

[54] MONEY-HANDLING DEVICE

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[51] Int. Cl. B65h 45/18

[58] Field of Search.....270/80-85, 61, 270/67; 221/36, 38, 40

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[57]

ABSTRACT

A paper money dispensing device stores bills in stacked relation, successively separates the lowermost bill from the stack of bills, and moves the separated bills to an area where they can be dispensed to a patron. That paper money dispensing device automatically senses when two bills stick together and are simultaneously separated from the stack of bills; and it moves those bills to a storage area for safe-keeping, and then separates further bills from the stack of bills and moves those further bills to the area where they can be dispensed to a patron. Where that paper money dispensing device is used to dispense a fixed number of bills, that paper money dispensing device separates the said number of bills from the stack of bills during each cycle of operation and then dispenses the separated bills at the start of the next-succeeding cycle of operation; thereby providing prompt dispensing of the bills to be dispensed during the next-succeeding cycle of operation. Where that paper money dispensing device is used to dispense variable numbers of bills, that paper money dispensing device separates the desired number of bills from the stack of bills and promptly dispenses the separated bills. That paper money dispensing device dispenses all of the bills of the desired number of bills at the same instant, and it folds those bills as they are dispensed; thereby minimizing the likelihood that a patron would inadvertently fail to take all of the bills due him.

21 Claims, 29 Drawing Figures

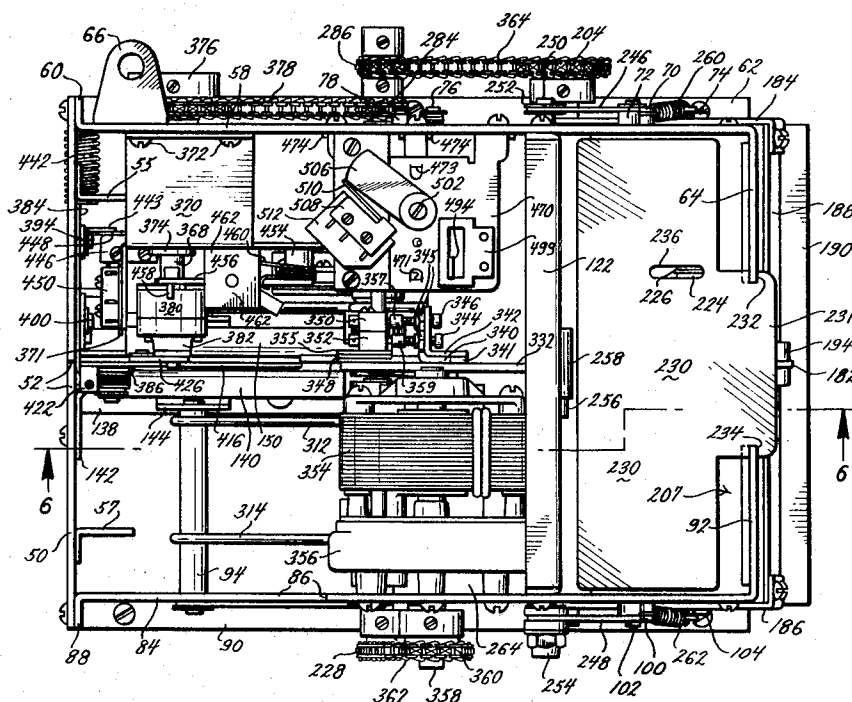
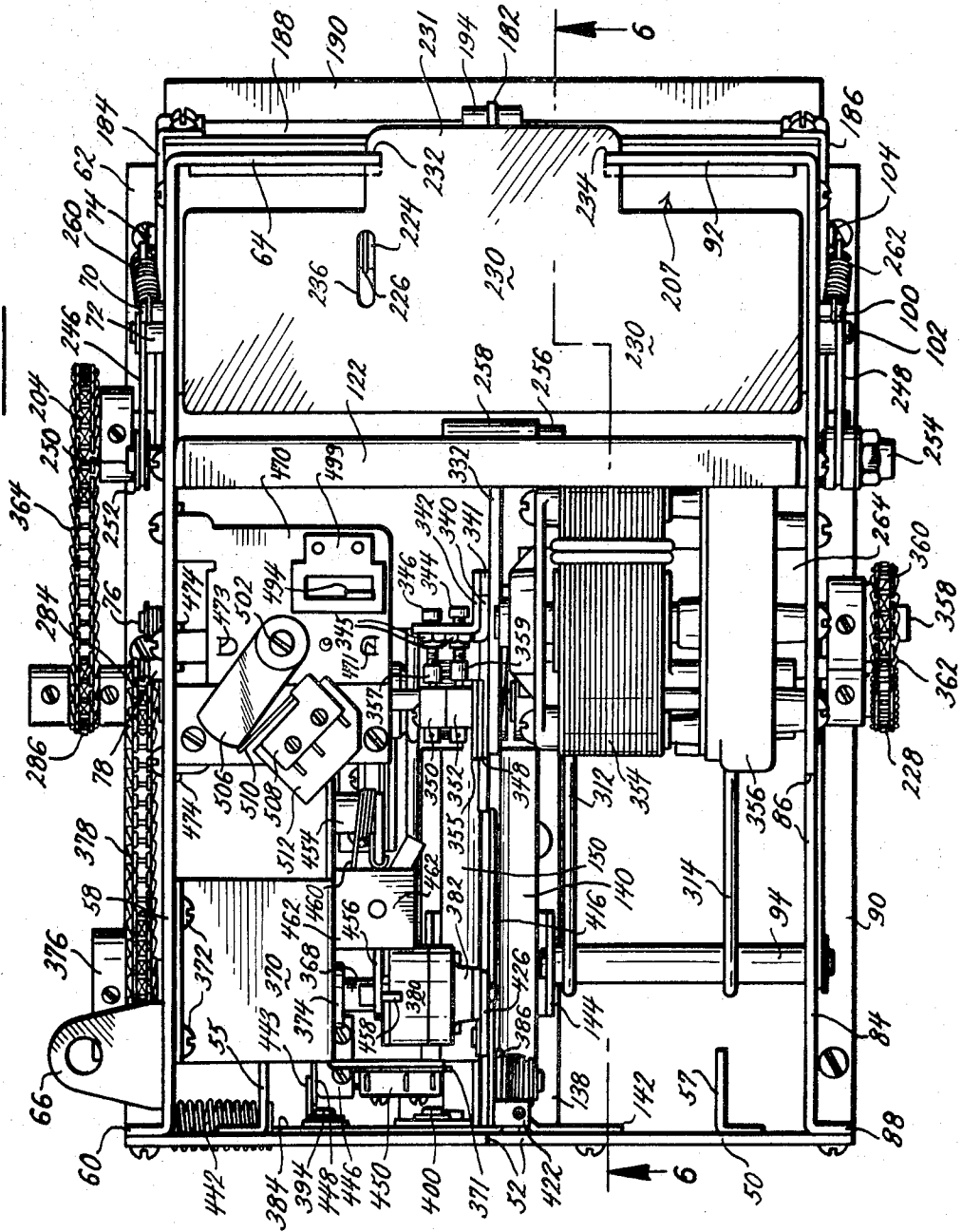
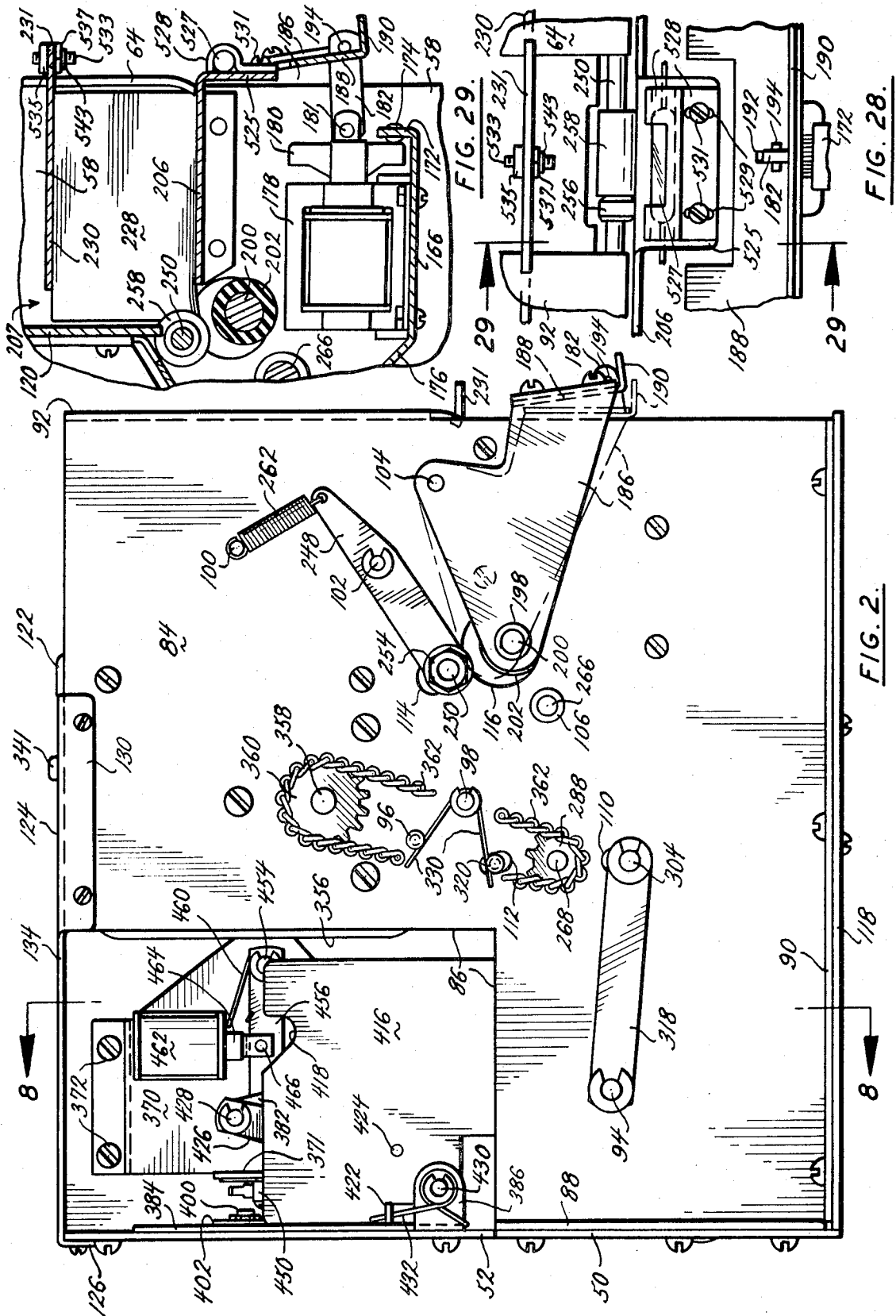
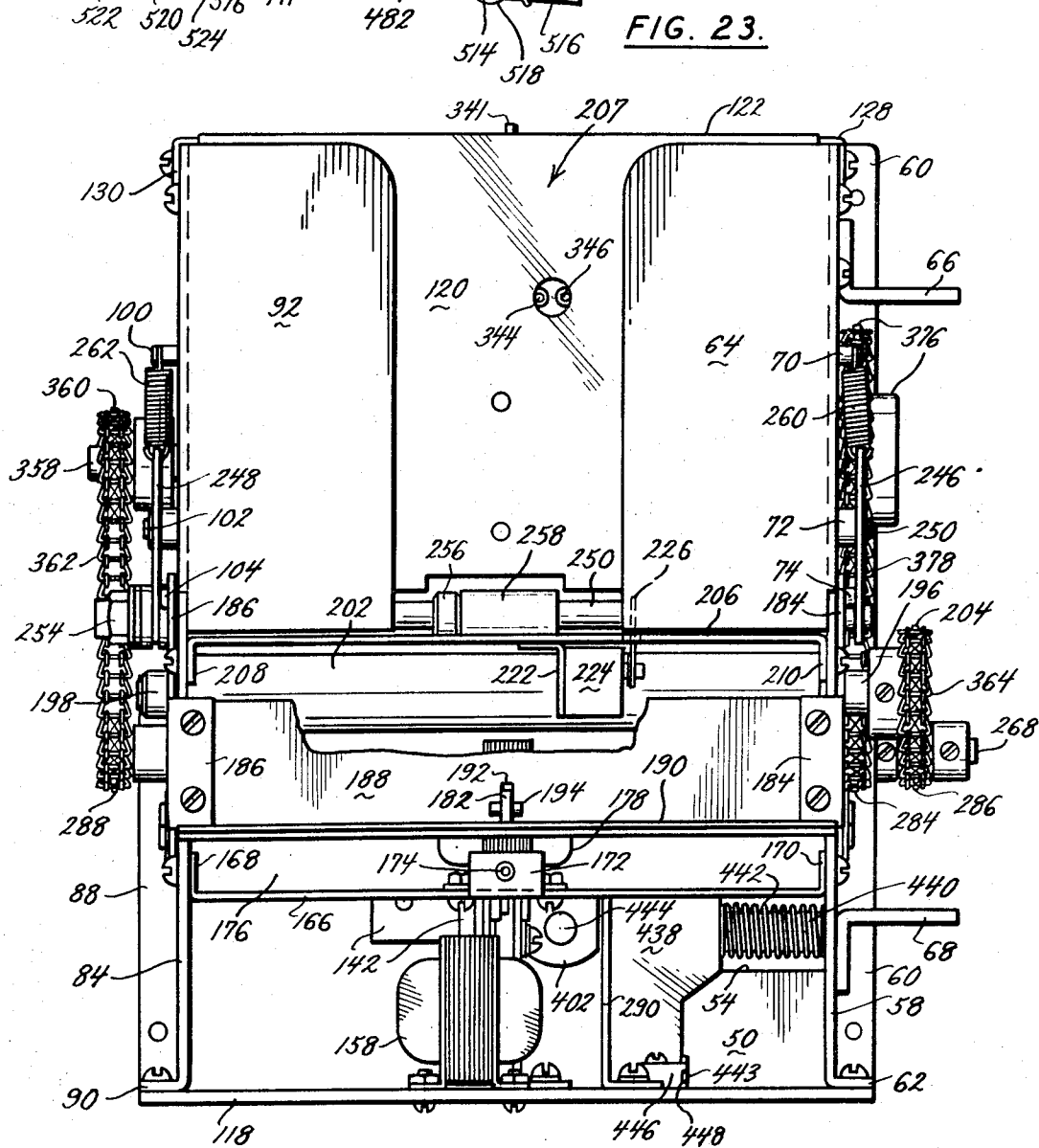
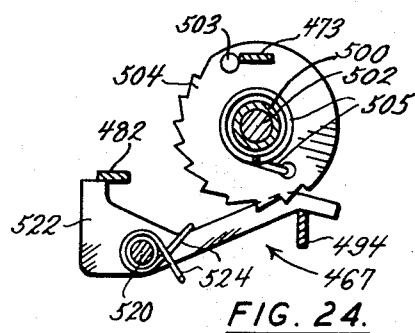
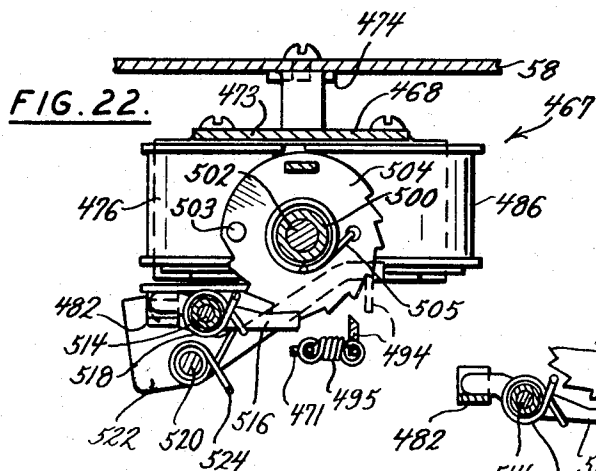


