

June 3, 1969

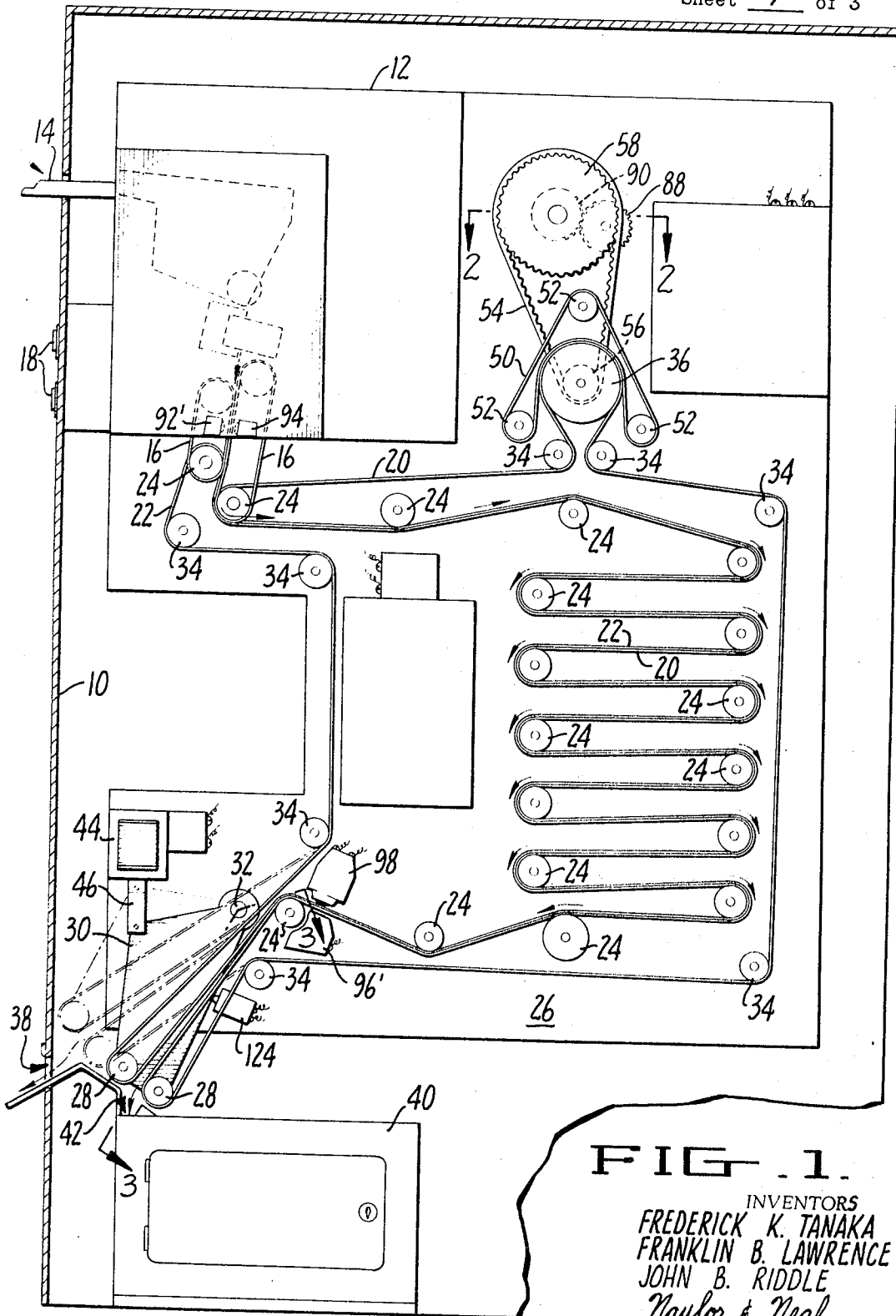
F. K. TANAKA ET AL

3,447,655

BILL VALIDATOR WITH ESCROW DEVICE

Filed Sept. 22, 1967

