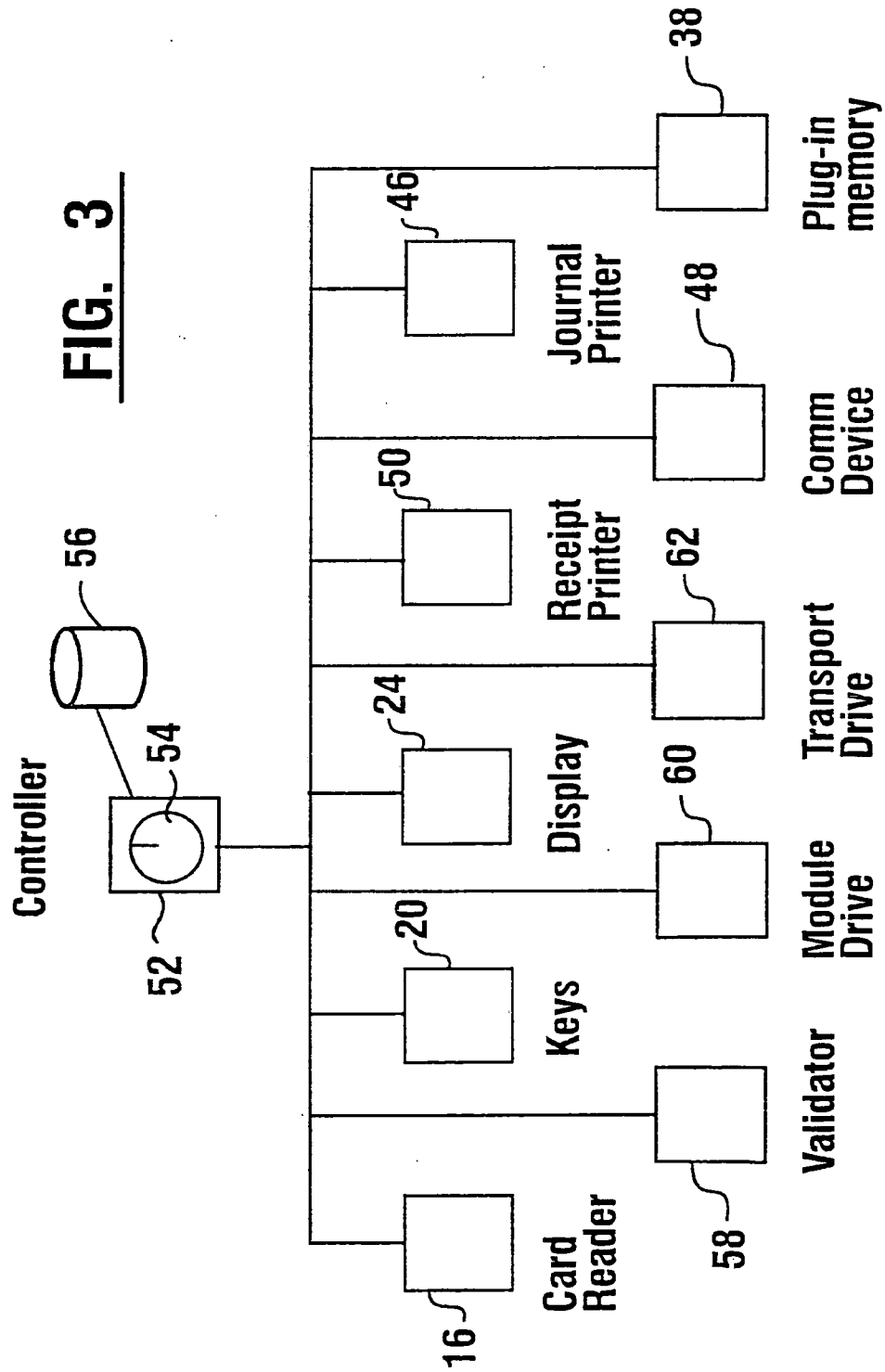


FIG. 2



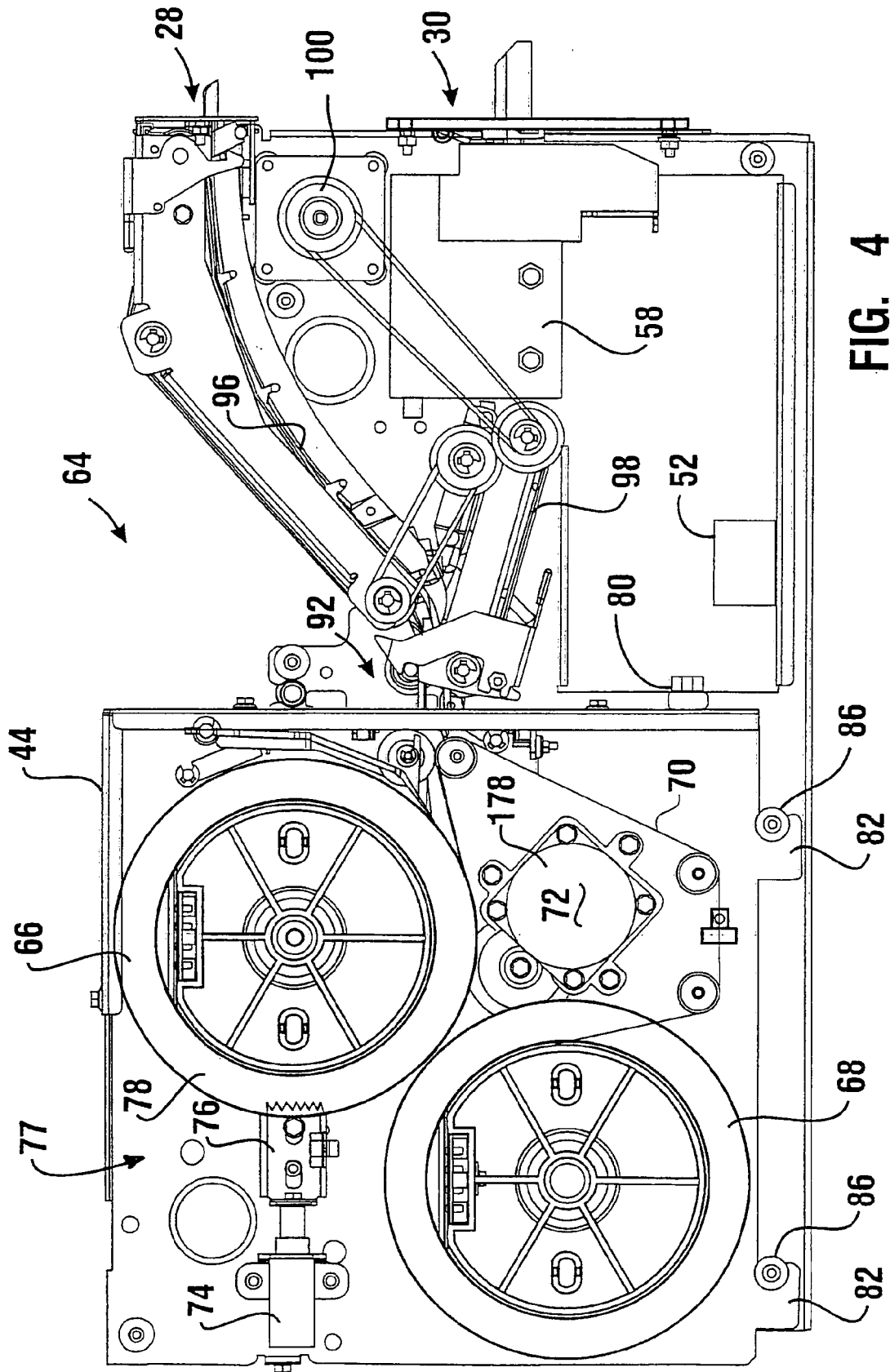
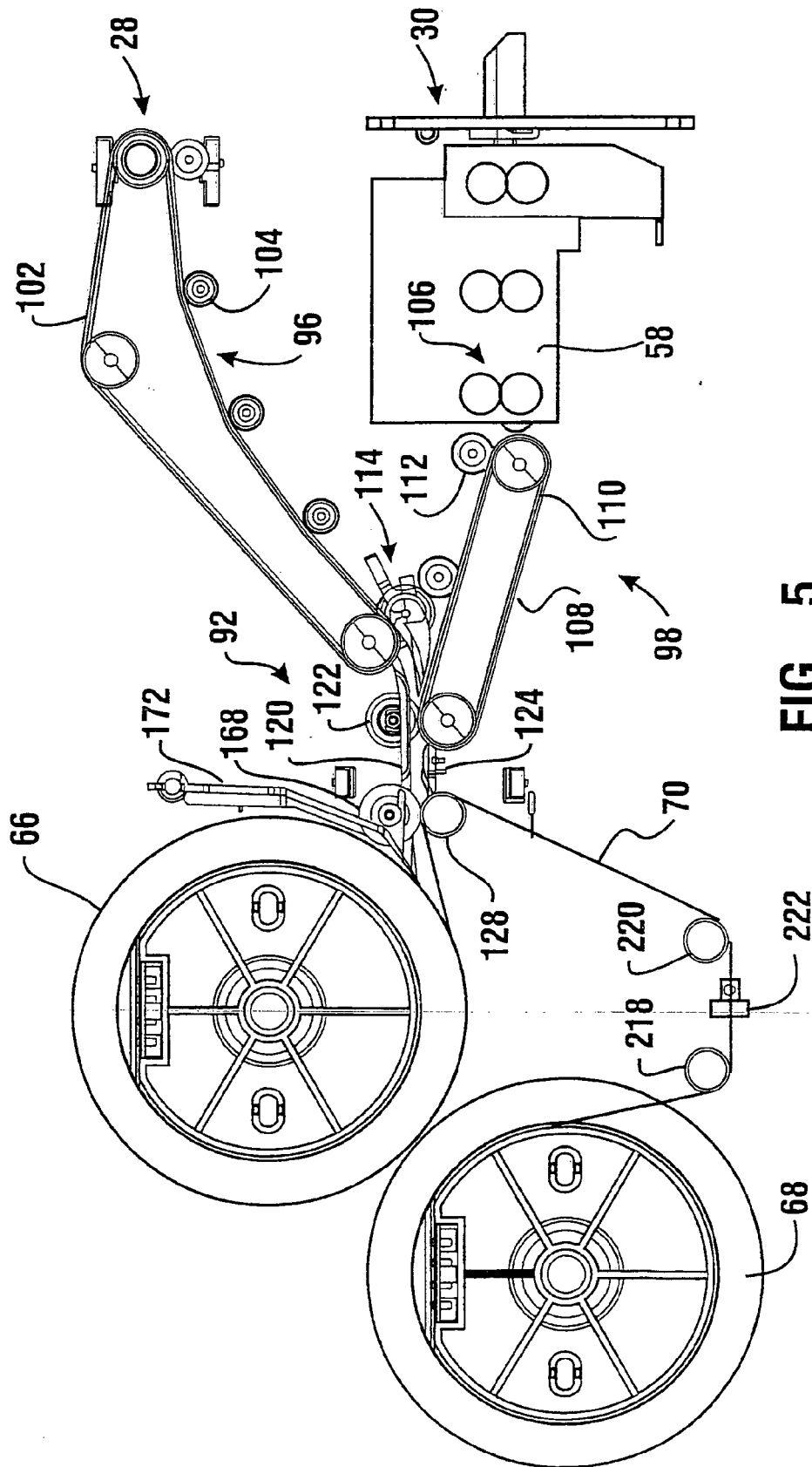