FIG. 1.







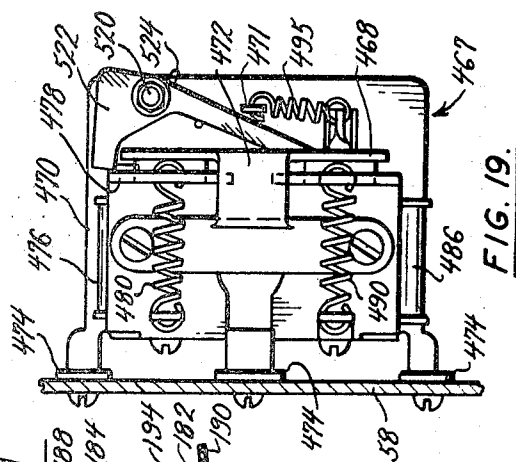
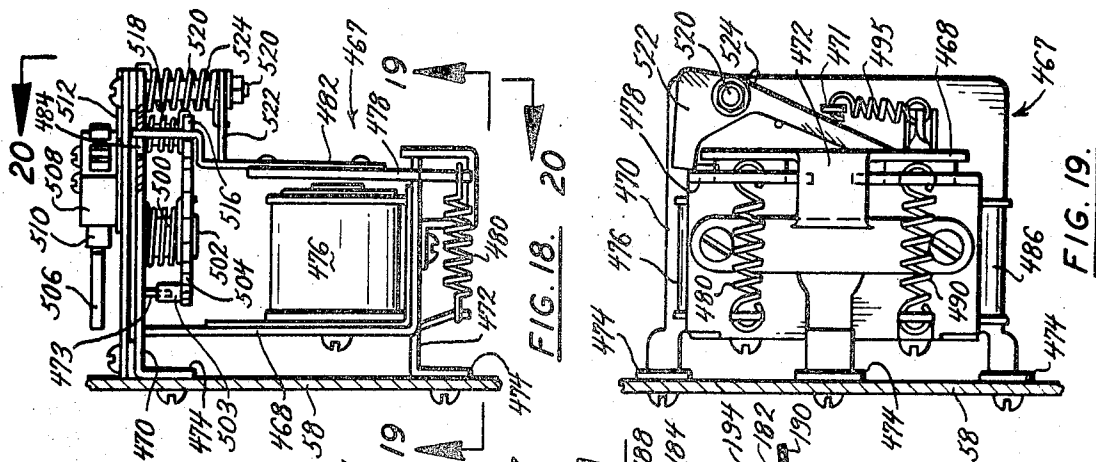
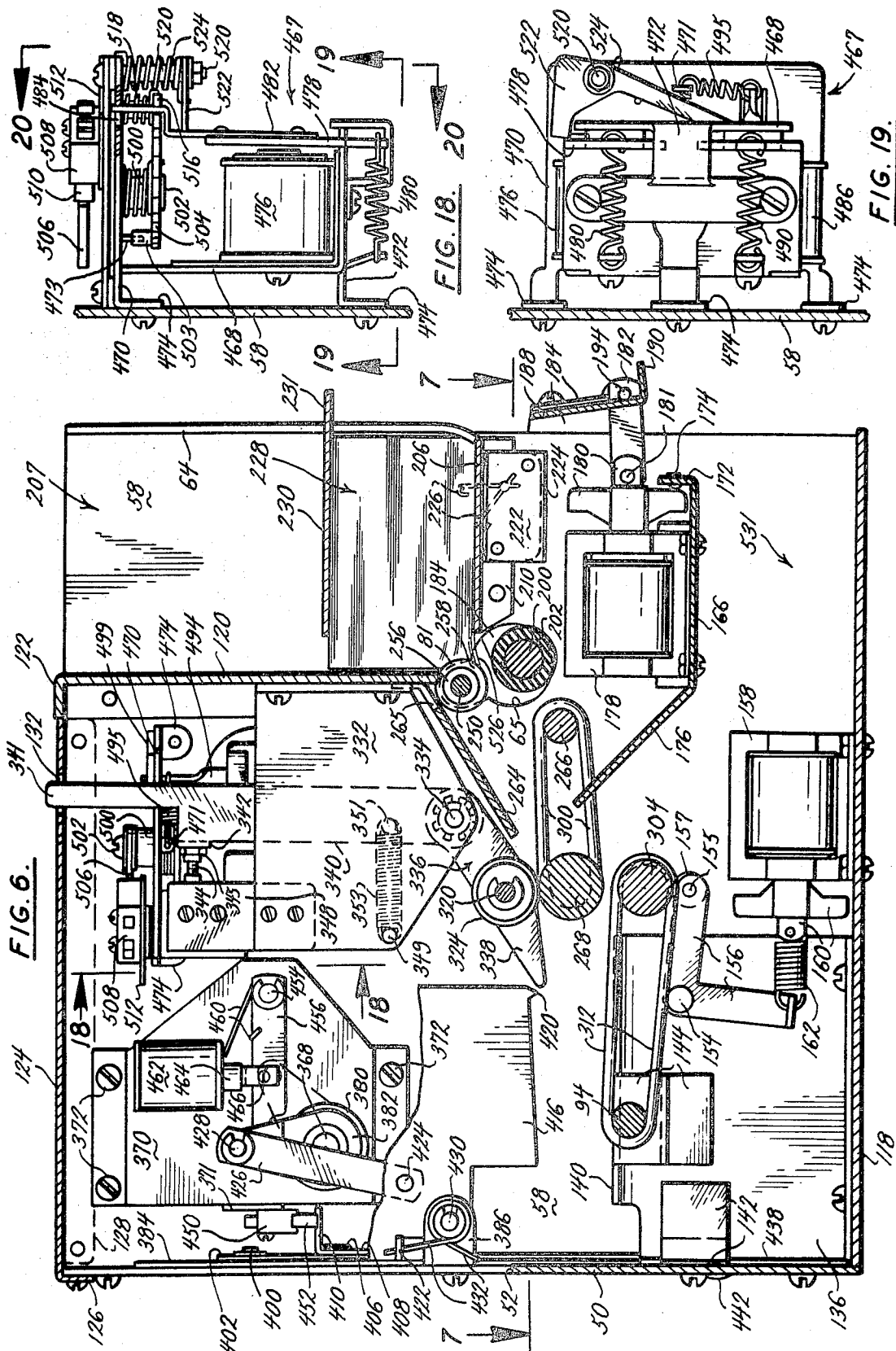
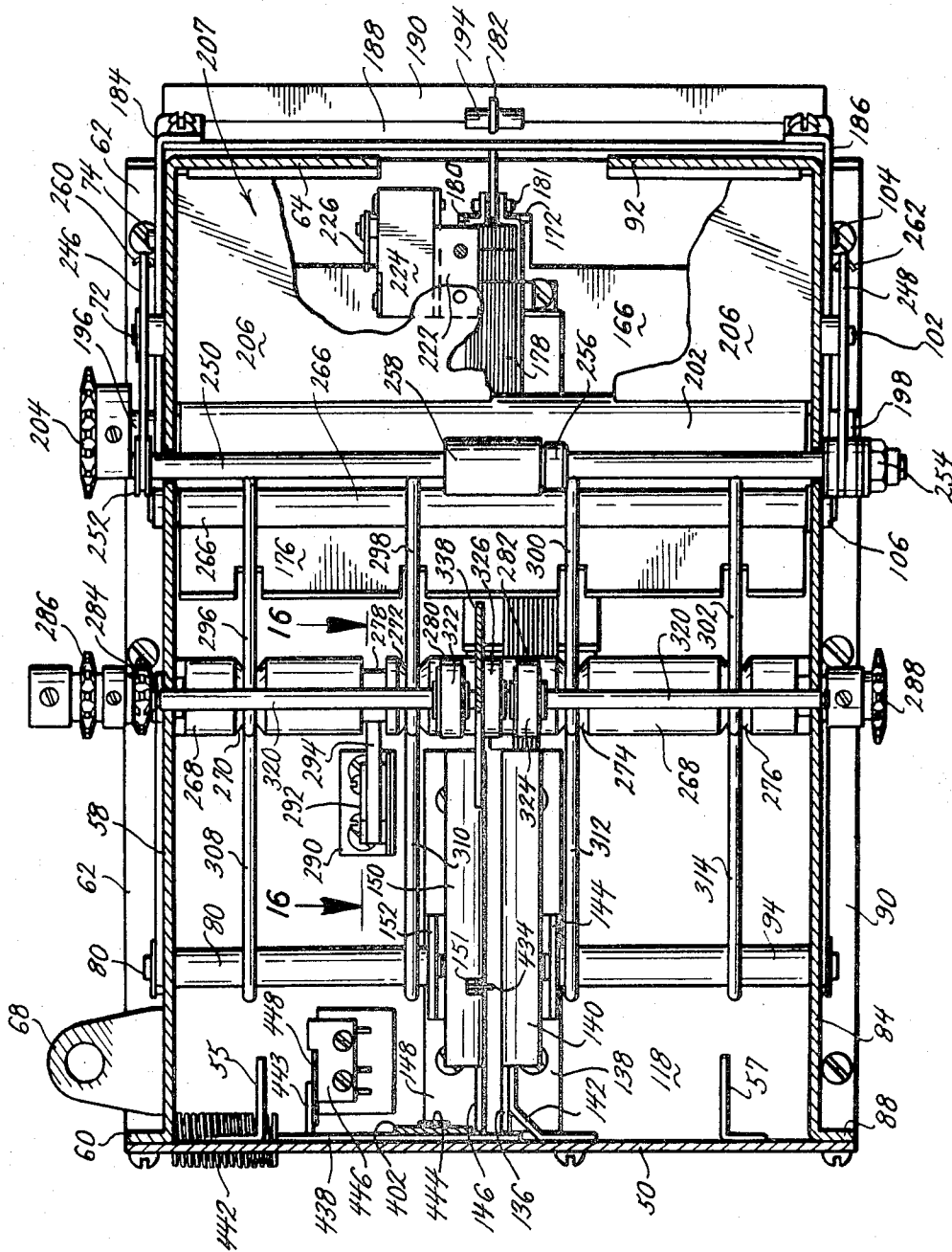
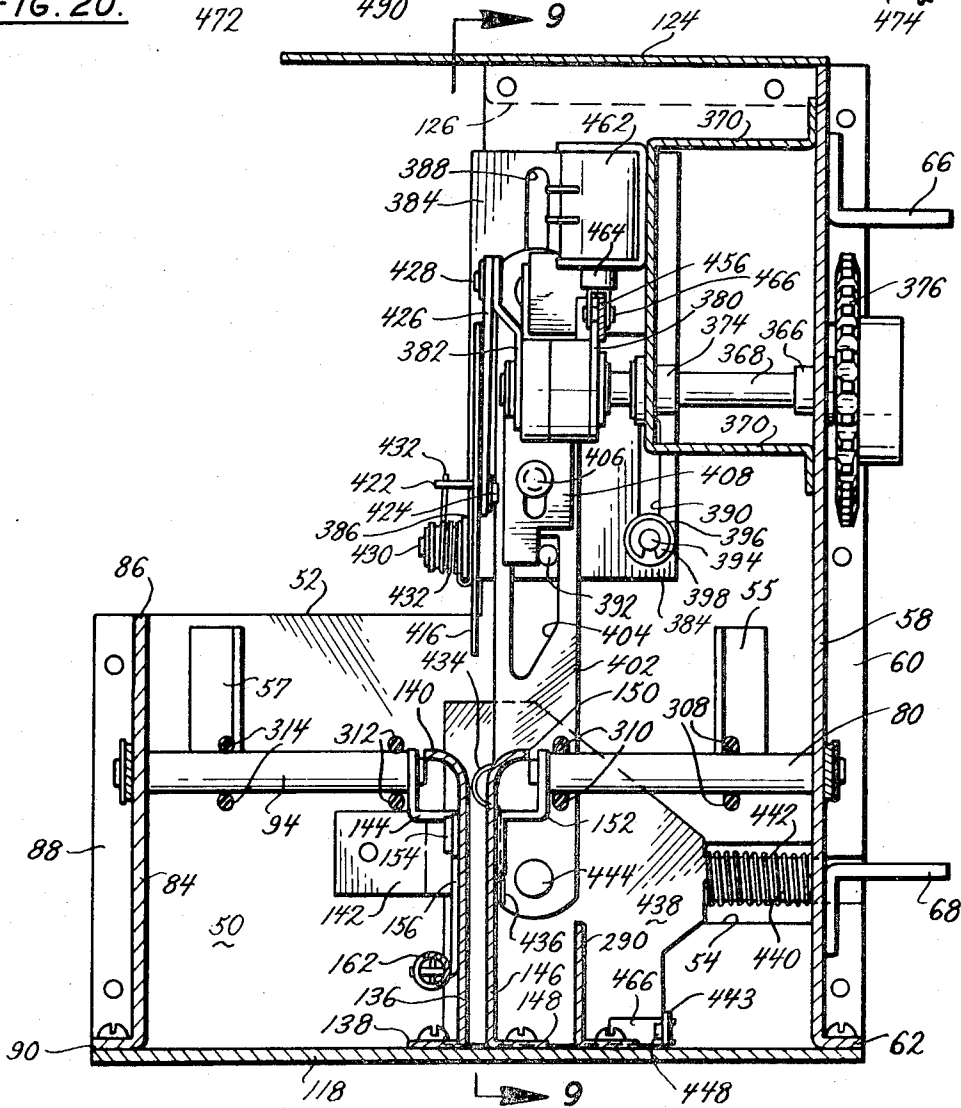
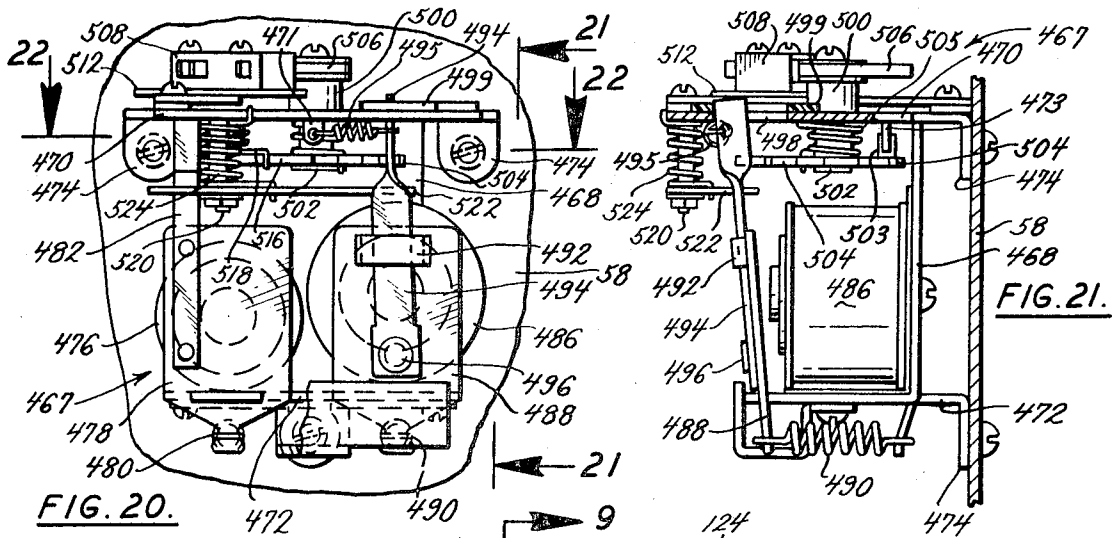
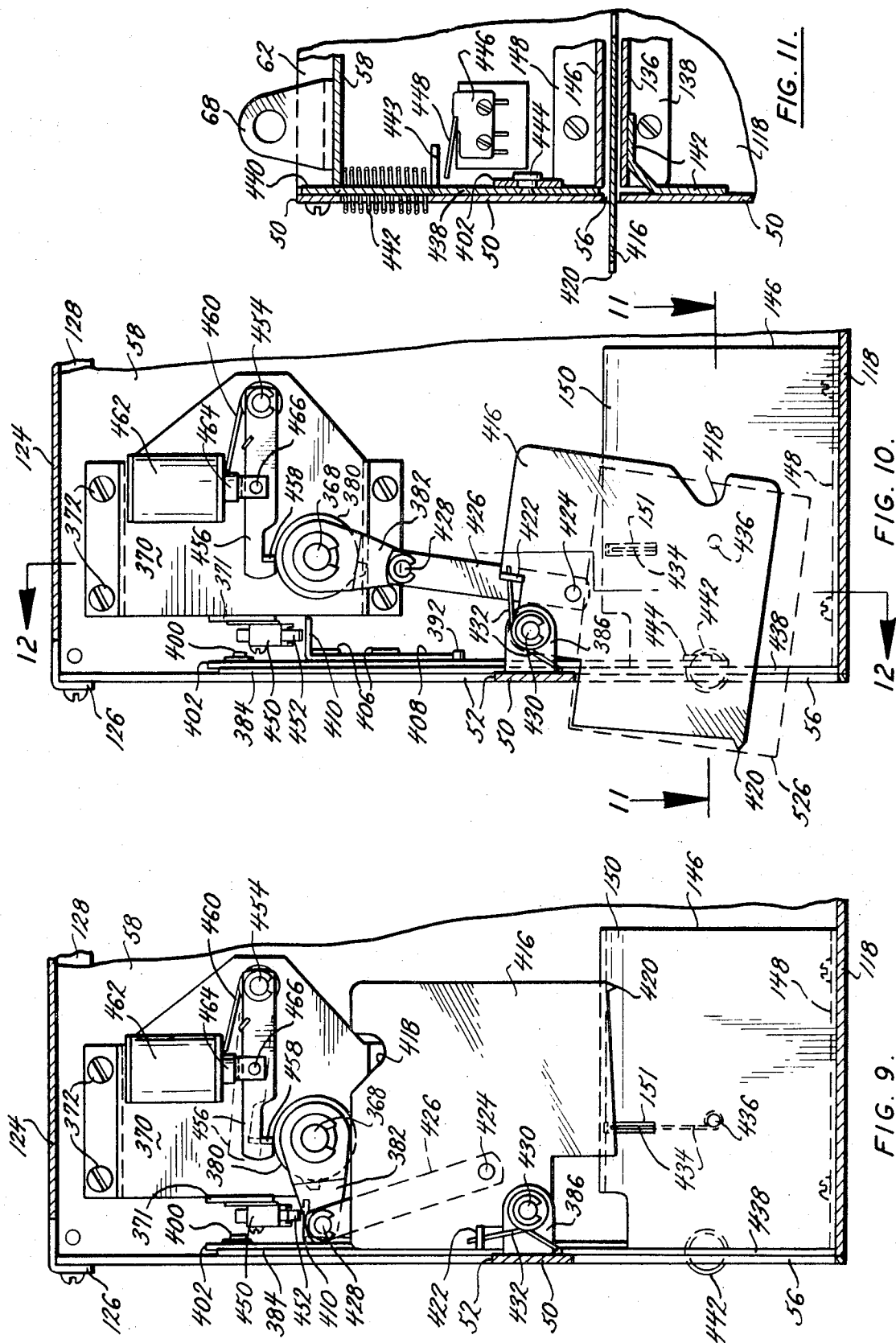