Sheet 1 of 3



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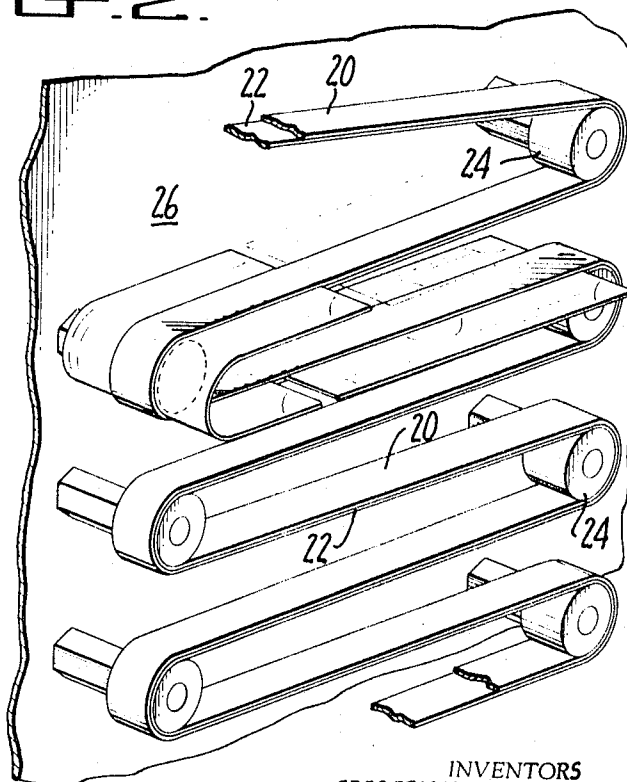
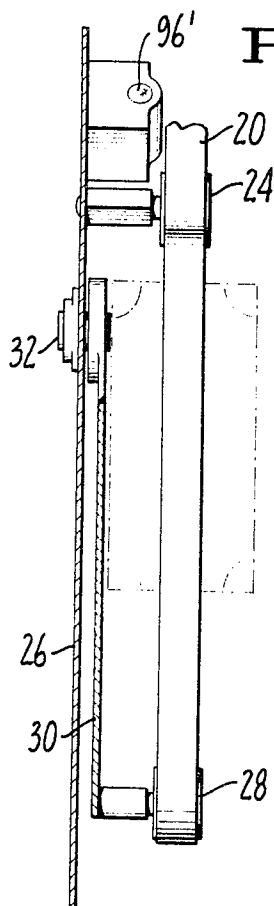