FIG. 4



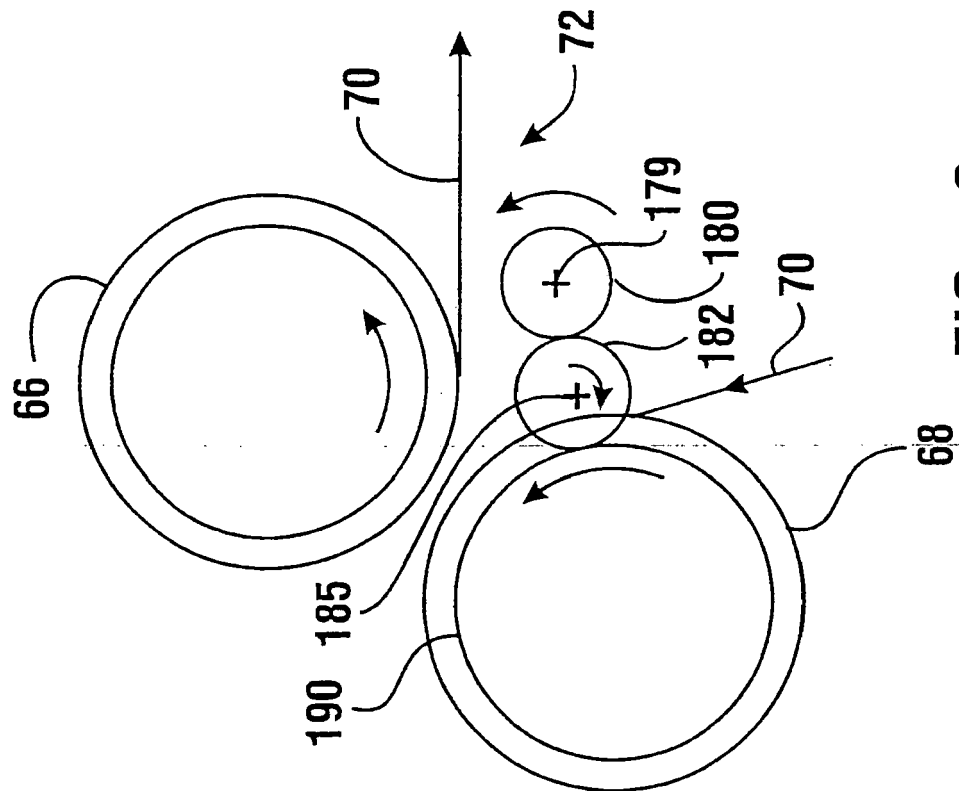


FIG. 6

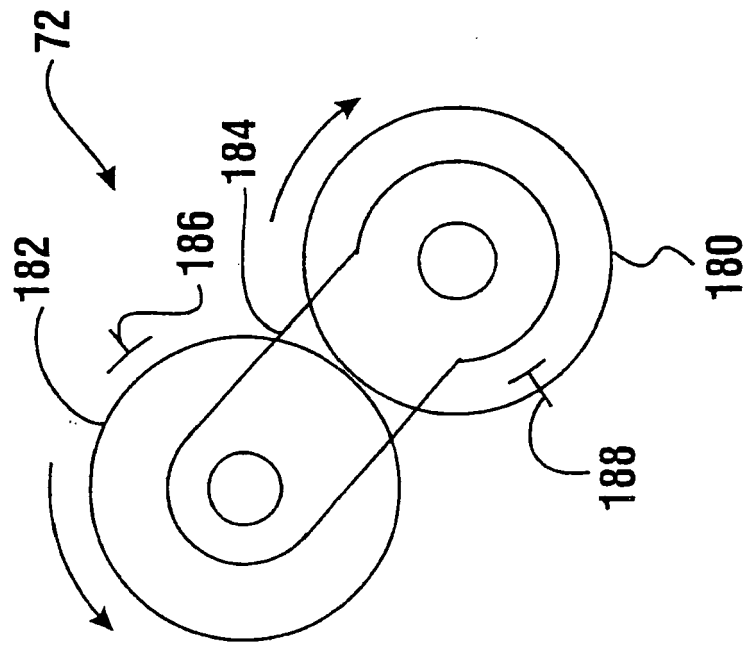


FIG. 7

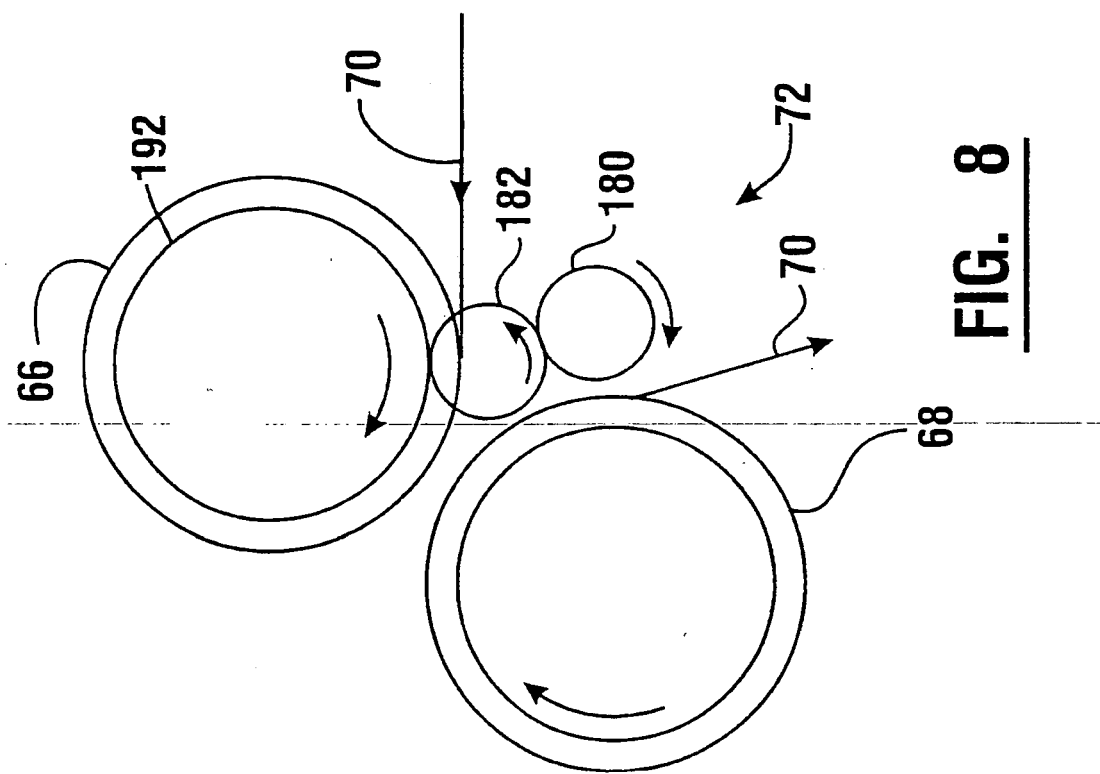