FIG. 7.







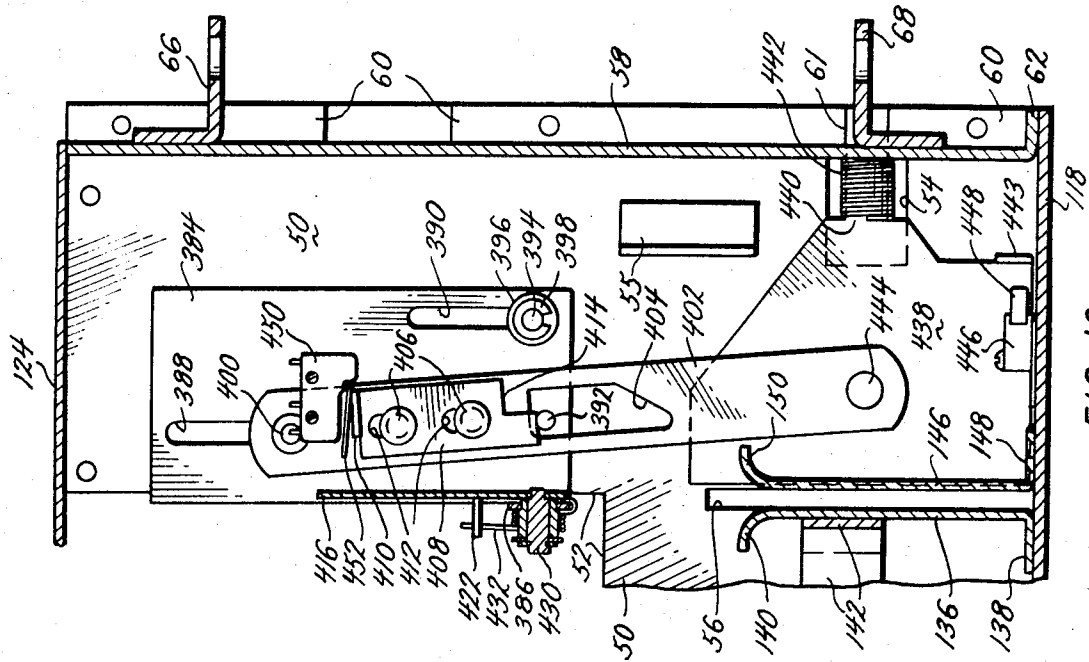


FIG. 13.

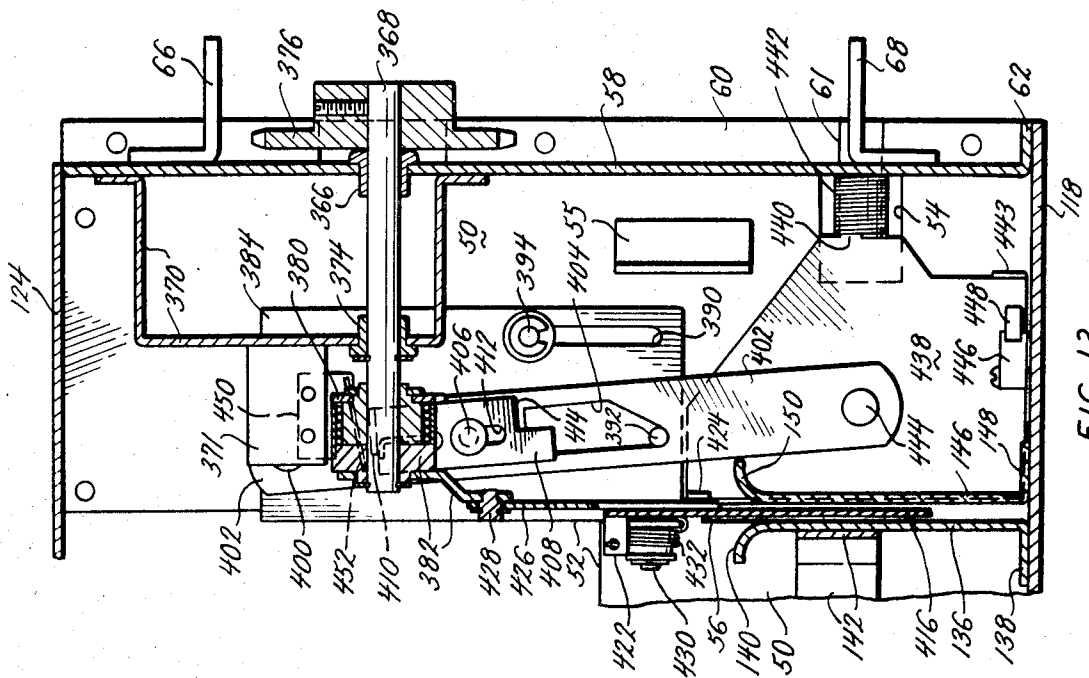


FIG. 12.