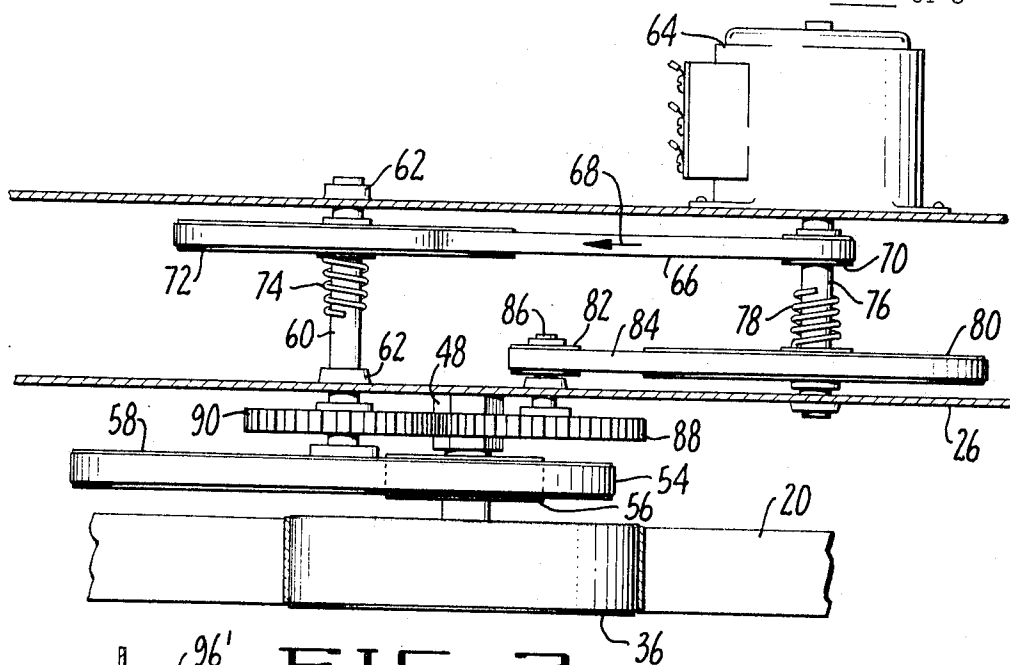
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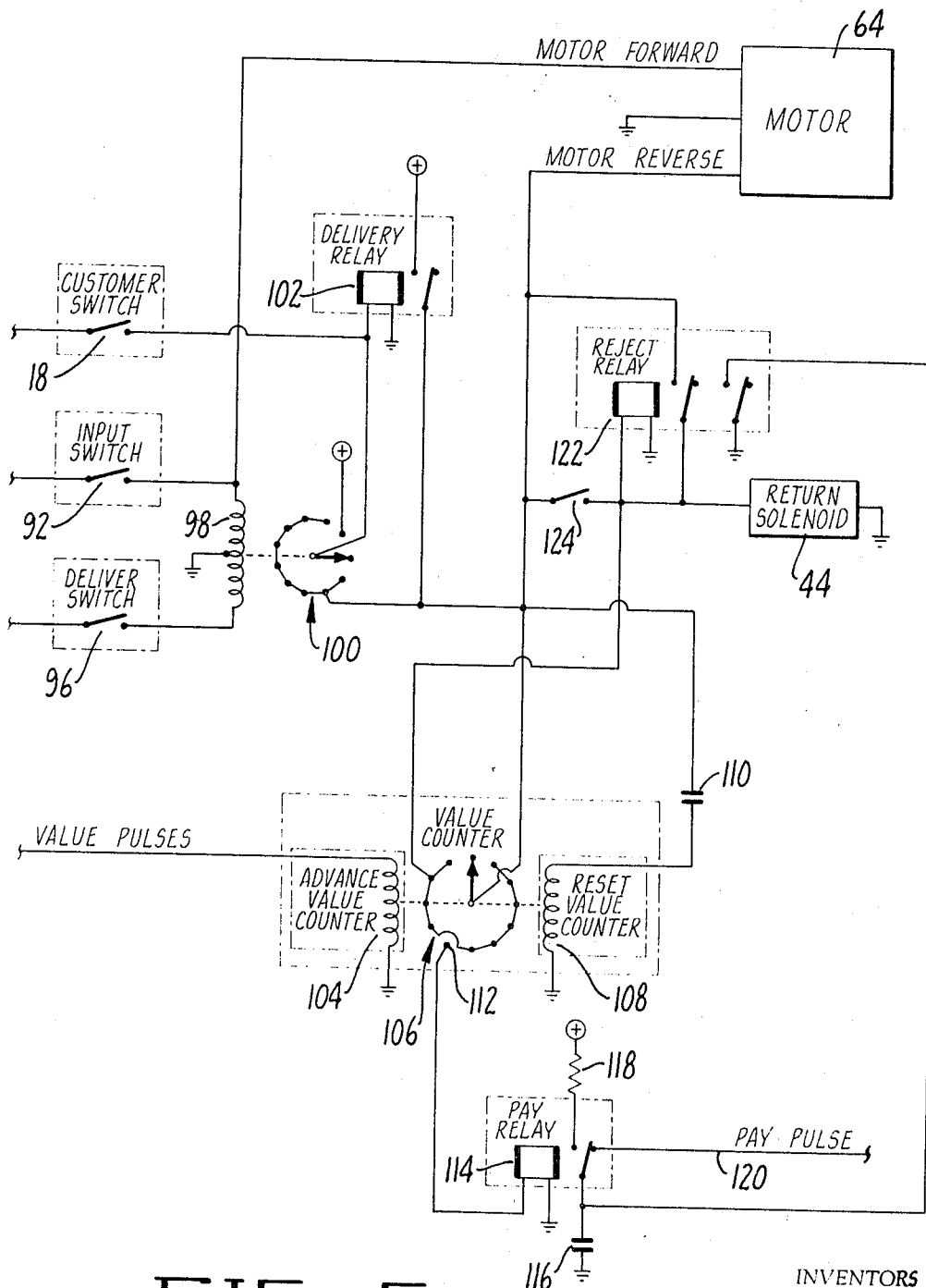


FIG. 5.