FIG. 8

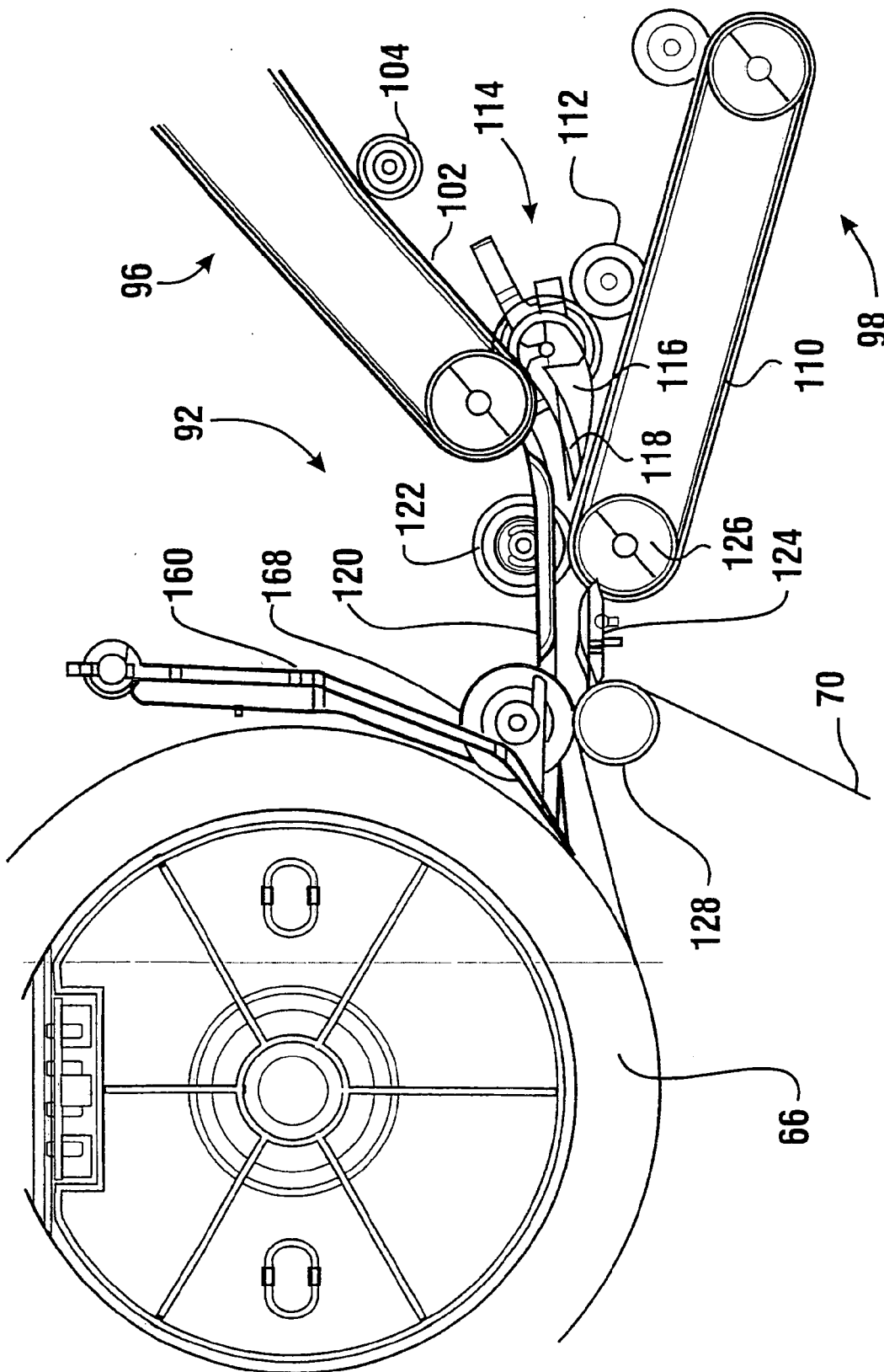


FIG. 9

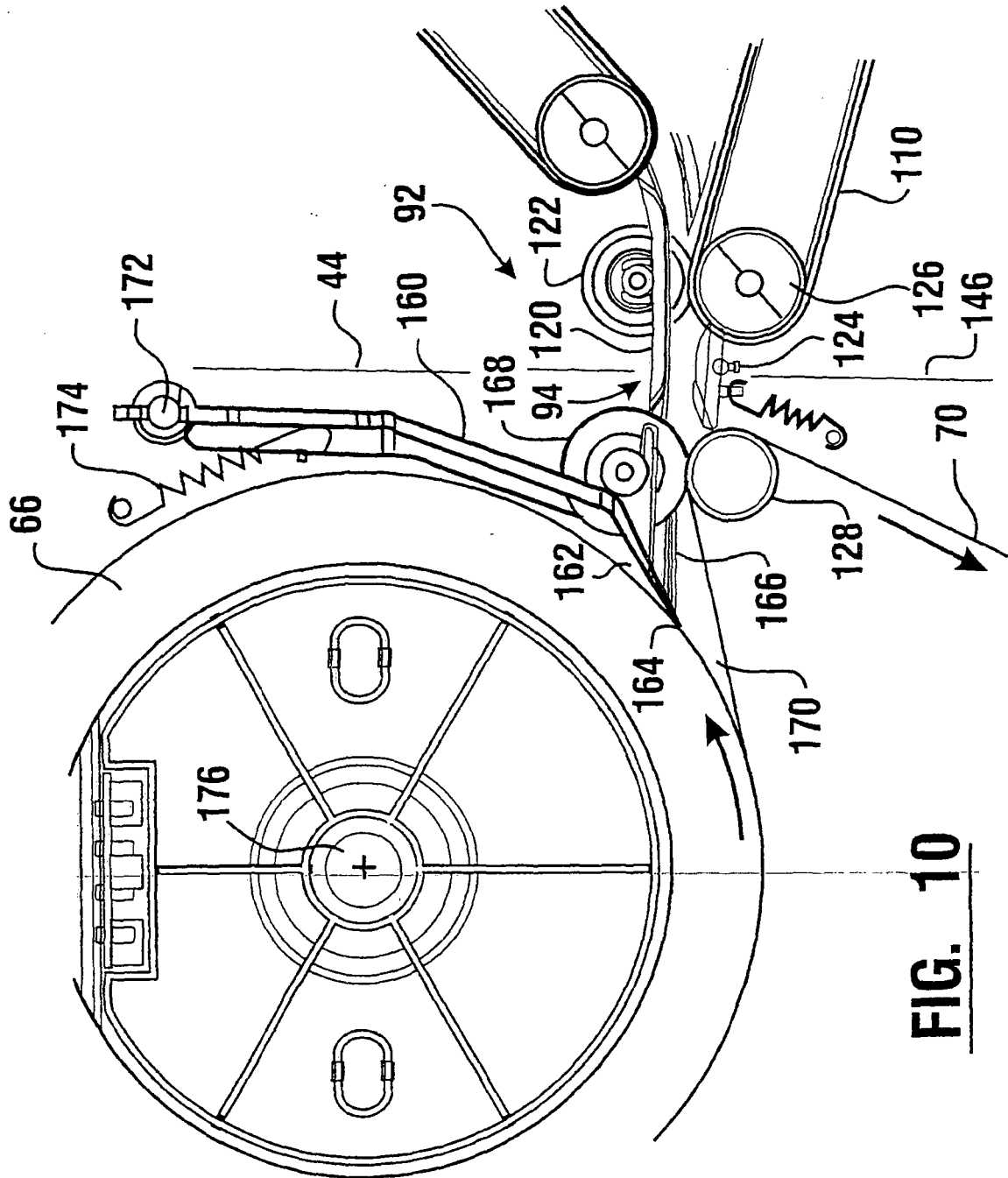
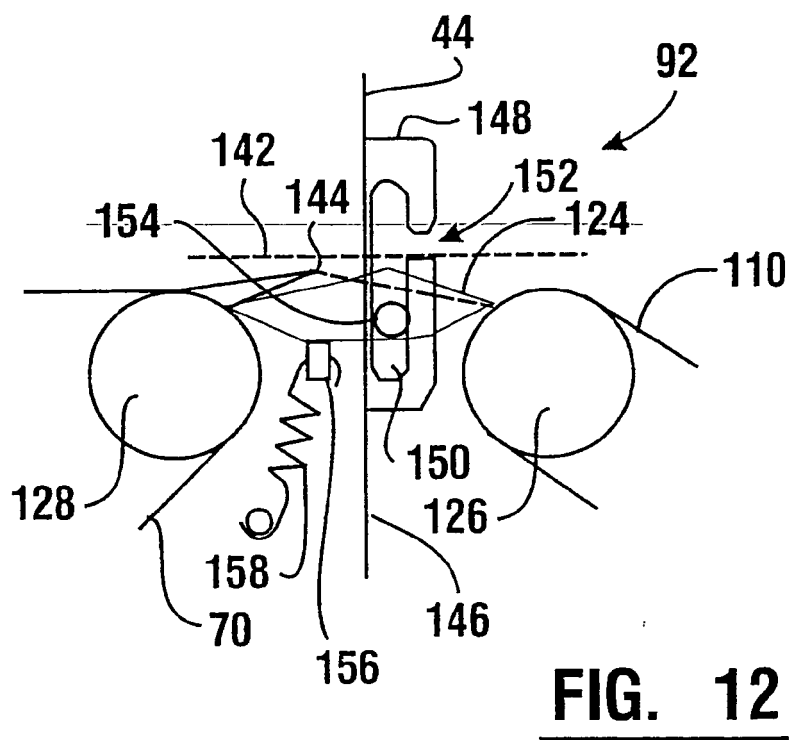