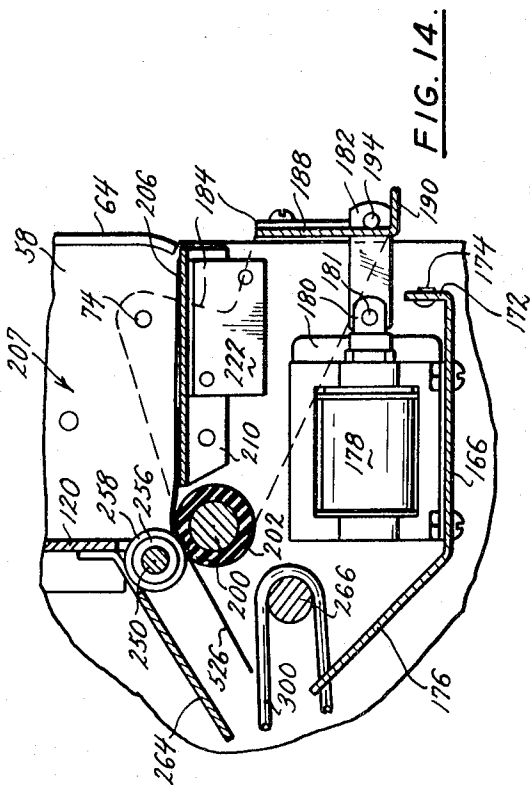


FIG. 14.

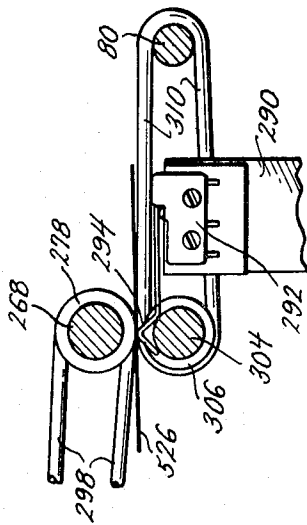


FIG. 17.

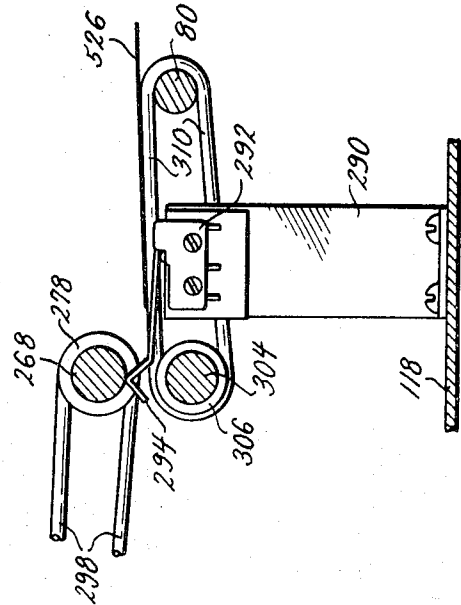


FIG. 16.

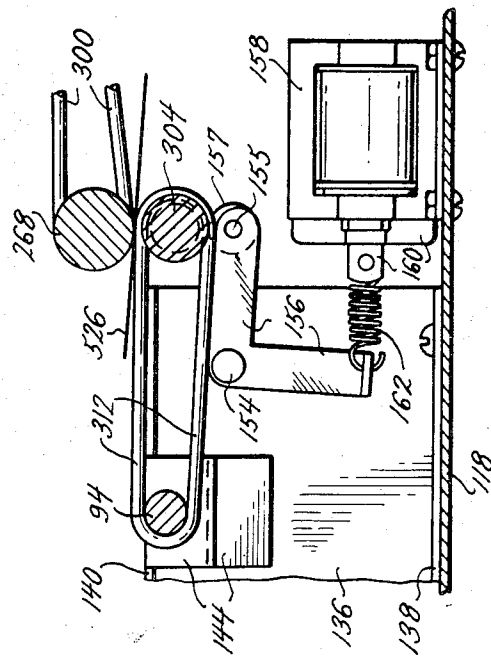


FIG. 15.

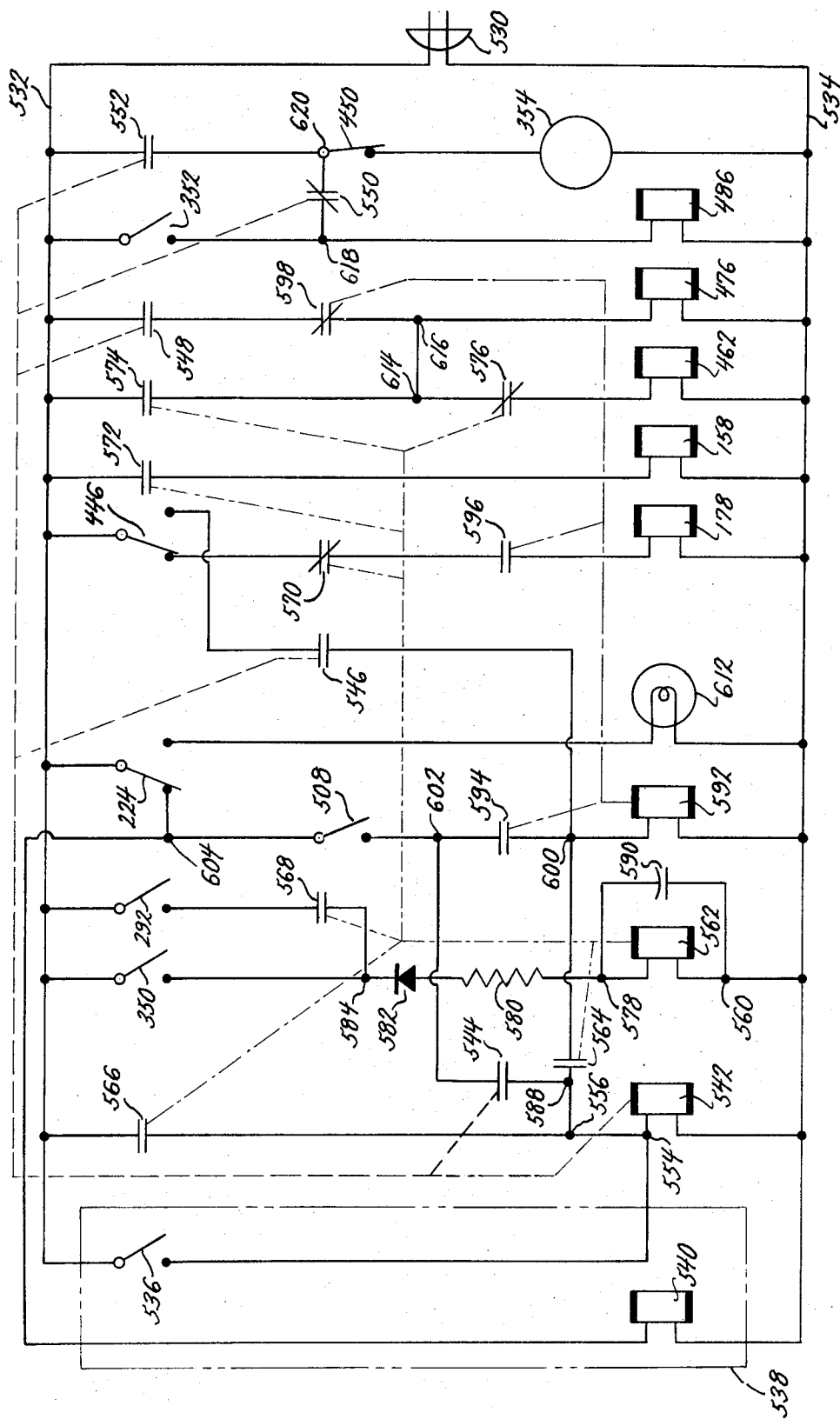


FIG. 25.

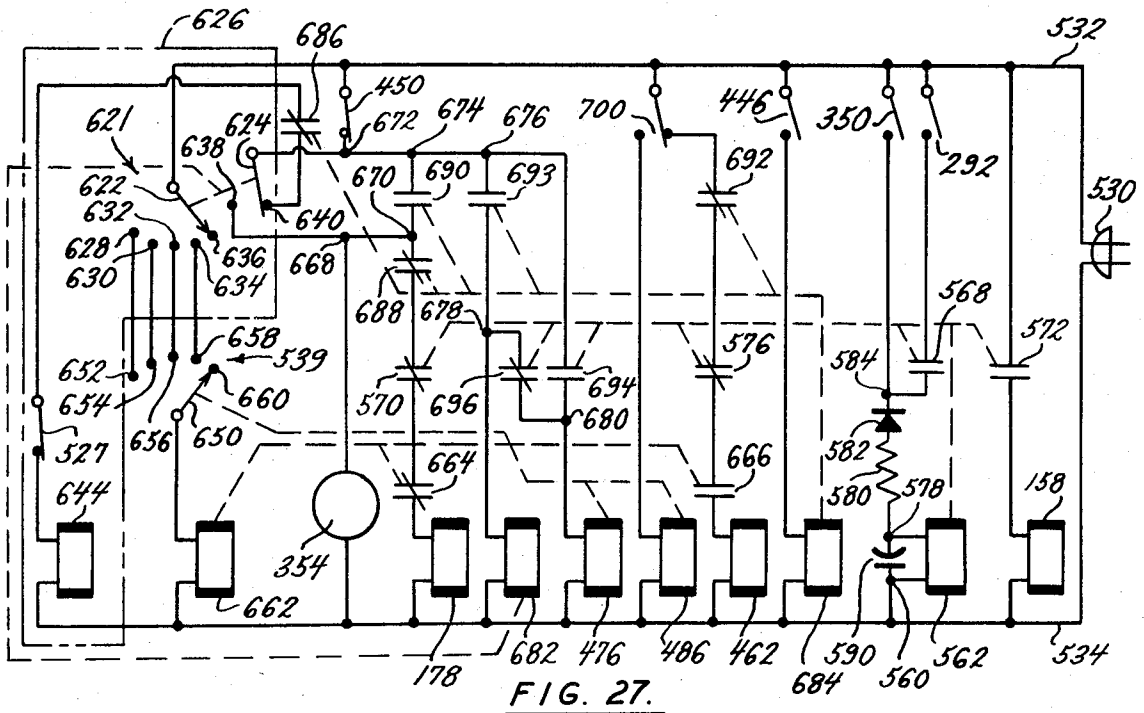


FIG. 27.

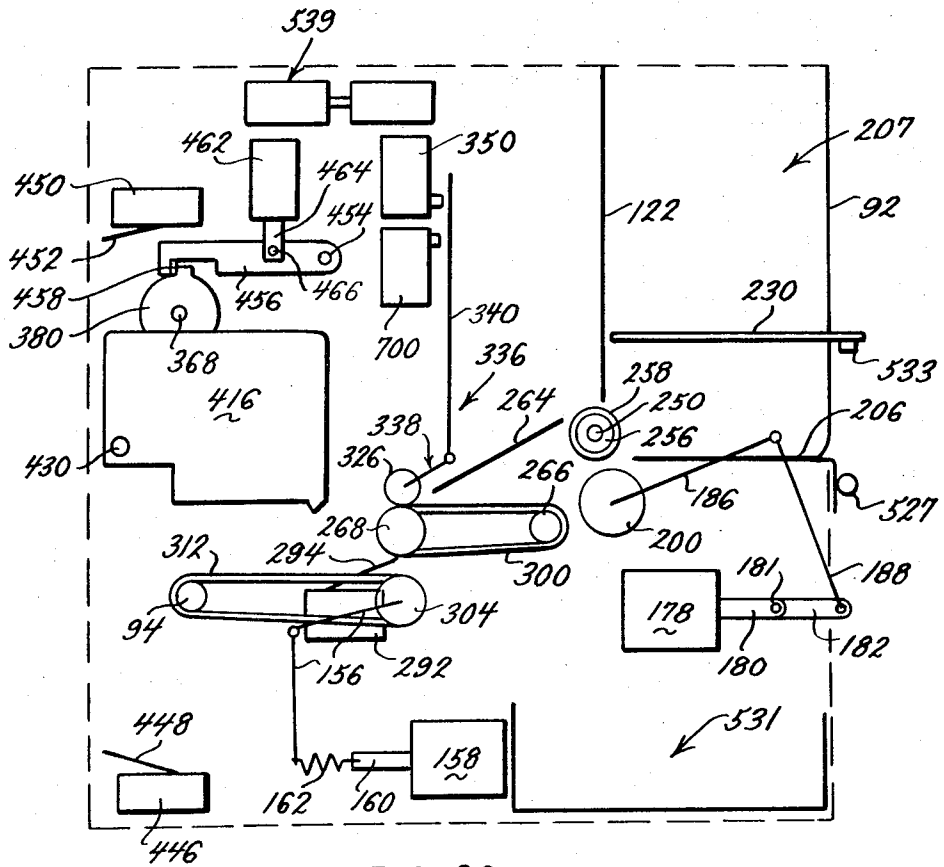


FIG. 26.