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3,447,655

BILL VALIDATOR WITH ESCROW DEVICE

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10 Claims

ABSTRACT OF THE DISCLOSURE

An improved escrow device for currency validators which includes the following features: (a) means for shifting the escrow discharge between a cash box and a bill return chute, (b) drive means for driving escrow belts at slow forward speed while taking in currency and at fast forward speed while discharging currency, (c) an improved drive of the above mentioned type in which slow and fast forward drive are effected by forward and reverse drive of a single motor through one-way clutches, and (d) means for clamping an escrow belt between an auxiliary belt and a drive capstan to prevent belt slippage.

Related applications

This application relates to improvements in the type of escrow device which forms the subject matter of an application of John B. Riddle and Robert B. McLaughlin for Bill Escrow Device, executed Aug. 28, 1967, and filed on or about Sept. 1, 1967. The escrow device of the present application may be used with currency validators of a variety of types, for instance the validator shown in U.S. Patent No. 3,256,968, granted to Micro-Magnetic Industries as the assignee of John B. Riddle and Robert B. McLaughlin.

Brief summary

Dollar bill validators such as those disclosed in the above mentioned patent include delivery means for delivering a bill from a validating station to a delivery station with recognizing means mounted at the validating station for determining that a bill tested by the validator is a valid piece of currency and generating a validating signal for each bill delivered by the delivery means. Where the validator is designed for recognizing bills of more than one denomination, the bills are generally delivered along the same path by the same delivery means, but different validating signals are generated for valid bills of different denomination.

When bill validators are used in automatic vending machines, it is frequently desirable to employ with the validator an escrow device which receives and holds bills, delivered by the validator for a period of time to permit a user of the vending machine to select a purchase which he desires. The vending machine thus includes a user controlled switch for selecting the purchase or returning his money, and operation of the user controlled switch restarts the escrow device so that the money previously held in escrow is taken by the vending machine and a product dispensed by the vending machine.

The above mentioned application discloses a particular type of escrow device in which validated bills are held in escrow by holding the bills between two endless belts which have a common run arranged in a serpentine path through the escrow device. At the input end of the common run of the belts, validated bills may be received from the validator or returned to the validator, and at the discharge end of the common run of the belts, the validated bills are discharged into a strongbox. The escrow

device of the above identified application also includes sorting means whereby five dollar bills accepted by the validator are diverted, and only one dollar bills are accumulated in the escrow device so that the most recently validated one dollar bills may be given out in change for a validated five dollar bill. While such sorting arrangements may be used in accordance with this invention, the preferred form of this invention described below does not include such a sorting arrangement.

While the escrow device shown in the above mentioned application has many advantages and features which are incorporated in the escrow device of this invention, the escrow device of this invention provides specific improvements which facilitate the use of the escrow device in vending machines which are employed to vend relatively high valued products such as monthly transportation tickets, the payment for which requires a substantial number of pieces of currency.

This escrow device supports validated bills between two endless belts arranged in a serpentine path with the length of the bill accumulating path sufficiently great to accommodate between about 5 and 25 bills. A new drive arrangement is provided for the escrow belts to prevent slippage of the belts even with the extremely long escrow paths of the belts and to provide two speed operation of the escrow belts. Thus, during the time when a validated bill is being delivered to the escrow belts by the currency validator, the escrow belts cannot run substantially faster than the delivery means of the validator. For this reason, a speed limit is set on the transport speed of the escrow belts, and where the escrow belts are employed to support a large number of bills previously validated, the discharge of those bills from the escrow belts would require substantially as much time as was involved in validation of the bills if the escrow belts were always driven at the same speed. The escrow device shown in this application provides a slow speed drive for the escrow belt during the period when bills are being accepted from the validator and a very high speed drive for the escrow belts during the period when the escrow device is restarted to either return the bills to a customer or deposit the bills in a cash box.