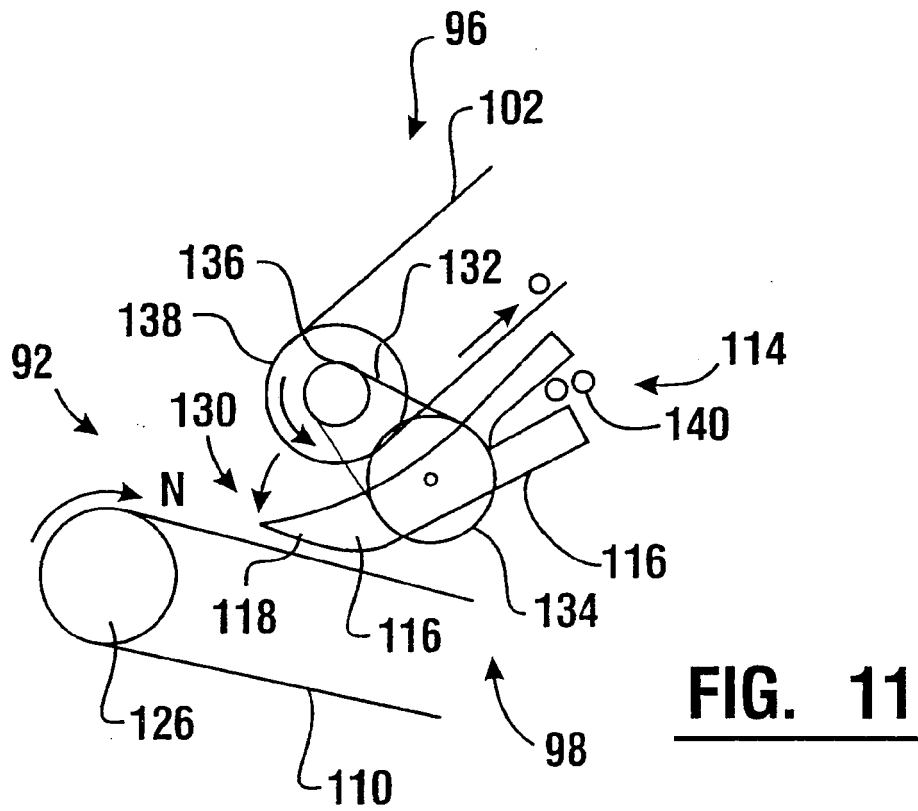
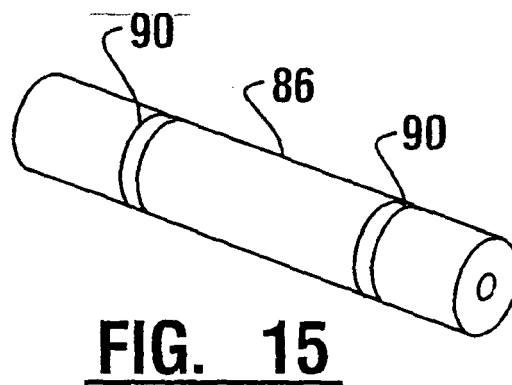
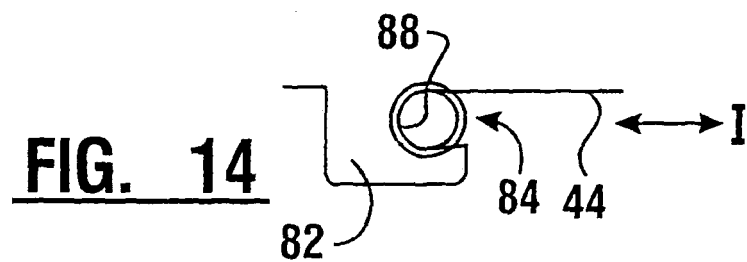
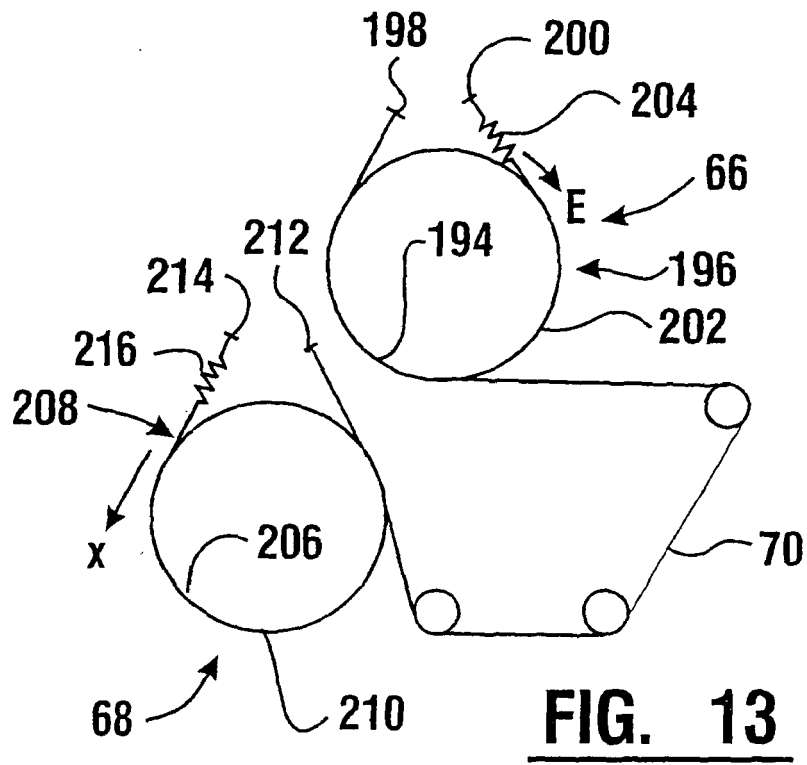