MONEY-HANDLING DEVICE

This invention relates to improvements in Money-Handling Devices. More particularly, this invention relates to improvement in a paper money dispensing device.

It is, therefore, an object of the present invention to provide an improved paper money dispensing device.

It would be desirable to provide a paper money dispensing device which stores bills in stacked relation, because bills occupy a minimum of space when they are in stacked relation. While it is desirable to hold bills in stacked relation with a paper money dispensing device, it is necessary to withdraw bills from the stack of bills one at a time. The paper money dispensing device provided by the present invention stores bills in stacked relation; but it withdraws those bills from the stack of bills one at a time and then moves those bills to an area where they can be dispensed to a patron. That paper money dispensing device automatically senses when two bills stick together and are simultaneously separated from the stack of bills; and it moves those bills to a storage area for safe-keeping, and then separates further bills from the stack of bills and moves those further bills to the area where they can be dispensed to a patron. In moving any bills, which stick together, to a storage area for safe keeping, the paper money dispensing device keeps those bills from being dispensed as a single bill — and thus protects the operator of a vending machine, incorporating the paper money dispensing device, from loss due to the dispensing of two bills as one. In separating further bills from the stack of bills, the paper money dispensing device makes it possible to dispense the desired number of bills, even though some bills in the stack of bills stick together. It is, therefore, an object of the present invention to provide a paper money dispensing device which stores bills in stacked relation, which withdraws bills from the stack of bills one at a time, which automatically senses when two bills stick together and are simultaneously separated from the stack of bills, which moves those bills to a storage area for safe keeping, and which then separates further bills from the stack of bills and moves those further bills to the area where they can be dispensed to a patron.

It would be desirable to provide a paper money dispensing device which could dispense bills promptly during each cycle of operation thereof; and the present invention provides such a paper money dispensing device. Where the paper money dispensing device is used to dispense a fixed number of bills, that paper money dispensing device separates the said number of bills from the stack of bills during each cycle of operation and then dispenses the separated bills at the start of the next-succeeding cycle of operation. Where that paper money dispensing device is used to dispense variable numbers of bills, that paper money dispensing device separates the desired number of bills from the stack of bills and then dispenses the separated bills. In both events, the paper money dispensing device promptly dispenses bills during each cycle of operation thereof. It is, therefore, an object of the present invention to provide a paper money dispensing device which promptly dispenses bills during each cycle of operation thereof.

It would be desirable to provide a paper money dispensing device which could dispense all of the bills

of a desired number of bills at the same instant, and which could fold those bills as they were dispensed. The paper money dispensing device provided by the present invention separates each of the bills of a desired number of bills from the stack of bills and moves each of those bills to an area where they can be dispensed to a patron; and then it simultaneously dispenses all of those bills to the patron — folding those bills as it does so. In simultaneously dispensing all of the bills of a desired number of bills, and in folding those bills as it does so, the paper money dispensing device provided by the present invention minimizes the likelihood that a patron would inadvertently fail to take all of the bills due him. It is, therefore, an object of the present invention to provide a paper money dispensing device which separates each of the bills of a desired number of bills from the stack of bills and moves each of those bills to an area where they can be dispensed to a patron, and then simultaneously dispenses all of those bills to the patron — folding those bills as it does so.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

In the drawing and accompanying description two preferred embodiments of the present invention are shown and described but it is to be understood that the drawing and accompanying description are for the purpose of illustration only and do not limit the invention and that the invention will be defined by the appended claims.

In the drawing,

FIG. 1 is a plan view of one preferred embodiment of paper money dispensing device that is made in accordance with the principles and teachings of the present invention, as that paper money dispensing device appears when the cover thereof has been removed.

FIG. 2 is a partially broken-away, elevational view of the right-hand side of the paper money dispensing device shown in FIG. 1,

FIG. 3 is a partially broken-away, rear elevational view of the paper money dispensing device shown in FIG. 1,

FIG. 4 is a front elevational view of the paper money dispensing device shown in FIG. 1,

FIG. 5 is an elevational view of the left-hand side of the paper money dispensing device shown in FIG. 1,

FIG. 6 is a partially broken-away, sectional view through the paper money dispensing device of FIG. 1, and it is taken along the broken plane indicated by the broken line 6—6 in FIG. 1,

FIG. 7 is a partially broken-away, sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 7—7 in FIG. 6,

FIG. 8 is a partially broken-away, sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 8—8 in FIG. 2,

FIG. 9 is a sectional view through the front portion of the paper money dispensing device shown in FIG. 1, and it is taken along the broken plane indicated by the broken line 9—9 in FIG. 8,

FIG. 10 is a sectional view which is generally similar to the sectional view shown in FIG. 9, but it shows the ejection plate of the paper money dispensing device in bill-dispensing position,

FIG. 11 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 11—11 in FIG. 10,

FIG. 12 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 12—12 in FIG. 10,

FIG. 13 is a sectional view which is generally similar to the sectional view shown in FIG. 12, but it shows the ejection plate of the paper money dispensing device in its normal position,

FIG. 14 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 6—6 in FIG. 1,

FIG. 15 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 6—6 in FIG. 1,

FIG. 16 is a sectional view through the paper money dispensing device shown in FIG. 1 and it is taken along the plane indicated by the line 16—16 in FIG. 7,

FIG. 17 is a sectional view which is generally similar to the sectional view shown in FIG. 16, but it shows a bill holding the actuator of the switch of FIG. 17 in its lower position,

FIG. 18 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 18—18 in FIG. 6,

FIG. 19 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 19—19 in FIG. 18,

FIG. 20 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 20—20 in FIG. 18,

FIG. 21 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 21—21 in FIG. 20,

FIG. 22 is a sectional view through the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 22—22 in FIG. 20,

FIG. 23 is a broken away, sectional view of part of the paper money dispensing device shown in FIG. 1, and it is taken along the plane indicated by the line 22—22 in FIG. 20,

FIG. 24 is a sectional view of the paper money dispensing device shown in FIG. 1 with some parts removed, and it is taken along the plane indicated by the line 22—22 in FIG. 20,

FIG. 25 is a schematic diagram of one preferred electrical circuit for the embodiment of paper money dispensing device shown in FIGS. 1-24,

FIG. 26 is a diagrammatic showing of a second preferred embodiment of the paper money dispensing device provided by the present invention,

FIG. 27 is a schematic diagram of one preferred electrical circuit for the embodiment of paper money dispensing device shown in FIG. 26,

FIG. 28 is a rear elevational view of part of the second preferred embodiment of paper money dispensing device shown in FIG. 26, and

FIG. 29 is a sectional view through the second preferred embodiment of paper money dispensing device shown in FIG. 26, and it is taken along the plane indicated by the line 29—29 in FIG. 28.

COMPONENTS OF PAPER MONEY DISPENSING DEVICE OF FIGS. 1-24

Referring to the drawing in detail, the numeral 50 denotes the front wall of one preferred embodiment of paper money dispensing device that is made in accordance with the principles and teachings of the present invention. As shown particularly by FIG. 4, that front wall has a large rectangular notch 52 in the upper right-hand corner thereof, has a small rectangular opening 54 in the lower left-hand corner thereof, and has a narrow, elongated, vertically-directed slot 56 adjacent the center of the lower portion thereof. An L-shaped stop 55 is fixedly secured to the inner surface of the lower portion of the front wall 50 to the right of the narrow, elongated, vertically-directed slot 56, as shown by FIG. 8, and a similar stop 57 is fixedly secured to the inner surface of the lower portion of that front wall to the left of the narrow, elongated, vertically-directed slot 56.

As shown by FIG. 1, a side wall 58 has a vertically-directed flange 60 at the front edge thereof which abuts the rear face of the left-hand edge of the front wall 50; and that flange has a notch 61 therein adjacent the lower end thereof, as shown by FIGS. 5, 12 and 13. The side wall 58 has a horizontally-directed flange 62 at the bottom thereof, as shown by FIG. 5; and it has a vertically-directed flange 64 extending inwardly from the rear edge thereof, as shown by FIG. 1. The bottom of the flange 64 is spaced a considerable distance above the level of the bottom of the wall 58; and the bottom edge of that flange is curved forwardly, as shown particularly by FIG. 6.

A circular opening 65 is formed in the wall 58, about midway between the top and bottom edges of that wall and to the right of the midpoint of that wall, as that wall is viewed in FIG. 6. An L-shaped bracket 66, with an opening in the horizontally-directed portion thereof, is secured to the outer face of wall 58 adjacent the upper right-hand corner of that wall, as that wall is viewed in FIG. 5. A similar bracket 68, with an opening in the horizontally-directed portion thereof, is secured to the outer face of wall 58 adjacent the lower right-hand corner thereof, as that wall is viewed in FIG. 5. The axes of the openings in the horizontally-directed portions of the L-shaped brackets 66 and 68 are aligned so they can telescope over a fixed pivot, not shown, in a vending machine or the like. A pin 70 is secured to and projects outwardly from the wall 58, and that pin is located in the upper left-hand portion of that wall, as that wall is viewed in FIG. 5. A pivot 72 is secured to the wall 58 below, and just a short distance to the right of, the pin 70; and a pivot 74 is secured to the wall 58 below the level of, and to the left of, the pivot 72. A pin 76 is disposed below the level of, and an appreciable distance to the right of, the pivot 72; and a pin 78 is disposed above the level of, and to the right of, the pin 76. A bushing 79 is mounted in an opening in the wall 58; and that bushing is disposed below the level of, and to the left of, the pin 76. An elongated roller 80 has one end thereof rotatably mounted in an opening in the wall 58 adjacent the lower right-hand portion of that wall, as that wall is viewed in FIG. 5. A circular opening 81 is provided in the wall 58 below the level of, and to the right of the pivot 72, as that wall is viewed in FIG. 5; and that opening is immediately above the opening 65, as shown by FIG. 6. A slot 82 is provided in the wall 58

below the level of, and to the right of, the pin 76; and a further slot 83 is provided in that wall directly below the slot 82.

The numeral 84 denotes the right-hand side wall of the paper money dispensing device shown in FIG. 1; and that righthand side wall has a large rectangular notch 86 in the upper lefthand portion thereof, as that wall is viewed in FIG. 2. A vertically-directed flange 88 is provided at the front edge of the wall 84, and that flange abuts the rear face of the right-hand edge of the front wall 50, as shown particularly by FIG. 1. A horizontally-directed flange 90 extends along the bottom edge of the wall 84, as shown by FIG. 2; and a vertically-directed flange 92 is bent forwardly, as indicated by FIG. 2; and the bends in the bottom edges of the flanges 64 and 92 are essentially identical.

An elongated roller 94 has one end thereof rotatably mounted in an opening in the wall 84 adjacent the lower left-hand portion of that wall, as that wall is viewed in FIG. 2. A pin 96 is secured to the wall 84 above the level of, and an appreciable distance to the right of, the pivot 94; and a pin 98 is secured to that wall below the level of, and to the right of, the pin 96. A pin 100 is secured to the wall 84 adjacent the upper right-hand corner of that wall, as that wall is viewed in FIG. 2; and a pivot 102 is secured to that wall below the level of, and slightly to the left of, the pin 100. A pivot 104 is secured to the wall 84 below the level of, and to the right of, the pivot 102. A bushing 106 is mounted in an opening in the wall 84 below the level of, and to the right of, the pin 98. A slot 110 is located in the wall 84 below the level of, and to the left of, the bushing 106; and a slot 112 is formed in that wall above the level of the slot 110. A circular opening 114 is located in the wall 84 above the level of, and an appreciable distance to the right of, the slot 112; and a larger circular opening 116 is formed in that wall below the level of the opening 114.

The numeral 118 denotes the bottom of the paper money dispensing device shown in FIG. 1; and that bottom is a flat plate which abuts the bottom faces of the flanges 62 and 90, respectively, of the walls 58 and 84. Machine screws suitably secure the side walls 58 and 84 to the front wall 50 and to the bottom 118. A partition 120, which is shown particularly by FIGS. 3 and 6, extend between the upper portions of the side walls 58 and 84; and it is secured to those side walls by machine screws. The partition 120 coacts with the side walls 58 and 84, the front wall 50, and the bottom 118 to constitute a strong and rugged frame for the paper money dispensing device shown in FIGS. 1-24.

The partition 120 has a flange 122 at the top thereof; and a cover 124 extends forwardly from that flange to overlie the front of the paper money dispensing device. The cover 124 has a flange 126 extending downwardly over the top edge of the front wall 50, as shown by FIGS. 4 and 6, it has a flange 128 extending downwardly over part of the top edge of the side wall 58, as shown by FIG. 5, and it has a flange 130 extending downwardly over part of the top edge of the wall 84, as shown by FIG. 2. A short slot 132 is formed in the cover 124, as shown by FIG. 6; and a large rectangular notch 134 is provided in that cover adjacent the large rectangular notches 52 and 86, respectively, in front wall 52 and in side wall 86.