Additionally, the structural arrangement employed in the escrow device of this invention obtains this two speed forward drive of the escrow belts by driving the belts with a single reversible motor through overriding clutches. It should be noted that it is preferable in the escrow device of this invention that the escrow belts be driven in a forward direction during receipt of bills from the validator, during delivery of the bills to the strongbox, and during return of the bills to the customer; the provision of high speed drive of such an escrow device to return bills to the customer through the validator itself involves certain disadvantages because of the high speed movement of bills through the delicate mechanism of the validator.

The escrow device of this invention provides a novel arrangement for selectively discharging escrow bills to either a customer return chute or a strong box where selective control is effected by bodily moving a pair of rollers over which the escrow belts are entrained to change the location of the path of escrowed bills.

The device of this invention also includes control means for counting the number of bills which have been validated by the validator and the total value of those bills so that the total value must equal a predetermined amount before an article to be sold will be dispensed by the vending machine. Additionally, the escrow device includes counting means for counting down from the number of bills accumulated in escrow to determine that all of those bills have been either returned to the customer or deposited in the cash box.

Other features and advantages of the invention will become apparent from the following description read in conjunction with the attached drawings in which:

Drawings

FIG. 1 is a side elevational view of a portion of a vending machine cabinet which incorporates a currency validator and one form of escrow device constructed in accordance with the principles of this invention;

FIG. 2 is a horizontal cross-sectional view of the apparatus of FIG. 1 taken on the plane indicated at 2—2 in FIG. 1;

FIG. 3 is a sectional view taken along the bifurcated plane indicated at 3—3 in FIG. 1;

FIG. 4 is a perspective view of a portion of the serpentine path of escrow belts illustrating the manner of support of validated bills between the escrow belts, and;

FIG. 5 is a schematic circuit diagram of electrical control elements which may be used for controlling the apparatus of FIGS. 1-4. FIG. 5 shows a circuit controlled primarily by electro-mechanical elements, but as will be obvious to those skilled in the art, solid state circuit components may be employed.

Detailed description

Referring now in detail to the drawings and particularly to FIGS. 1-4, the structure illustrated therein includes a housing 10 supporting a currency validator 12 which has an input tray 14 in which the customer may deposit currency to be validated and a pair of delivery belts 16 between which validated bills are delivered by the validator. As explained hereinafter, the validator also contains one or more electrical output lines for delivering validating signals indicative of the value of a piece of currency delivered by the validator. The cabinet 10 also supports a pair of user control switches 18 by which a user may select a purchase to be made with currency he has deposited in the machine.

Bills which are delivered by the validator delivery belt 16 are gripped between a pair of endless rubber belts 20 and 22 which have a common run extending in a serpentine path over a plurality of rollers 24 which are supported on an interior partition 26 of the cabinet 10. The common run of the belts 20 and 22 ends at a pair of rollers 28 which are supported on a plate 30 which is in turn pivotally supported on the interior panel 26 by a pivot mounting 32. The return runs of the belts 20 and 22 are entrained over idler rollers 34 and a drive capstan 36.

The cabinet 10 has a bill return chute 38 in its front panel and a strongbox 40 securely mounted within the cabinet with an input opening 42 for receiving bills from the escrow belts. A solenoid actuator 44 is connected by a link 46 to the pivot plate 30 to swing the pivot plate from its solid line position where it discharges bills into the cash box into its phantom line position of FIG. 1 where it returns bills to a customer.

Drive train

As indicated above, the endless belts 20 and 22 are driven through their common run by rotation of the rotary capstan 36 which is mounted in a bearing 48 on the interior panel 26 (see FIG. 2). The portion of the belt 20 which engages the periphery of the capstan 36 is held on the capstan 36 by an auxiliary belt 50 entrained over three idler rollers 52 as illustrated in FIG. 1. The belt and rollers 50 and 52 are omitted from FIG. 2 for clarity of illustration. The drive capstan 36 is rotated by a drive belt 44 which is entrained over a notched pulley 56 on the shaft of capstan 36 and a notched pulley 58 which is mounted on a shaft 60 which is in turn mounted for rotation in bearings 62 attached to the cabinet 10 (FIG. 2).