FIG. 10





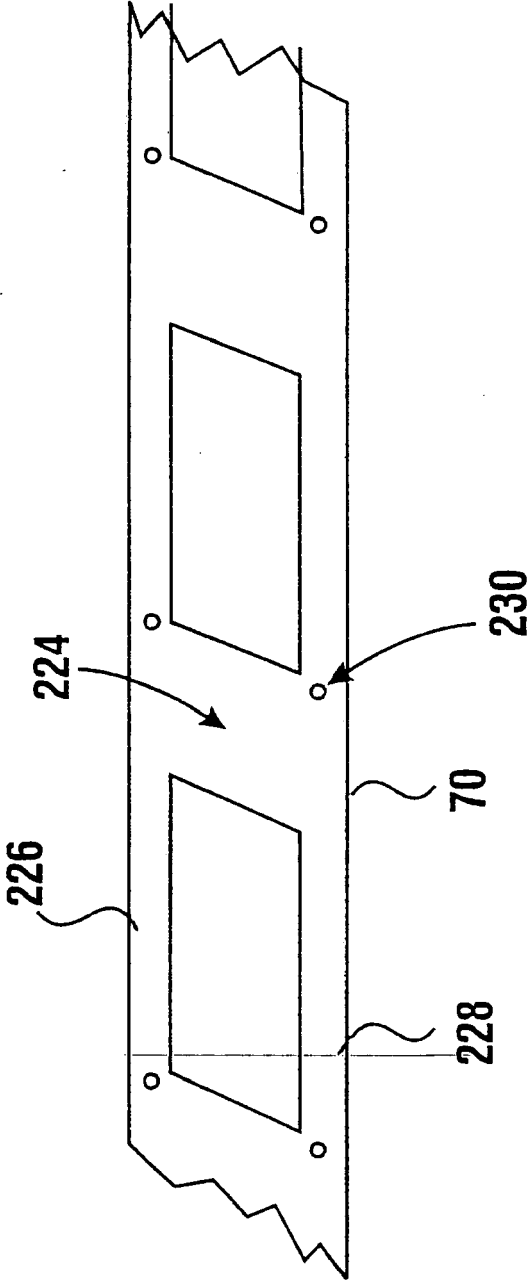
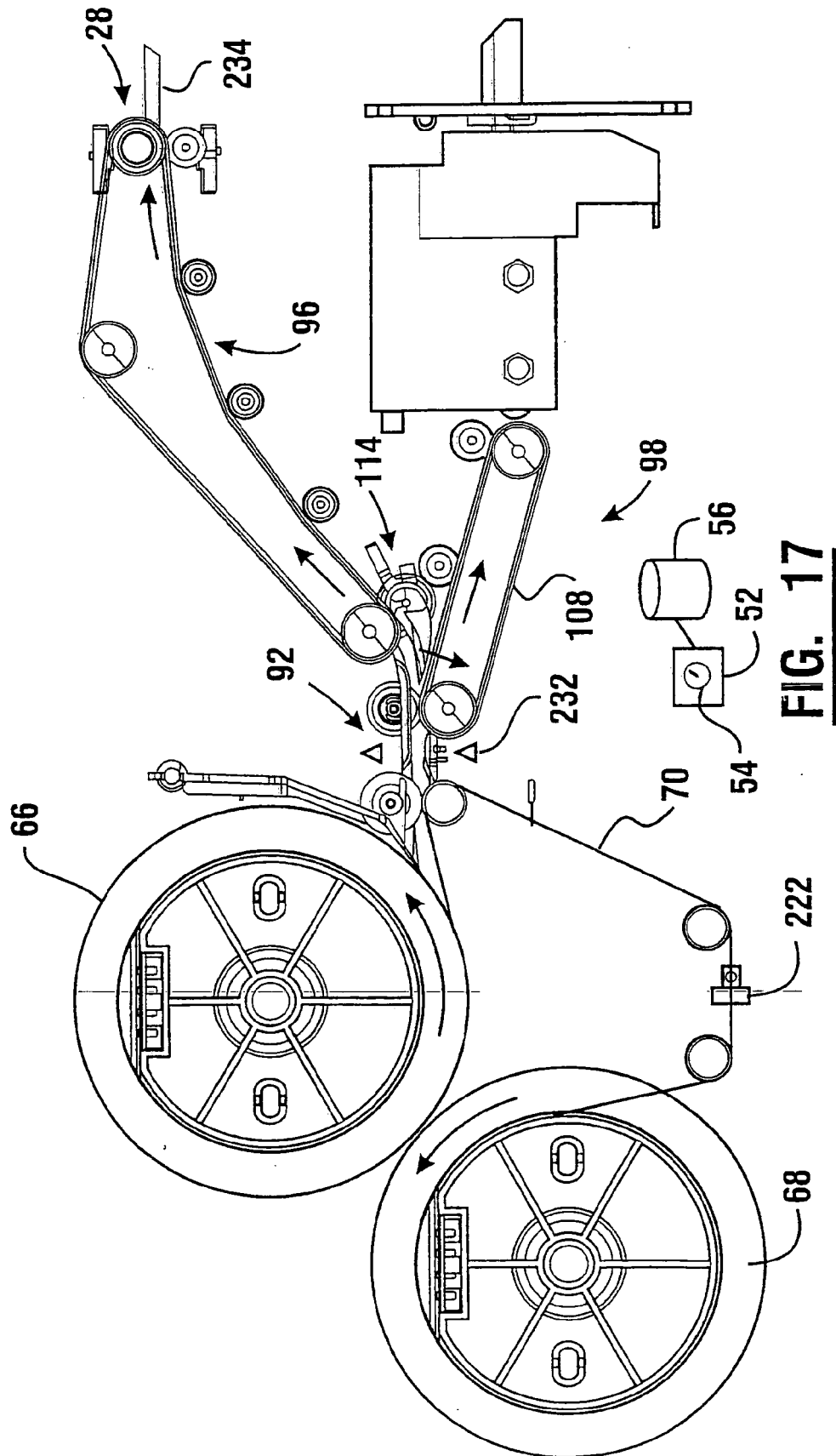