The numeral 136 denotes a vertically-directed guide which has a horizontally-directed foot 138 secured to the bottom 118 of the paper money dispensing device adjacent the front wall 50. The upper edge 140 of the guide 136 is arcuate, and it curves upwardly and to the left in FIG. 8. A brace 142 is secured to the rear face of the front wall 50 and to the left-hand face of the guide 136, as that guide is viewed in FIG. 8. A bracket 144 has a vertically-directed portion secured to the left-hand face of the guide 136 in FIG. 8, has a horizontally-directed portion which extends to the left from that guide, and has a second vertically-directed portion which extends upwardly from the horizontally-directed portion and has an opening therein to accommodate the inner end of the elongated roller 94, as shown particularly by FIG. 8. The numeral 146 denotes a vertically-directed guide which has a horizontally-directed foot 148 secured to the bottom 118 adjacent the front wall 50. The guide 146 is in register with, but spaced a short distance away from, the guide 136; and the arcuate upper edge 150 of the guide 146 curves upwardly and away from the arcuate upper edge 140 of the guide 136, as shown by FIGS. 2, 12 and 13. A slot 151 is provided in the lower portion of the arcuate upper edge, and in the upper portion of the vertically-directed section, of the guide 146; and that slot is shown particularly by FIG. 7. A bracket 152 has a vertically-directed portion secured to the right-hand face of the guide 146 in FIG. 8, has a horizontally-directed portion which extends to the right from that guide, and has a second vertically-directed portion which extends upwardly from the horizontally-directed portion and has an opening therein to accommodate the inner end of the elongated roller 80, as shown by FIG. 8. The confronting faces of the guides 136 and 146 define a narrow, vertically-directed space which is squarely in register with the narrow, elongated, vertically-directed slot 56 in the front wall 50.

The numeral 154 denotes a pivot which is secured to the outer face of the guide 136, as shown by FIGS. 6 and 8. That pivot rotatably supports an L-shaped lever 156 which has an ear with an opening therein at the bottom of the vertically-directed arm thereof, and which has a roller 157 rotatably secured to the end of the horizontally-directed arm thereof by a pivot 155. A solenoid 158, which is referred to as the bill reject solenoid, is bolted to the bottom 118 at a point disposed to the right of the guide 136, as that solenoid and guide are viewed in FIG. 6. The armature 160 of that solenoid is connected to the ear at the bottom of the vertically-directed arm of the L-shaped lever 156 by a helical extension spring 162.

The numeral 166 denotes a horizontally-directed wall that is located in the lower right-hand portion of FIG. 6; and that wall extends between and is secured to the rear portions of the side walls 58 and 84. That horizontally-directed wall has a flange 168 which abuts the wall 84 and it has a flange 170 which abuts the wall 58, as shown by FIG. 3. An ear 172 extends upwardly from the rear edge of the horizontally-directed wall 166, adjacent the center of that edge; and an opening in that ear accommodates a resilient stop 174, as shown by FIGS. 3 and 6. The front edge 176 of the horizontally-directed wall 166 inclines upwardly and to the left in FIG. 6; and it extends over the solenoid 158. A sole-

noid 178 is bolted to the upper surface of the horizontally-directed wall 166; and that solenoid is referred to as the bill feed solenoid. The armature 180 of the solenoid 178 can move between a position where it abuts the core of that solenoid and the position shown by FIG. 6 where it abuts the resilient stop 174. A pin 181 connects the armature 180 with a link 182 which has the right-hand end thereof extending through a slot 192 in a connecting plate 188 that has the opposite ends thereof secured to crank arms 184 and 186, as shown by FIG. 3. The lower edge of the connecting plate 188 has a flange 190 thereon to stiffen that connecting plate. A pin 194 which is longer than the slot 192 is wide, is held within an opening in that portion of the link 182 which extends rearwardly through the slot 192. That pin will prevent accidental separation of the link 182 from the connecting plate 188, and it will respond to energization of the bill feed solenoid 178 to pull the lower end of the connecting plate 188 to the left in FIG. 6.

The crank arm 184 is rotatably mounted on the pivot 74, as shown by FIG. 5; and the crank arm 186 is rotatably mounted on the pivot 104, as shown by FIG. 2. The pivots 74 and 104 are coaxial; and hence the crank arms 184 and 186 will rotate about the same axis. The connecting plate 188 and the crank arms 184 and 186 constitute a rigid structure which is generally U-shaped in plan and which extends around the rear portions of the side walls 58 and 84. A bushing 196 is secured to the crank arm 184, as shown by FIG. 3; and a similar bushing 198 is secured to the crank arm 186, as shown by FIG. 3. Those bushings are coaxial; and they rotatably support an elongated roller 200 which has a sleeve 202 thereon made from a material which has a high coefficient of friction. The roller 200 extends through the circular openings 65 and 116, respectively, in the walls 58 and 84; and those circular openings permit the crank arms 184 and 186 to move that roller, and the sleeve 202 thereon, in an arcuate path relative to the axis defined by the pivots 74 and 104. A sprocket wheel 204 is fixedly secured to that end of the roller 200 which projects outwardly from the bushing 196, and hence that sprocket wheel is adjacent the outer face of the wall 58, as shown by FIGS. 1 and 3. The weight of the roller 200 and the weight of the sprocket wheel 204 act to bias the crank arm 184 and the connecting plate 188 for rotation in the clockwise direction in FIG. 5 and act to bias the crank arm 186 and the connecting plate 188 for rotation in the counter-clockwise direction in FIG. 2. Normally, the crank arm 186 and the connecting plate 188 will be in the solid-line position shown in FIG. 2; but they will respond to the pull, which the link 182 and the pin 194 apply to that connecting plate as the bill feed solenoid 178 is energized, to rotate to the dotted-line position shown by FIG. 2.

The numeral 206 denotes a horizontally-directed wall which serves as the floor of a currency receptacle 207 for stacked bills; and that wall is shown at the right of FIG. 6. The upper rear portions of the walls 58 and 84 define the sides of that currency receptacle, the partition 120 defines the front of that currency receptacle, and the flanges 64 and 92, respectively, on the rear edges of the walls 58 and 84 define the rear of that currency receptacle. The wall 206 has flanges 208 and 210

which abut the walls 84 and 58, respectively, as shown by FIG. 3. A slot, not shown, is provided in the wall 206; and that slot is parallel to the walls 58 and 84. The numeral 222 denotes an L-shaped bracket which has the horizontally-directed portion thereof secured to the under surface of the wall 206, as shown by FIG. 3; and a switch 224, that is referred to as the empty switch, is secured to the vertically-extending portion of that bracket. The actuator 226 of that switch extends upwardly through the slot in the horizontally-directed wall 206. Whenever a stack 228 of bills is disposed within the currency receptacle 207, the lowermost bill of that stack will hold the actuator 226 in its lower position; and, whenever that actuator is held in that position, the movable contact of the switch 224 will be in engagement with the left-hand fixed contact of that switch, as shown by FIG. 25. However, whenever all of the bills have been dispensed from the currency receptacle 207, the actuator 226 will move to the upper position indicated by FIGS. 3 and 6; and, at such time, the movable contact of the switch 224 will be in engagement with the right-hand fixed contact of that switch.

The numeral 230 denotes a flat plate which is shown in the right-hand portion of FIG. 6; and that plate is dimensioned to fit within the currency receptacle 207. That plate has a tab 231 at the rear edge thereof; and a notch 232 in one side of that tab accommodates the inner edge of the flange 64 while a notch 234 in the opposite side of that tab accommodates the inner edge of the flange 92. The notches 232 and 234 coast with the confronting edges of the flanges 64 and 92, respectively, to prevent accidental separation of the plate 230 from the currency receptacle 207 while permitting that plate to move vertically relative to that currency receptacle. The plate 230 serves as a weight to urge the lowermost bill of the stack 228 of bills against the wall 206. A slot 236 is provided in the plate 230; and that slot is in register with the slot, not shown, in the horizontally-directed wall 206. Whenever the currency receptacle 207 is devoid of all currency, the actuator 226 of the switch 224 will extend upwardly through the slot 236 as well as through the corresponding slot in the wall 206.

The numeral 246 denotes a lever which is rotatably mounted on the pivot 72 in the upper left-hand portion of FIG. 5; and the lower end of that lever has an opening therein which receives one end of an elongated rod 250. A C-washer 252 seats in an annular groove in the end of the rod 250 to prevent accidental separation of that rod from the lever 246. The numeral 248 denotes a lever which is rotatably mounted on the pivot 102 in the upper right-hand portion of FIG. 2; and the lower end of that lever has an opening therein which receives the other end of the elongated rod 250. A nut 254 is threaded onto that other end of the rod 250 to prevent accidental separation of that rod from the lever 248. The rod 250 has an enlarged-diameter portion 256 adjacent the center thereof; and a sleeve 258 of a material which has a high coefficient of friction is telescoped over that enlarged-diameter portion. The sleeve 258 is in register with the sleeve 202 on the rotatably mounted, elongated roller 200; and, whenever the crank arm 186 is rotated from the solid-line position to the dotted-line position in FIG. 2, the sleeve 202 on the roller 200 will engage the sleeve 258. A helical exten-

sion spring 260 has the upper end thereof hooked around the pin 70, and has the lower end thereof hooked in an opening in the upper end of the lever 246, as shown particularly by FIG. 5. A helical extension spring 262 has the upper end thereof hooked around the pin 100, and has the lower end thereof hooked in an opening in the upper end of the lever 248, as shown by FIG. 2. Those helical extension springs urge the ends of the elongated rod 250 downwardly toward the lower edges of the circular openings 81 and 114, in the walls 58 and 84, respectively. However, those springs can yield and permit that rod to be moved upwardly when the sleeve 202 on the roller 200 presses against the sleeve 258 on the enlarged central portion 256 of that rod.

The numeral 264 denotes an inclined guide which is suitably secured to the forward face of the partition 120, as shown particularly by FIG. 6. The central portion of the upper edge of that inclined guide is cut-away, as indicated by the numeral 265 in FIG. 6, to permit unimpeded upward movement of the sleeve 258 whenever that sleeve is engaged and moved upwardly by the sleeve 202 on the roller 200.

The numeral 266 denotes an elongated roller which is shown to the left of the roller 200 in FIG. 6; and the roller 266 is rotatably held by the bushing 79 in the wall 58 and by the bushing 106 in the wall 84. An elongated roller 268 is shown to the left of the roller 266 in FIG. 6; and the roller 268 has one end thereof rotatably mounted in an opening in the wall 58 and has the other end thereof rotatably mounted in an opening in the wall 84. The roller 268 is parallel to the rollers 250 and 266, as indicated by FIG. 7; and that roller has V-shaped annular grooves 270, 272, 274 and 276 therein. The V-shaped groove 270 is spaced a short distance inwardly from the wall 58, and the groove 276 is spaced a short distance inwardly from the wall 84, as shown by FIG. 7. The V-shaped grooves 272 and 274 are spaced inwardly, respectively, from the grooves 270 and 276; and an annular groove 278 of rectangular cross section is provided in the roller 268 intermediate the grooves 270 and 272. The portion of the roller 268 which is intermediate the grooves 272 and 274 has two spaced annular areas 280 and 282 which have knurling thereon. That knurling is intended to give those annular areas a high coefficient of friction.

A sprocket wheel 284 is fixedly secured to that portion of the roller 268 which extends through and projects beyond the wall 58, as shown by FIG. 7. A second sprocket wheel 286 also is fixedly secured to that portion of that roller; and that second sprocket wheel is disposed outwardly of the sprocket wheel 284, as shown by FIG. 7. A sprocket wheel 288 is fixedly secured to that portion of the roller 268 which extends through and projects beyond the wall 84, as shown by FIG. 7. The teeth of the sprocket wheel 286 are in register with the teeth of the sprocket wheel 204, as shown by FIG. 7.

The numeral 290 denotes an L-shaped bracket which is shown in the upper left-hand portion of FIG. 7; and that bracket has the horizontally-directed portion secured to the bottom 118, as shown by FIGS. 16 and 17. A switch 292, that is referred to as the bill reject holding switch, is secured to the vertically-directed portion of the L-shaped bracket 290; and the actuator

of that switch normally extends into the annular groove 278 in the roller 268, as shown by FIG. 16. However, that actuator can be moved into the moved position shown in FIG. 17. Whenever the actuator 294 is lodged within the groove 278 in the roller 268, the switch 292 will be open; but that switch will close whenever that actuator 294 is moved out of the groove 278.

The numerals 296, 298, 300 and 302 denote endless belts, of circular cross section, which are resilient in nature; and those belts are shown in FIG. 7. The endless belt 296 passes around the elongated roller 266 and through the groove 270 in the roller 268; and the endless belt 298 extends around the roller 266 and through the groove 272 in the roller 268. The endless belt 300 extends around the roller 266 and through the groove 274 in the roller 268; and the endless belt 302 extends around the roller 266 and through the groove 276 in the roller 268. Notches are formed in the inclined front edge 176 of the horizontal wall 166, as shown by FIG. 7; and those notches accommodate the lower runs of the endless belts 296, 298, 300 and 302.