The drive shaft 60 may be rotated at two different speeds by a reversible motor 64. When the motor 64 is operated in its forward mode, it drives a belt 66 in the direction of arrow 68 by means of a pulley 70, and the belt

66 drives the drive shaft 60 by means of a pulley 72 and a one-way friction clutch 74 mounted on the shaft 60. As indicated by the relative diameters of the pulleys 70 and 72, the drive shaft 60 turns over at a substantially slower speed than the motor shaft 76 when the motor is operating its forward mode.

The drive shaft 60 may be driven in the same direction at a higher speed than the motor shaft when the motor is operated in reverse, and in that situation, the motor shaft 76 drives a frictional one-way clutch 78 which is attached to a pulley 80 which drives a pulley 82 by means of a belt 84, and the pulley 82 rotates a shaft 86 which drives the shaft 60 by means of a pair of reversing gears 88 and 90 mounted on the shafts 86 and 60 respectively.

Thus, when the motor 64 is operated in its forward mode, the belts 20 and 22 are driven through the serpentine common run in the direction indicated by the arrows in FIG. 1, and the belts move at a slow speed comparable to the speed of the delivery belts 16 of the bill validator. When the motor 64 is driven in reverse, the belts 20 and 22 are driven in the same direction but at a much greater speed so that any bills held in escrow by the belts are rapidly delivered to either the cash box 40 or the return chute 38 depending upon the operation of the solenoid 44.

Control elements

With reference to FIG. 5, a number of control elements are employed to control operation of the apparatus of FIGS. 1-4. Thus, an input switch 92 is provided at the upstream end of the common run of belts 20 and 22. The input switch is illustrated in FIG. 5 as a simple mechanical switch, but it is preferably provided in the form of a photodetector 92' in FIG. 1 illuminated by a light source 94.

Similarly, a delivery switch 96 is mounted adjacent to the delivery ends of the common run of the belts and is preferably provided in the form of a photodetector 96' containing a photoresistor illuminated by a light source 98 (see FIGS. 1 and 3).

The input and delivery switches 92 and 96 are connected to the opposite ends of a center grounded coil 98 which operates the arm of a stepper switch 100. Each time the input switch 92 cycles on and off, the arm of counter 100 is advanced one step to count up the number of bills accumulated in the escrow device, and each time the delivery switch 96 is cycled on and off, the arm of stepper switch 100 is moved back one unit to count the number of bills delivered by the escrow device.

The zero contact of counter 100 interrupts any electrical circuit through the counter. The final contact of the counter is connected to a positive source of voltage to energize a delivery relay which, when energized, applies power to the reverse terminal of the motor 64 to drive the motor 64 in reverse and empty the escrow belts at high speed thereby preventing overfilling of the escrow path.

The delivery relay 102 may also be energized when the customer actuated switch 18 is closed. When the delivery relay is thus energized, it will remain energized through its own arm switch and through counter 100 until counter 100 counts down to zero from the number of bills which have been accumulated in the escrow device. Thus, when a customer selects a purchase by closing the switch 18, the delivery relay 102 will remain energized until the entire escrow device has been emptied at high speed by reverse operation of the motor, and the remainder of the circuitry of FIG. 5 will automatically determine whether the bills in the escrow device are returned to the customer, or in the alternative, are deposited in the cash box while an article of merchandise is returned to the customer.

As indicated above, the validator 12 generates an electrical signal for each valid bill it delivers to the escrow device. Preferably, this validating signal is in the form of a series of pulses, the number of which is proportional to

the value of the bill received. These validating pulses are connected to the advancing coil 104 of a stepper switch counter 106 of the type which is provided with a reset coil 108. Each validating pulse applied to the coil 104 advances the arm of counter 106 from its zero position to accumulate a record of the value of the bills in the escrow device. As indicated hereinafter, this record is retained on the counter 106 until the conclusion of a cycle when a capacitor 110 discharges to apply voltage of proper polarity through coil 108 to reset the counter 106 to zero.