FIG. 16



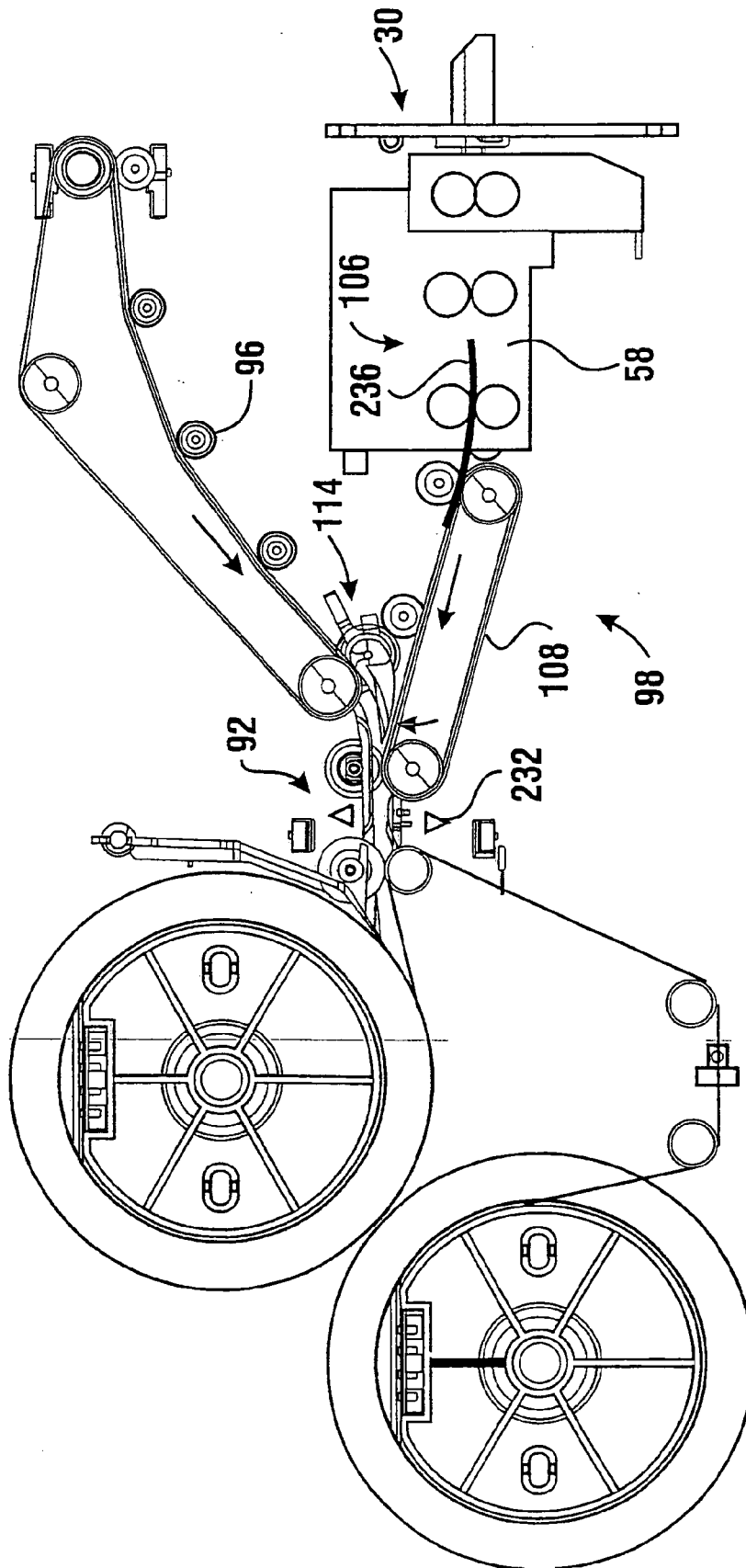


FIG. 18

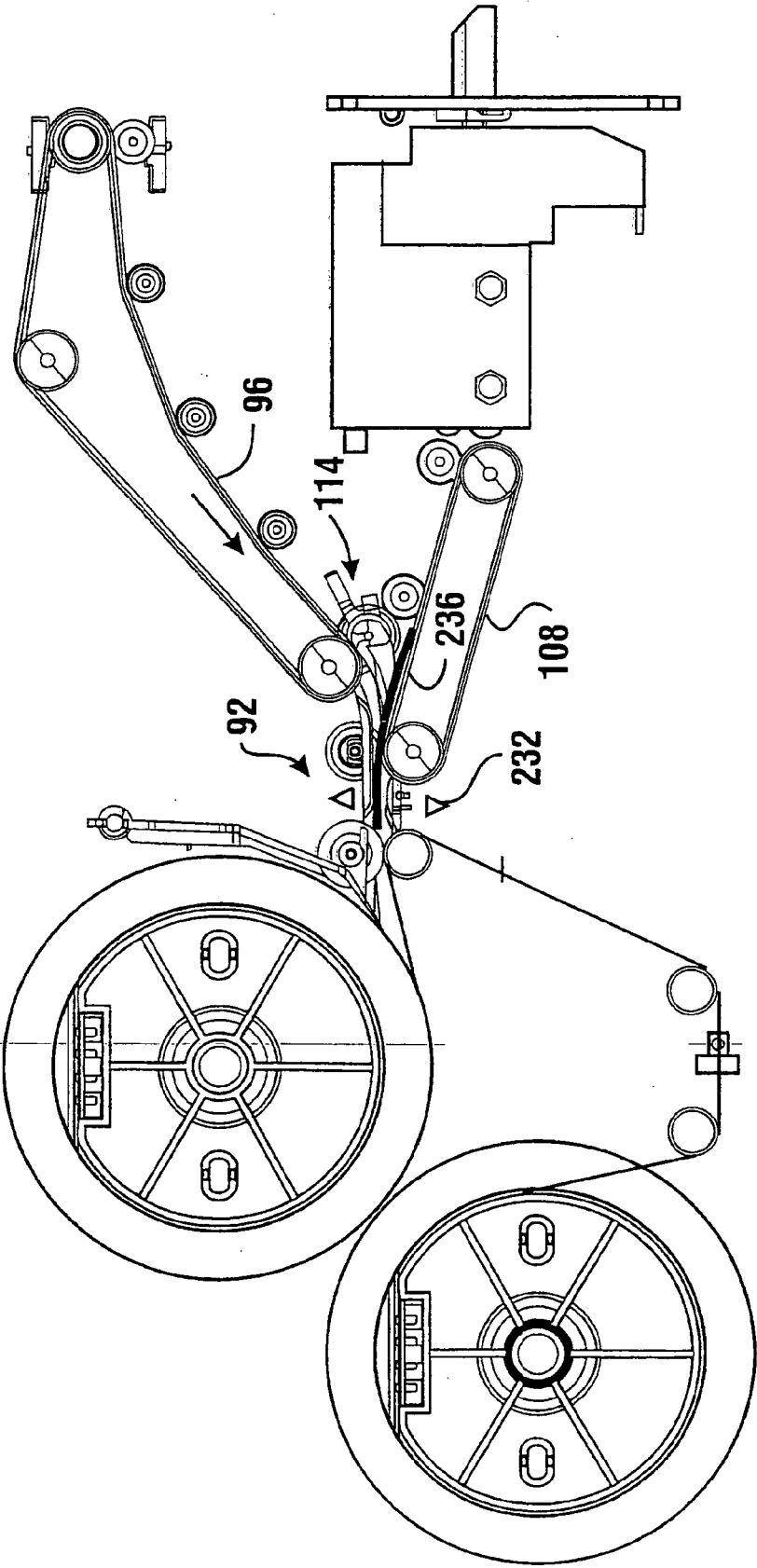


FIG. 19