The numeral 304 denotes an elongated roller which has four V-shaped grooves, not shown, that are in register with the four V-shaped grooves 270, 272, 274 and 276 in the elongated roller 268. The roller 306 is parallel to and disposed below the level of the roller 268; and, as indicated by FIGS. 6 and 16, the roller 304 is normally spaced an appreciable distance below the roller 268. However, as indicated by FIGS. 15 and 17, the roller 304 can be moved upwardly until it is very close to the roller 268. As indicated particularly by FIGS. 16 and 17, the roller 304 has an annular groove 306 therein which is rectangular in cross section and which is in register with the annular groove 278 in the roller 268; and the annular groove 306 will accommodate the end of the actuator 294 of switch 292 whenever that end is moved out of the annular groove 278 in the roller 268, as shown by FIG. 16. A resilient, endless belt 308, of circular cross section, extends around the roller 80 and through the groove, not shown, in the roller 304 which is in register with the groove 270 in the roller 268; and a resilient, endless belt 310, of circular cross section, extends around the roller 80 and through the groove, not shown, in the roller 304 which is in register with the groove 272 in the roller 268. A resilient, endless belt 312, of circular cross section, extends around the roller 94 and through the groove, not shown, in the roller 304 which is in register with the groove 274 in the roller 268; and a resilient, endless belt 314 extends around the roller 94 and through the groove, not shown, in the roller 304 which is in register with the groove 276 in the roller 268. One end of the roller 304 is held in an opening in the lower end of a lever 316 which has the upper end thereof rotatably held by the outer end of the roller 80, as shown by FIG. 5. Suitable fasteners, such as C-washers, prevent accidental separation of the lever 316 from the ends of the rollers 80 and 304. The other end of the roller 304 is held in an opening in the lower end of a lever 318 which has the upper end thereof rotatably supported by the outer end of the roller 94, as shown by FIG. 2. Suitable fasteners, such as C-washers, prevent accidental separation of the lever 318 from the rollers 94 and 304.

The numeral 320 denotes an elongated rod which has one end thereof extending through the slot 82 in the wall 58, as shown by FIG. 5, and which has the other end thereof extending through the slot 112 in the wall 84, as shown by FIG. 2. A narrow roller 322, which is shown in FIG. 7 and which has a surface with a high coefficient of friction, is rotatably mounted on the rod 320 in register with the knurled area 280 on the roller 268. A narrow roller 324, which is shown in FIGS. 6 and 7 and which has a surface with a high coefficient of friction, is rotatably mounted on the rod 320 in register with the knurled area 282 on the roller 268. A ball bearing 326, which is shown in FIG. 7, has the inner race thereof loosely telescoped over the rod 320; and that ball bearing is located between the rollers 322 and 324. The inner race of the ball bearing 326 is fixedly secured to the foot 338 of a lever 336; and that lever is rotatably mounted on a pivot 334 which is secured to a partition 332 that extends forwardly from the partition 120.

The lever 336 has an upwardly-extending arm 340; and the upper end of that arm has a reduced-width projection 341 which extends through the slot 132 in the cover 124 of the paper money dispensing device. That slot limits rotation of the lever 336 about the pivot 334; but that rotation is sufficient in one direction to permit the outer race of the ball bearing 326 to reset upon the roller 268, and it is sufficient in the opposite direction to permit one or more bills to pass between the confronting surfaces of that ball bearing and that roller.

A torsion spring 328 is wound around the pin 76 on the wall 58, as shown by FIG. 5; and one end of that spring bears against the under surface of the pin 78, while the other end of that spring extends into an annular groove adjacent that end of the rod 320 which projects through the slot 82 in the wall 58. A torsion spring 330 is wound around the pin 98 on the wall 84, as shown by FIG. 2; and one end of that spring bears against the under face of the pin 96, while the other end of that spring extends into an annular groove adjacent that end of the rod 320 which extends through the opening 112 in the wall 84. The torsion springs 328 and 330 urge the rollers 322 and 324 into engagement, respectively, with the knurled areas 280 and 282 on the roller 268. However, those springs can yield to permit the rollers 322 and 324 to be raised upwardly by bills passing between the confronting surfaces of those rollers and the knurled areas 280 and 282 on the roller 268. The inner diameter of the inner race of the ball bearing 326 is large enough to permit the rod 320 to move short distances relative to the slots 82 and 112, respectively, in the walls 58 and 84 without moving that ball bearing. Also, that ball bearing can move short distances, and thus can cause rotation of the lever 336, without engaging the rod 320.

The upwardly-extending arm 340 of the lever 336 has an ear 342 thereon, as shown by FIG. 1; and that ear has threaded openings therein which receive the shanks of set screws 344 and 346. Lock nuts 345 are disposed at the forward face of the ear 342, and those lock nuts coact with the threaded openings in that ear to hold the set screws 344 and 346 fixed relative to that ear. In practice, one end of an Allen wrench is passed forwardly through the small, circular opening, which is in the partition 120 and which is shown by FIG. 3, to

adjust the set screws 344 and 346; and then the lock nuts 345 are suitably tightened to hold those set screws fixed relative to the ear 342. A pin 349 is secured to the partition 332, as indicated by FIG. 6; and a pin 351 is mounted on the upper arm 340 of the lever 336. A helical extension spring 353 has one end thereof hooked around the pin 349 and has the other end thereof hooked around the pin 351; and that helical extension spring biases the lever 336 for rotation in the counter clockwise direction in FIG. 6. However, that spring can yield to permit that lever to rotate in the clockwise direction when a bill is passed between the outer race of the ball bearing 326 and the adjacent surface of the roller 268.

The numeral 348 denotes a vertically-directed plate which is secured to the upper edge of the forward end of the partition 332 by screws, as shown by FIG. 6. The upper end of that plate supports a switch 350 and a switch 352; and the switch 350 is referred to as the double bill detection switch, while the switch 352 is referred to as the bill counting switch. A plate 355 of insulation is interposed between the plate 348 and one side of the switch 352; and the switch 350 abuts the other side of that switch, as shown by FIG. 1. A ferrule 357 of relatively-stiff plastic material is pressed or threaded onto the end of the shank of the set screw 346, and a similar ferrule 359 is pressed or threaded onto the end of the shank of the set screw 344. Those ferrules have plane faces which are larger than the end faces of the shanks of the set screws 346 and 344, and the plane faces of those ferrules are in register with the actuators of the switches 350 and 352. The switch 350 is normally held "open" by the set screw 346 and the ferrule 357; and the switch 352 is normally held "open" by the set screw 344 and the ferrule 359. As shown particularly by FIG. 1, the actuator of the switch 350 is further in its retracted position than is the actuator of the switch 352; and hence the switch 352 will "close" before the switch 350 "closes" when the upper arm 340 of the lever 336 moves the set screws 344 and 346 away from the actuators of those switches. The set screws 344 will be set so the switch 352 will close whenever a single bill passes between the roller 268 and the outer race of the ball bearing 326; and the set screw 346 will be set so the switch 350 will remain open when a single bill passes between the roller 268 and the outer race of the ball bearing 326 but will close when two or more bills simultaneously pass between that roller and that outer race.

The numeral 354 denotes an electric motor which is equipped with a gear housing 356; and that gear housing is secured to the wall 84, as shown by FIG. 1. That gear housing contains a speed-reducing gear train; and hence the output shaft 358 of that gear housing rotates much slower than does the shaft of the motor 354. The output shaft 358 extends through an opening in the wall 84 and has a sprocket wheel 360 fixedly secured to it, as shown by FIG. 2. A sprocket chain 362 meshes with the teeth on that sprocket wheel and also meshes with the teeth on the sprocket wheel 288, as shown by FIGS. 1 and 2. A sprocket chain 364 meshes with the teeth on the sprocket wheel 286 and also meshes with the teeth on the sprocket wheel 204, as shown by FIG. 5. The sprocket chain 362 enables the motor 354 to rotate the roller 268, and the sprocket chain 364 enables the roller 268 to rotate the roller 200.

The numeral 366 denotes a bushing which is shown in the upper right-hand portion of FIG. 8; and that bushing is mounted within an opening in the wall 58. That bushing rotatably supports one end of a shaft 368; and the other end of that shaft is rotatably supported by a bushing 374 which is mounted within an opening in a generally C-shaped bracket 370. That bracket is secured to the wall 58 by machine screws 372, as shown by FIG. 6; and that bracket has an inwardly-extending ear 371, as shown by FIG. 1. The shaft 368 has a sprocket wheel 376 fixedly secured to the outer end thereof, and the teeth of that sprocket wheel are in register with the teeth of that sprocket wheel 284, as shown by FIG. 1. A sprocket chain 378 meshes with the teeth on the sprocket wheel 284 and also meshes with the teeth on the sprocket wheel 376; and, as a result, the sprocket chain 378 coacts with the sprocket chain 362 and the roller 268 to enable the motor 354 to rotate the shaft 368.

The numeral 380 denotes a single lobe cam which has a spring-type clutch within the hub thereof, as shown by FIG. 12. That spring-type clutch tends to cause the cam 380 and its hub to rotate with the shaft 368; but it will permit that cam to be held stationary by an ear 458 on a latch 456, whenever that ear is in position to intercept and hold the lobe on that cam, as shown by FIGS. 9 and 10. A crank 382 has the hub thereof secured to the hub of the cam 380, and hence that crank will rotate with the shaft 368 whenever the cam 380 rotates with that shaft. However, whenever the ear 458 on the latch 456 engages and holds the lobe on the cam 380, the crank 382 will be held against rotation.

The numeral 384 denotes a generally-rectangular, slide plate which is mounted immediately adjacent the rear face of the upper portion of the front wall 50, as shown by FIG. 2; and that slide plate has an ear 386 extending rearwardly from the lower edge of one side thereof, as shown by FIGS. 1 and 2. Vertically-directed slots 388 and 390 are provided in the upper left-hand and lower right-hand portions, respectively, of the slide plate 384, as shown by FIG. 8. A pin 392 is secured to, and extends rearwardly from, the slide plate 384; and that pin is located in the lower left-hand portion of that plate, as shown by FIG. 8. A stud 394 extends rearwardly from the front wall 50 and extends through the slot 390 in the slide plate 384; and a washer 396 and a C-washer 398 coact with that stud to help guide that slide plate while helping hold that slide plate immediately adjacent the rear face of the front wall 50. A pivot 400 extends rearwardly from the rear wall 50 and extends through the slot 388 in the slide plate 384; and that pivot helps guide movement of the slide plate 384 relative to the front wall 50.

The numeral 402 denotes a generally vertically-directed lever which has an opening in the upper end thereof that is telescoped over the pivot 400. That lever abuts the rear face of the slide plate 384, and it helps hold that slide plate immediately adjacent the rear face of the front wall 50. A slot 404, of generally trapezoidal configuration, is formed in the lever 402, as shown by FIG. 13; and that slot accommodates the pin 392 which extends rearwardly from the slide plate 384. A slide 408, with a horizontally-directed ear 410 at the upper end thereof, has longitudinally-extending slots 412 therein; and headed pins 406 extend through those

slots and seat in openings within the lever 402. The pins 406 hold the slide 408 in assembled relation with the lever 402, but they coact with the slots 412 to permit that slide to reciprocate short distances axially of the lever 402. A rectangular notch 414 is provided in the lower right-hand edge of the slide 408, as shown by FIGS. 8, 12 and 13.

The numeral 416 denotes an ejector plate which is shown particularly by FIGS. 9 and 10; and that ejector plate has a notch 418 in one edge thereof, and it has a point 420 at one corner thereof. An ear 422 is bent outwardly from the plate of the ejector plate 416; and a pin 424 is fixedly secured within an opening in that ejector plate. The ear 422 extends to the left from the ejector plate 416 and the pin 424 extends to the right from that ejector plate, as shown by FIG. 12. A connecting rod 426 has an opening in the lower end thereof telescoped over the pin 424, and it has an opening in the upper end thereof telescoped over a pin 428 carried by the end of the crank 382. A pivot 430 is secured to the ejector plate 416 below the level of the ear 422, and that pivot extends through a bushing mounted on the ear 386 at the lower edge of the slide plate 384; and, as a result, that ejector plate can rotate relative to that slide plate. Because that slide plate can reciprocate vertically, the ejector plate 416 also can reciprocate vertically; and hence that ejector plate can reciprocate as well as rotate. A torsion spring 432 encircles the bushing on the ear 386, at the lower edge of the slide plate 384; and one end of that spring extends through an opening in the ear 422 on the ejector plate 416, while the other end of that spring is bent under the lower edge of the ear 386. As a result, that torsion spring biases the ejector plate 416 for rotation in the counter clockwise direction about the pivot 430 to the position shown by FIG. 9. However, that torsion spring can yield to permit that ejector plate to rotate in the clockwise direction about that pivot to the position shown by FIG. 10.

The numeral 436 in FIG. 9 denotes a pin which is secured to the guide 146; and that pin extends outwardly from that guide, as shown by FIG. 8. A spring 434 has the lower end thereof secured to the guide 146 by the pin 436; and the arcuate upper end of that spring extends through the slot 151 in that guide. As indicated by FIG. 8, that spring closely approaches the guide 136, and thus is in the path of the ejector plate 416. However, because the upper end of that spring is arcuate, the ejector plate 416 will move that upper end to the right in FIG. 8, as that ejector plate is rotated from its upper position to its lower position.