A predetermined terminal 112 of the counter 106 is selected corresponding to the value of money which must be present in the escrow device as payment for an article to be delivered, and this terminal 112 is connected to the coil of a pay relay 114. Thus, if at the time the delivery relay 102 is first energized, the counter 106 has counted the proper value of money in the escrow device, the pay relay 114 will be energized to charge capacitor 116 through lead relay 118, and when the delivery relay 102 is deenergized after the escrow device is emptied, the pay relay 114 will be energized to charge capacitor 116 through lead relay 118, and when the delivery relay 102 is deenergized after the escrow device is emptied, capacitor 116 is delivered as a pay-out pulse on line 120 which may be connected to any suitable operator for dispensing an article stored in the vending machine. As indicated in FIG. 5, all of the terminals of counter 106 except for the zero terminal and the terminal 112 are wired together and connected to the coil of a reject relay 122. Thus, in the event that the counter has not counted to proper value at the time the user controlled switch 18 is operated, the reject relay 122 is energized and will remain energized through its own switch-on until the counter 100 counts down to zero and the delivery relay 102 is again deenergized. At any time that the reject relay 122 is energized, it energizes the return solenoid 44 to swing the delivery end of the escrow belts to the phantom line position that is illustrated in FIG. 1. Thus, when the user has not deposited the proper amount of money for the purchase he selects, the return solenoid 44 is operated and the entire contents of the escrow device are returned to the customer.

A safety limit switch 124 is mounted adjacent to the pivot plate 30 at the discharge end of the escrow belts with the switch 124 positioned to be open only when the structural parts of the apparatus are in the position illustrated in full-line in FIG. 1. In the event that a user of the machine attempts to tamper with the delivery end of the escrow device to recover his money while it is supposedly being delivered to the cash box, the switch 124 closes energizing the reject relay 22 so that any additional bills left in the escrow device will be returned to the person who seeks them. At any time that the reject relay operates, the capacitor 116 from which a pay pulse must come is grounded through the arm contacts of the reject relay preventing the machine from paying out value.

As indicated in FIG. 5, the input switch 92 is connected to not only pulse the counter 100 but also is connected to be the forward terminal of motor 64 so that the escrow belts are driven forward at slow speed at any time that a bill is delivered by the validator.

While one specific embodiment of the invention has been illustrated and described in detail herein, it is obvious that many modifications hereof may be made without departing from the spirit and scope of the invention.

We claim:

1. In a bill validator having delivery means for delivering an accepted bill along a predetermined path, recognizing means for generating a validating signal when a valid bill is delivered by said delivery means and an escrow device comprising a pair of endless belts having the majority of their lengths positioned adjacent to each other and forming a common belt run which has a length equal to between four and twenty-five times the length of bills to be held thereby with a minority of the length

of each belt forming a return run extending from one end of said common run back to the other end of said common run, a plurality of rollers supporting said belts and including rollers supporting said common run of said belts under tension in a serpentine path whereby bills positioned between said belts in said common run will be gripped by said belts and moved along said common run when said belts are moved, said rollers including entry rollers positioned at one end of said common run and exit rollers positioned at the other end of said common run with said entry and exit rollers supporting the ends of said common run and guiding said return runs of said belts into and out of said common run, means supporting said entry rollers adjacent to said delivery means for receiving bills from said delivery means and gripping said bills between said belts in said common run, means supporting said exit rollers remote from said delivery means for discharging bills from said common run, and drive means for at least one of said rollers for moving said common run along its length between said entry and exit rollers, the improvement comprising:

(A) bill collection means adjacent to said exit rollers for collecting and storing bills;

(B) bill return means adjacent to said exit rollers and spaced away from said bill collection means for returning bills to a user of the validator;

(C) shifting means for moving said means supporting said exit rollers from a first position for delivering bills to said collection means to a second position for delivering bills to said bill return means;

(D) control means for stopping said drive means after delivery of bills to said common run;

(E) a user controlled switch for selecting a purchase to be made with bills in said escrow device, and restarting said drive means, and;

(F) control means for selectively operating said shifting means when said drive means is restarted.