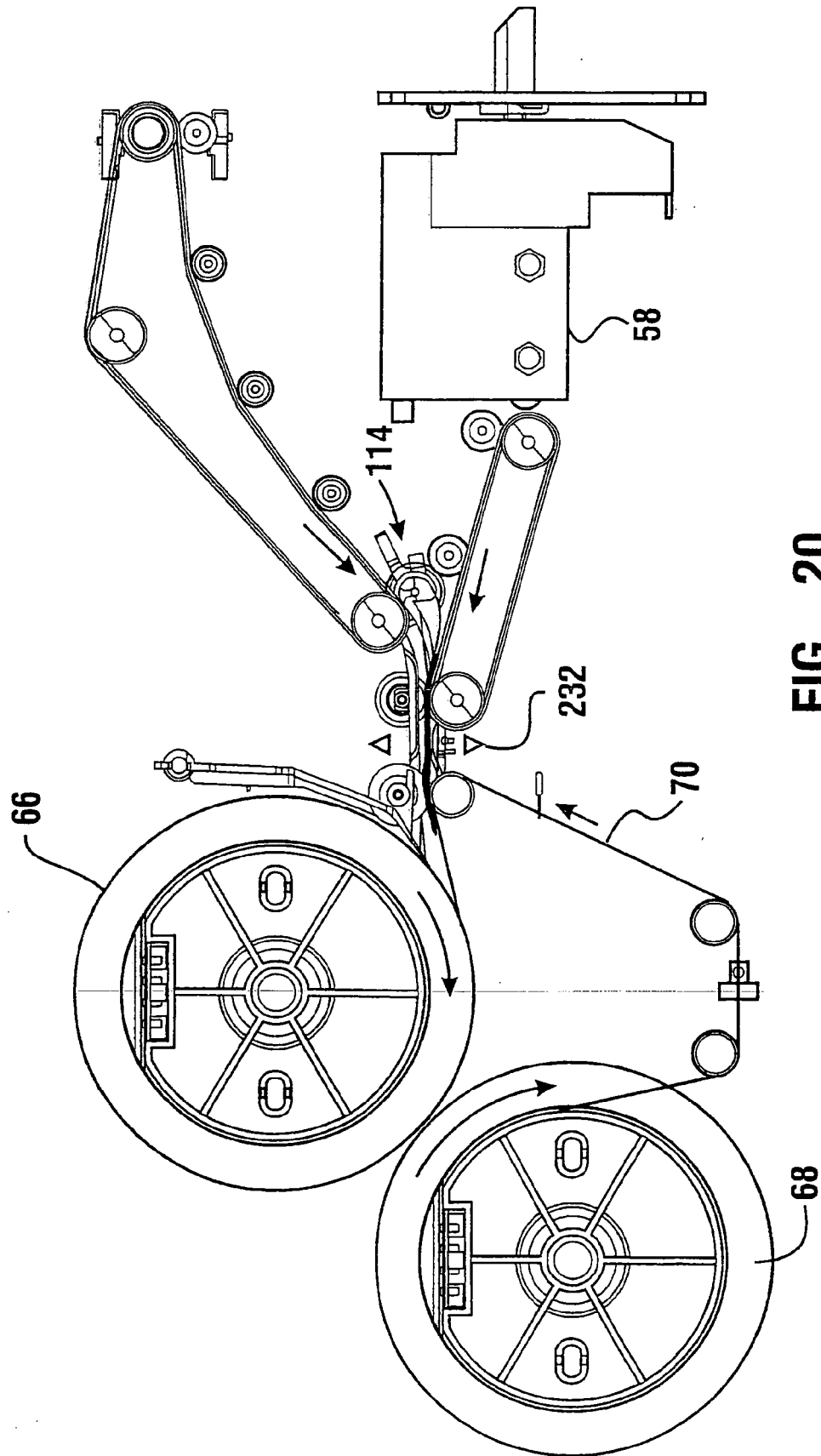


FIG. 20

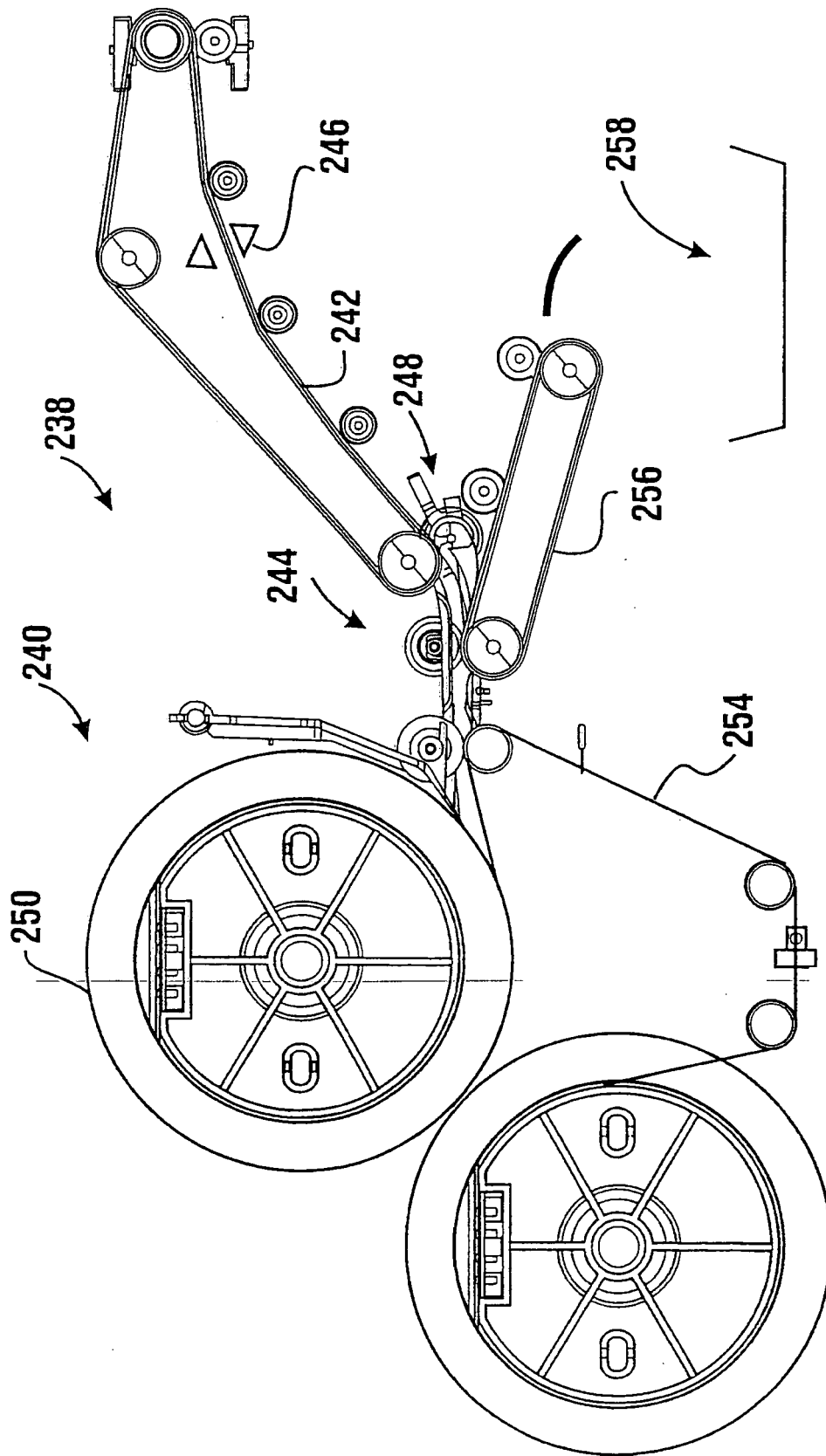
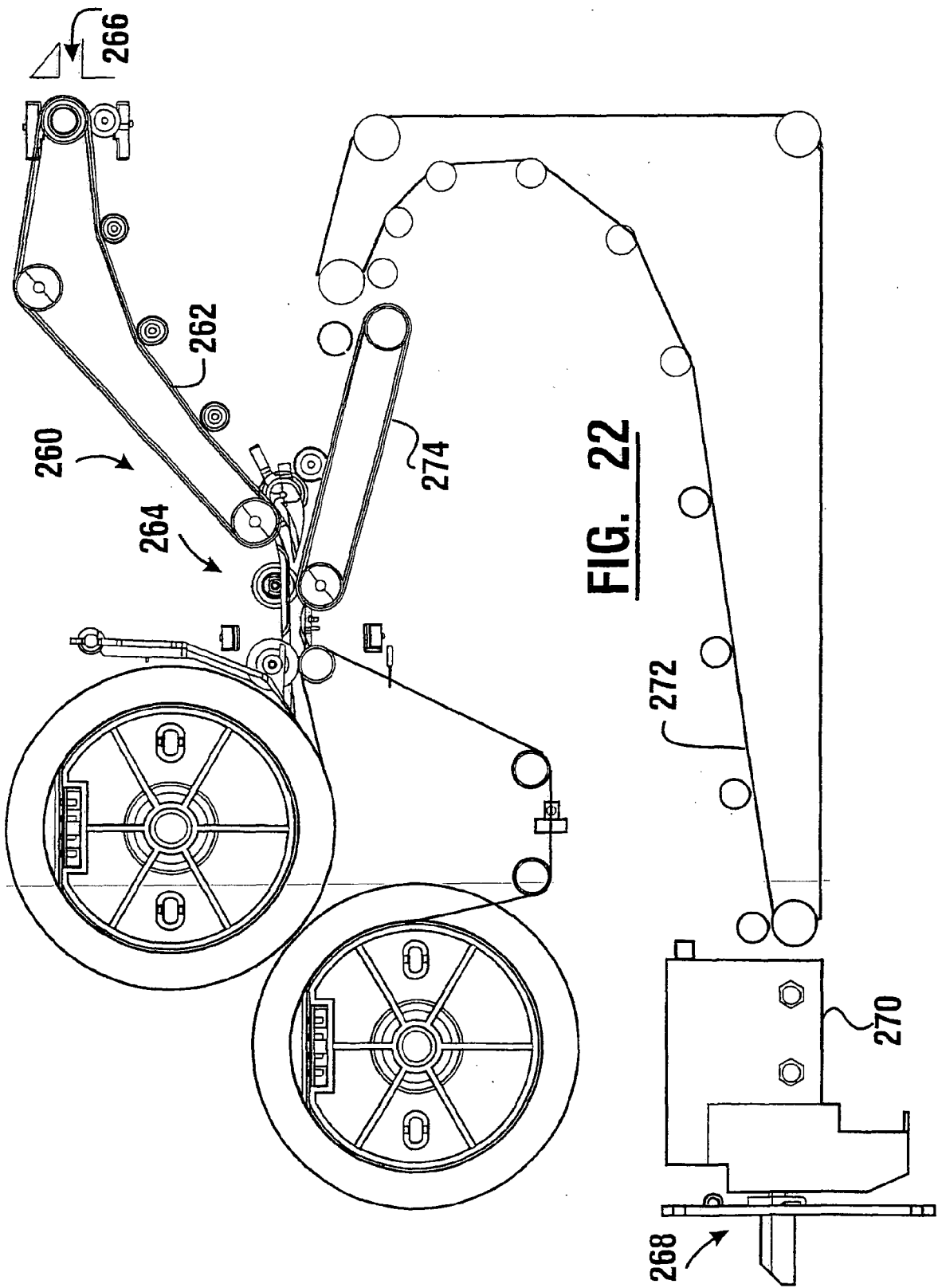


FIG. 21



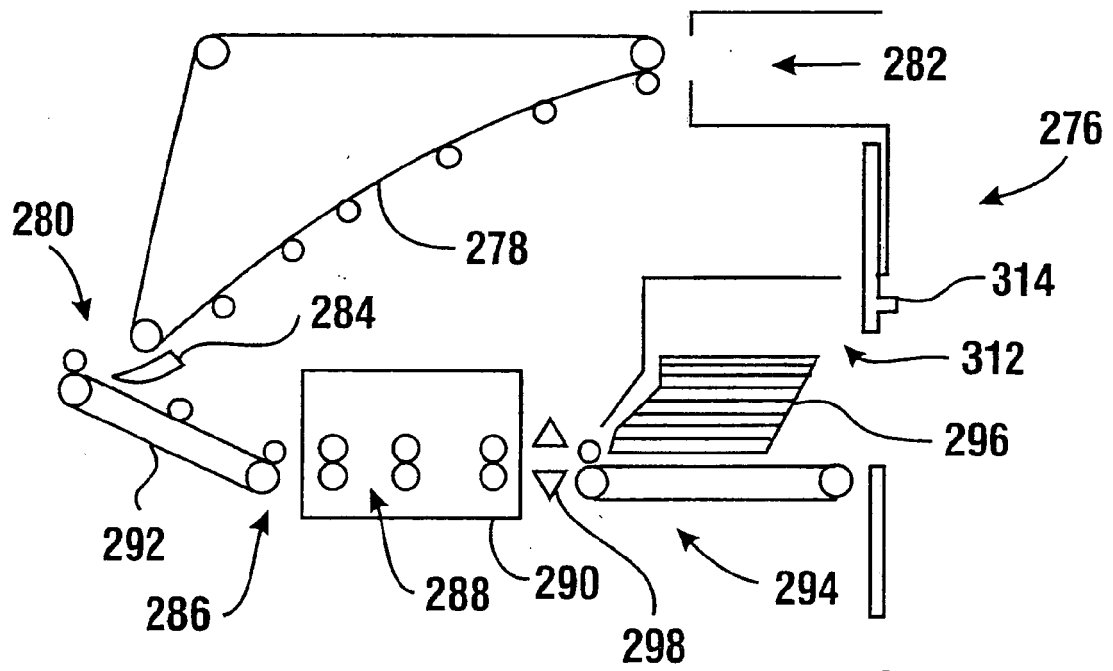


FIG. 23

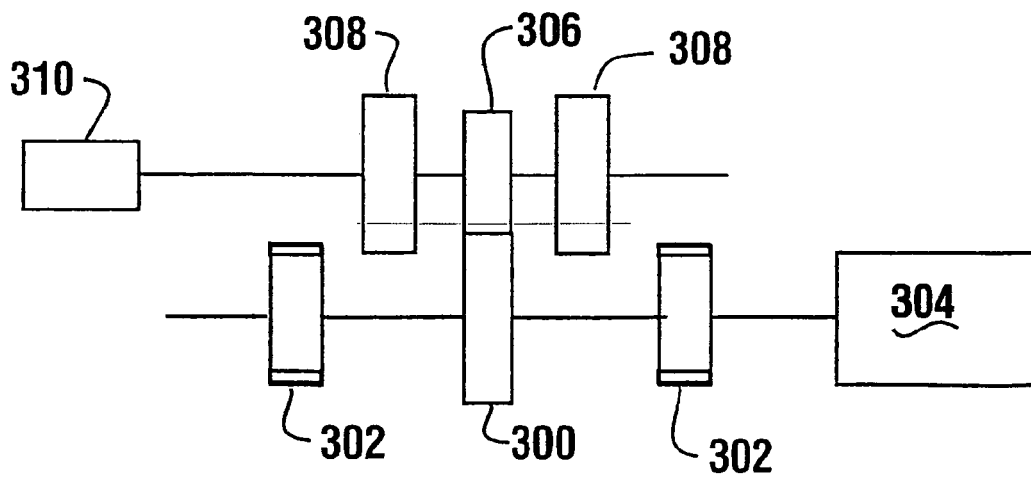
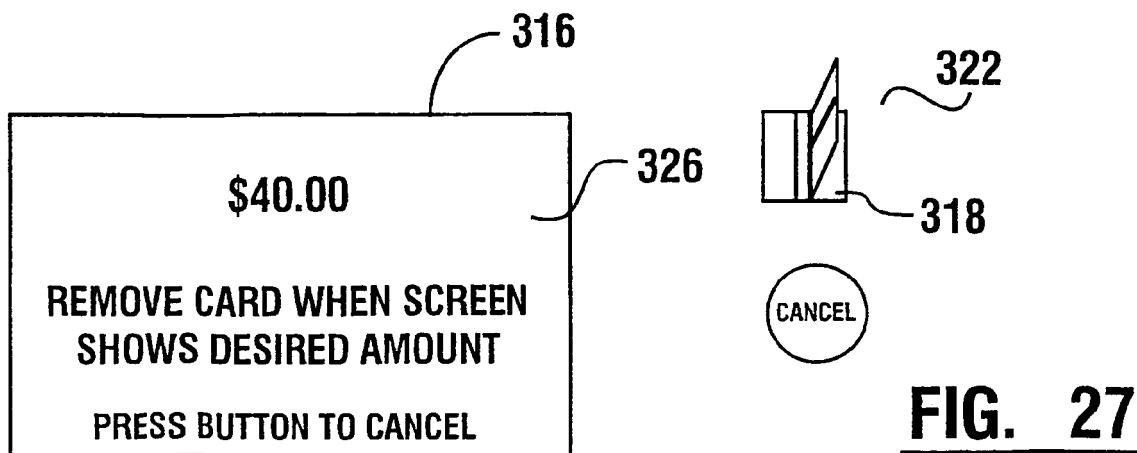
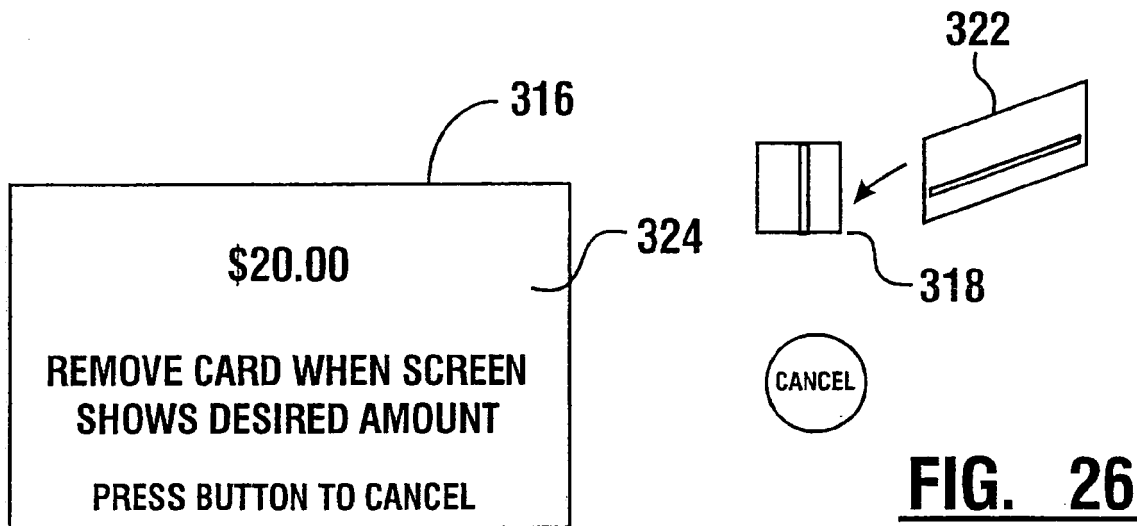
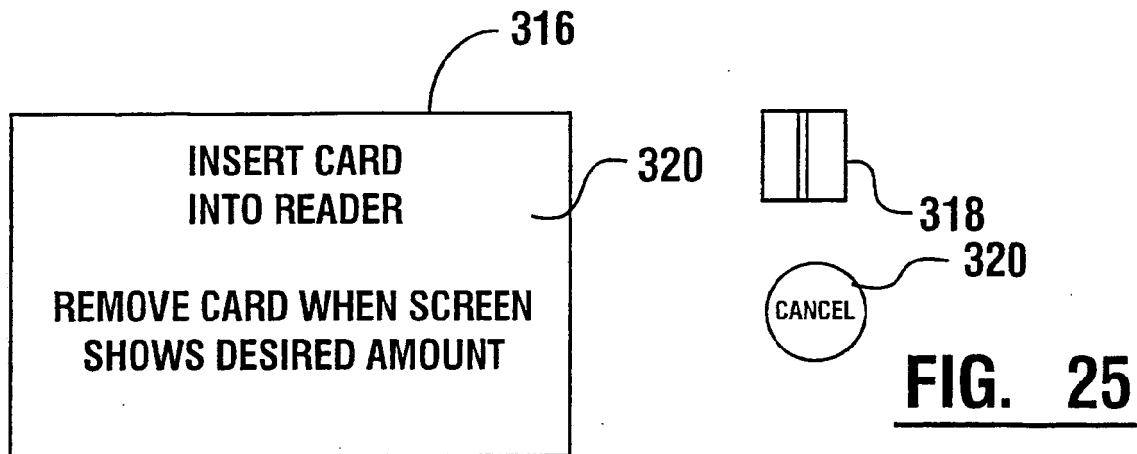


FIG. 24



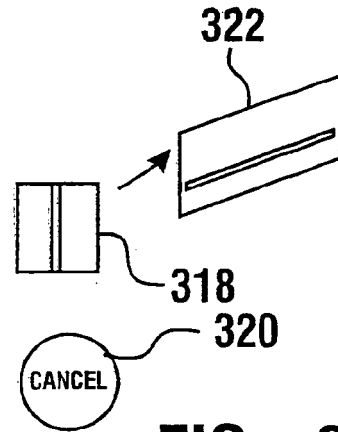
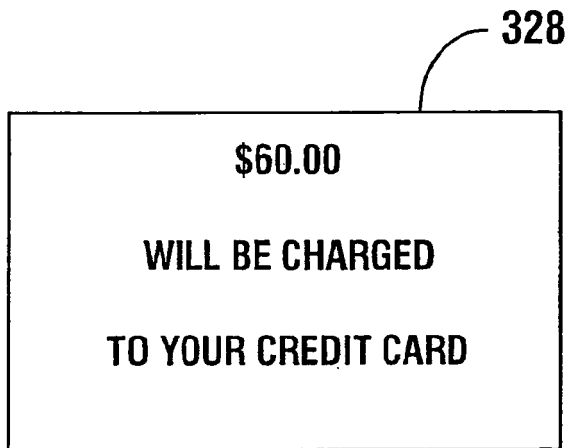


FIG. 28

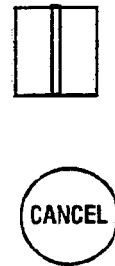
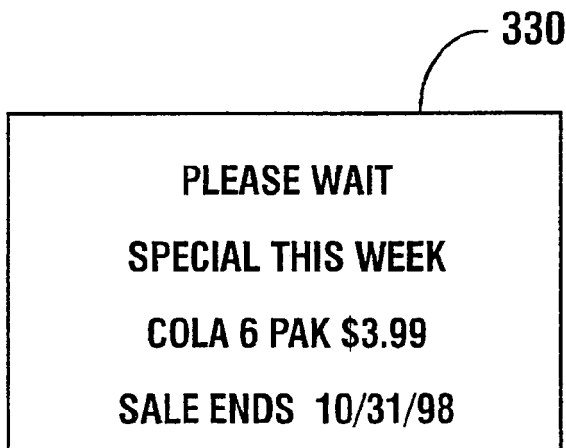


FIG. 29

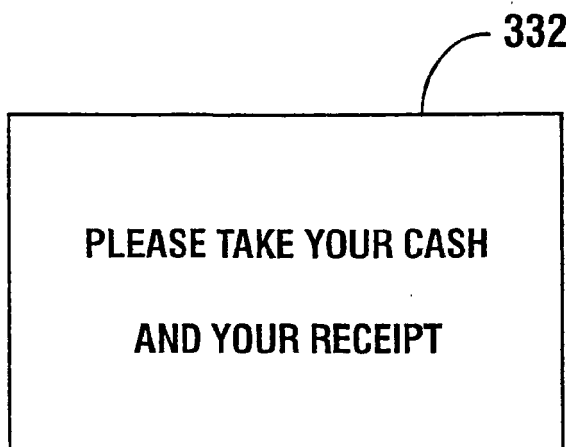


FIG. 30

REFERENCES CITED IN THE DESCRIPTION

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- US 749260 A [0108]