2. The apparatus of claim 1 in which said drive means for said escrow device includes means for driving said belts at two different speeds with one of said speeds substantially greater than the other speed and control means for operating said drive means at the slower speed as bills are delivered to said escrow device by said delivery means and for operating said drive means at said greater speed when said drive means is restarted by said user controlled switch.

3. The apparatus of claim 1 characterized further by the inclusion of a plurality of idler rollers adjacent to said roller which is driven by said drive means and a third endless belt entrained over said idler rollers and around a substantial portion of the periphery of said drive roller with at least one belt of said pair of belts held between said third belt and said drive roller.

4. The apparatus of claim 1 characterized further by the inclusion of counting means connected to said validator for counting the number of validating signals generated by said validator before operation of said user controlled switch, a detector mounted adjacent to said exit rollers for detecting bills leaving said common run with said detector connected to said counting means for decreasing the number accumulated on said counting means when a bill is detected by said detector, and control means connecting said counting means and said drive means for stopping said drive means when said counting means reaches zero after operation of said user controlled switch.

5. In a bill validator having delivery means for delivering an accepted bill, recognizing means for generating a validating signal for each bill delivered by said delivery means, and escrow means for temporarily holding bills delivered by said delivery means with said escrow means including at least one endless belt with a finite run thereof for engaging and holding said bills, the improvement comprising:

(A) first drive means connected to said belt for ad-

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vancing said belt in a predetermined direction and at a first speed;

(B) second drive means connected to said belt for advancing said belt in said predetermined direction and at a second speed substantially greater than said first speed, and;

(C) control means for alternatively operating said first drive means while bills are delivered by said delivery means and said second drive means after delivery of bills by said delivery means.

6. The apparatus of claim 5 in which said control means includes stop means for stopping operation of said first drive means after delivery of bills by said delivery means, at least one user controlled switch adapted to be operated after operation of said stop means, and means for operating said second drive means responsive to operation of said user controlled switch.

7. In a bill validator having delivery means for delivering an accepted bill, recognizing means for generating a validating signal for each bill delivered by said delivery means, and escrow means for temporarily holding bills delivered by said delivery means with said escrow means including at least one belt for engaging and holding said bills and a rotary member mounted in engagement with said belt for advancing said belt when said rotary member is rotated; the improvement comprising:

(A) first drive means connected to said rotary member for rotating said rotary member in a predetermined direction at a first speed;

(B) second drive means connected to said rotary member for rotating said rotary member in said predetermined direction at a second speed substantially greater than said first speed;

(C) a reversible electric motor;

(D) a first one-way clutch connecting said electric motor to said first drive means for driving said first drive means when said motor is running forward;

(E) a second one-way clutch connecting said electric motor to said second drive means for driving said second drive means when said motor is running in reverse, and;

(F) control means for running said motor forward while bills are delivered by said delivery means and running said motor in reverse after delivery of bills by said delivery means.

8. The apparatus of claim 7 in which said control

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means includes stop means for stopping forward operation of said motor after delivery of bills by said delivery means, at least one user controlled switch adapted to be operated after operation of said stop means, and circuit means for restarting said motor in reverse responsive to operation of said user controlled switch.

9. The apparatus of claim 8 characterized further by the inclusion of:

(A) a cash box adjacent to said belt for receiving bills from said belt;

(B) bill return means adjacent to said belt for returning bills from said belt to a customer;

(C) diverter means movable between first and second positions for diverting bills to said cash box and said return means respectively;

(D) return control means for holding said diverter means in said second position after operation of said user controlled switch, and;

(E) money accepting means for holding said diverter means in said first position after operation of said user controlled switch.

10. The apparatus of claim 5 characterized further by the inclusion of a security cash box and a bill return receptacle mounted adjacent to the discharge end of said belt when said belt is advanced in said predetermined direction with said security cash box and bill return receptacle spaced apart from each other and adapted to alternatively receive bills delivered by said belt, and support means including at least one roller engaging said belt at said discharge end thereof movably mounted for moving said belt laterally of its path between first and second discharge positions in which said belt is positioned to deliver bills from said belt to said security cash box and said bill return receptacle respectively.

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U.S. Cl. X.R.

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