The numeral 438 denotes a barrier which has a generally rectangular left-hand portion, has the upper right-hand corner thereof cut-away at an angle, and has a horizontally-directed extension 440, as indicated by FIG. 8. A helical compression spring 442 surrounds the projection 440; and it has one end thereof bearing against the wall 58 while having the other end thereof bearing against the right-hand side of the barrier 438. That helical compression spring normally holds the barrier 438 in the position indicated by FIG. 8, wherein the left-hand portion of that barrier overlies and blocks the narrow, elongated, vertically-directed slot 56 in the front wall 50. However, as indicated by FIGS. 12 and 13, that helical compression spring can yield to permit the barrier 438 to move to the right, and thereby move

out of registry with the narrow, elongated, vertically-directed slot 56 in the front wall 50. As the barrier 438 moves to the right in FIGS. 12 and 13, the projection 440 thereon moves into the notch 61 in the flange 60 on the side wall 58. A pin 444 extends rearwardly from the barrier 438, and that pin extends into an opening in the lower end of the lever 402. That pin enables counter clockwise rotation of the lever 402 in FIG. 8 to shift the barrier 438 from the position shown in FIG. 8 to the position shown in FIGS. 12 and 13. An ear 443 extends rearwardly from the right-hand lower portion of the barrier 438; and that ear is in the path of the actuator 448 of a switch 446 which is referred to as the barrier switch. That switch is insulated from, but is secured to, the bottom 118 of the money-holding device, as shown by FIGS. 12 and 13. Whenever the barrier 438 is in position to block the narrow, elongated, vertically-directed slot 56, the movable contact of the barrier switch 446 is in engagement with the left-hand fixed contact of that switch, as shown by FIG. 25. However, whenever that barrier is in the position shown by FIGS. 12 and 13, and thus is out of registry with the slot 56, the movable contact of the switch 446 is in engagement with the right-hand fixed contact of that switch.

The numeral 450 denotes a switch which is secured to the ear 371 on the bracket 370; and that switch is referred to as the motor control switch. The actuator 452 of that switch lies in the path of movement of, and is cyclically engaged by, the ear 410 at the top of the slide 408. Whenever the slide 408 is in the upper position indicated by FIG. 13, the actuator 452 will be in its raised position and the switch 450 will be "closed"; but whenever that slide is in the lower position indicated by FIG. 10, the actuator 452 of that switch will be in its lower position and that switch will be "open".

The numeral 454 denotes a pivot which is shown in the upper right-hand portions of FIGS. 9 and 10; and that extends forwardly from the bracket 370. That pivot rotatably supports the latch 456; and a torsion spring 460 is wound around that pivot and has one end thereof overlying the upper edge of that latch while having the other end thereof bearing against the mounting bracket for a solenoid 462 supported by the bracket 370. That torsion spring biases the latch 456 for rotation in the counter clockwise direction in FIGS. 9 and 10 about the pivot 454, and thus biases the ear 458 for movement into the path of the lobe on the cam 380. However, that torsion spring can yield to permit rotation of the latch 456 in the clockwise direction in FIGS. 9 and 10, and thus can permit movement of the ear 458 out of the path of the lobe on the cam 380. The solenoid 462 is referred to as the payout solenoid, and the plunger 464 of that solenoid is rotatably secured to the latch 456 by a pin 466. Whenever the payout solenoid 462 is de-energized, the torsion spring 460 will urge the ear 458 on the latch 456 into the path of the lobe on the cam 380; but, whenever that solenoid is energized, the plunger 464 will raise the latch 456 from the solid-line position to the dotted-line position in FIG. 9, and thus will raise the ear 458 out of the path of the lobe on the cam 380.

FIGS. 18-24 show a counter which is generally denoted by the numeral 467; and that counter includes a bracket 468 which as a top 470, which has an ear 471

that extends downwardly from the top 470 as shown by FIG. 20, and which has a second ear 473 that extends downwardly from the top 470 as shown by FIG. 21. The bracket 468 has a bottom 472, and it has ears 474 which are secured to the wall 58 by machine screws. The coil, of an electromagnet which is fixedly secured to the bracket 468, is denoted by the numeral 476; and that electromagnet is referred to as the reset electromagnet. The armature 478 of that electromagnet is adjacent the coil 476; and a helical extension spring 480 biases that armature to the position shown by FIG. 18, but that spring can yield to permit that armature to move into engagement with the core of that electromagnet whenever the coil 476 is energized. An arm 482, which has a forwardly-extending offset adjacent the upper end thereof, is secured to the armature 478; and the upper end of that arm extends into a slot 484 in the top 470 of the bracket 468. That slot is long enough to permit the armature 478 to move between the position shown in FIG. 18 and the position wherein it engages the core of the re-set electromagnet whenever the coil 476 of that electromagnet is energized.

The numeral 486 denotes the coil of a second electromagnet which is secured to the bracket 468; and that second electromagnet is referred to as the stepping electromagnet. The armature 488 of the stepping electromagnet is adjacent the coil 486; and a helical extension spring 490 biases that armature to the position shown by FIG. 21, but that spring can yield to permit that armature to move into engagement with the core of that electromagnet whenever the coil 486 is energized. A U-shaped guide 492 is secured to the upper portion of the outer face of the armature 488, and a pivot 496 extends forwardly from the lower portion of that outer face. A pawl 494 has an opening in the lower end thereof which is telescoped over the pivot 496; and the U-shaped guide 492 overlies the midportion of that pawl; and hence that U-shaped guide and that pivot hold that pawl in assembled relation with the armature 488 while permitting that pawl to rotate a limited distance about that pivot. The upper end of the pawl 494 is displaced ninety degrees from the plane of the lower portion of that pawl, and hence that upper end is generally parallel to the axis of the core disposed within the coil 486. The upper end of the pawl 494 extends into a slot 498 in the top 470 of the bracket 468; and that slot is long enough to permit that pawl to move from the position shown in FIG. 21 to the position which that pawl will assume when the armature 488 is moved against the core of the stepping electromagnet by energization of the coil 486. A slotted plate 499 is secured atop the top 470 of the bracket 468; and the slot in that plate is aligned with the slot 498 in the top 470, as shown particularly by FIG. 21. A helical extension spring 495 has one end thereof hooked through an opening in the ear 471, which depends downwardly from the top 470 of the bracket 468, and has the other end thereof hooked through an opening in the upper end of the pawl 494, as shown by FIG. 20. The spring 495 biases the pawl 494 for rotation about the pivot 496 to the position shown by FIG. 20, but that spring can yield to permit that pawl to move from the solid-line position to the dotted-line position shown in FIG. 22.

The numeral 500 denotes a bushing which is mounted within an opening in the top 470 of the bracket 468; and a short, vertically-directed shaft 502 is rotatably mounted within that bushing. A ratchet wheel 504 is fixedly secured to the lower end of the shaft 502, and an arm 506 is fixedly secured to the upper end of that shaft—so that ratchet wheel and that arm can rotate as a unit. A pin 503 extends upwardly from the ratchet wheel 504, as shown by FIG. 18, and the ear 473 which depends downwardly from the top 470 of the bracket 468 lies in the path of that pin. A torsion spring 505 surrounds the bushing 500, and it has one end thereof disposed within an opening in the ratchet wheel 504 while having the other end thereof disposed within an opening in the top 470 of the bracket 468. That torsion spring biases the ratchet wheel 504 for rotation in the clockwise direction in FIGS. 22–24, but it can yield to permit rotation of that ratchet wheel in the counter clockwise direction.

The numeral 508 denotes a switch which is spaced from the top 470 of the bracket 468 by a plate 512 of insulation; and that switch is referred to as the total count switch. The actuator 510 of that switch lies in the path of the arm 506; and, whenever that arm is in the position shown by FIG. 21, and thus is spaced away from the actuator 510 of the switch 508, that switch will be "closed". However, whenever the arm 506 is in engagement with the actuator 510 of the switch 508, as shown by FIG. 1, that switch will be "open".

The numeral 514 denotes a pivot which depends downwardly from the top 470 of the bracket 468, and a pawl 516 has the hub thereof encircling, and supported by, that pivot. A torsion spring 518 encircles the hub of the pawl 516 and biases the right-hand end of that pawl into the path of teeth on the ratchet wheel 504, as shown by FIG. 22. However, that spring can yield to permit the right-hand end of the pawl 516 to be moved out of the path of the teeth of the ratchet 504, as shown by FIG. 23. The numeral 520 denotes a further pivot which depends downwardly from the top 470 of the bracket 468; and a lever 522 has the hub thereof encircling, and supported by, that pivot. A torsion spring 524 encircles the hub of the lever 522 and biases that lever toward the position indicated by FIG. 24; but that spring can yield to permit that lever to be moved into the position indicated by FIG. 22.

Whenever the arm 482 is in the position shown by FIGS. 18, 23 and 24, the forwardly-extending offset thereof will engage the pawl 516 and hold that pawl out of engagement with the ratchet wheel, as shown by FIG. 23; and hence that ratchet wheel will assume the position shown by FIG. 24, and the arm 506 will be spaced away from the actuator 510 of the switch 508. The arm 482 will be moved to the position shown by FIGS. 18, 23 and 24 as the coil 476 retracts the armature 478; and it will then be held in that position by the left-hand portion of the lever 522, as shown by FIG. 24. However, whenever the coil 486 moves the armature 488 to retracted position, the pawl 494 will engage the lever 522 and move the left-hand portion of the lever out of the path of the forwardly-extending offset of arm 482; and that forwardly-extending offset will then move the position shown by FIG. 22, wherein the pawl 516 engages the ratchet wheel 504 and prevents clockwise rotation of that ratchet wheel. As the pawl 494 moves

the lever 522, it will also engage a tooth in the ratchet wheel 504 and rotate that ratchet wheel in the counter clockwise direction; and the pawl 516 will then hold that ratchet wheel in its advanced position.

The numeral 526 denotes a bill which has been moved from its position within the currency receptacle 207 and is in the process of being dispensed. That bill is shown in different positions in FIGS. 6, and 14–17. Thus, FIG. 6 shows the leading edge of the lowermost bill 526 in the currency receptacle 207 abutting the sleeve 258 on the elongated diameter central portion 256 of the rod 250. FIG. 14 shows that bill after the leading edge thereof has been gripped between the sleeve 258 and the sleeve 202 on the roller 200 and has been advanced to the left in FIG. 14; and FIG. 16 shows that bill after it has been moved into position atop the endless belts 308, 310, 312 and 314. FIGS. 15 and 17 show the bill 526 being rejected—FIG. 15 showing that bill being gripped and moved by the endless belts 296, 298, 300 and 302 and by the endless belts 308, 310 312 and 314, and FIG. 17 showing that bill moving the actuator 294 of the bill reject holding switch 292 downwardly as it is moved toward rejected position by those endless belts.

The numeral 531 denotes a storage area adjacent the bottom 118 and to the right of the bill reject solenoid 158, as shown by FIG. 6. That storage area is as wide as the currency receptacle 207, and it is longer than that currency receptacle; and hence bills can readily enter, and come to rest in, that storage area. Bills that rest upon the endless belts 308, 310, 312 and 314 will move toward the storage area 531 whenever the roller 304 is raised upwardly by energization of the bill reject solenoid 158; and the inclined front edge 176 of the wall 166 will guide those bills into that storage area.

CIRCUIT OF PAPER MONEY DISPENSING DEVICE OF FIGS. 1–24

Referring particularly to FIG. 25, the numeral 530 denotes a male plug which can be inserted in a suitable electrical outlet; and one of the prongs of that plug is connected to conductor 532, while the other prong of that plug is connected to a conductor 534. A single-pole, single-throw switch 536, shown in the upper left-hand portion of FIG. 25, is located in the vending machine or other device in which the paper money dispensing device of the present invention is mounted; and that switch can be a switch, a relay, or some other circuit-making component of that vending machine or of the money-responsive equipment of that vending machine. That vending machine or other device will have a money accept control device 540 of standard and usual design; and the switch 536 and the money accept control device 540 are shown enclosed by a dash-dot line 538 in FIG. 25. The lower terminal of the money accept control device 540 is connected directly to the conductor 534, and the movable contact of the switch 536 is directly connected to the conductor 532.

The stationary contact of switch 536 is connected to the upper terminal of the coil 542 of a starting relay by a junction 554; and the lower terminal of that coil is directly connected to the connector 534. The coil 542 controls normally-open relay contacts 544, normally-open relay contacts 546, normally-open relay contacts 548, normally-closed relay contacts 550, and normally-open relay contacts 552.

A junction 560 connects the lower terminal of the coil 562 of a double bill relay to the conductor 534; and a junction 578, a resistor 580, a diode 582, and a junction 584 connect the upper terminal of that coil fixed contact of the double bill detection switch 350. The junctions 560 and 578 connect a capacitor 590 in parallel with the coil 562, and thus make the double bill relay a slow-to-release relay. The coil 562 of the double bill relay controls normally-open relay contacts 564, normally-open relay contacts 566, normally-open relay contacts 568, normally-closed relay contacts 570, normally-open relay contacts 572, normally-open relay contacts 574, and normally-closed relay contacts 576. A junction 556 connects the junction 554 to the lower relay contact 566; and junction 556 and a junction 588 connect the junction 554 to the lower relay contact 544 and to the left-hand relay contact 564. The lower relay contact 568 is connected to the junction 584, and the upper relay contact 568 is connected to the stationary contact of the bill reject holding switch 292. The movable contacts of the double bill detection switch 350 and of the bill reject holding switch 292 are connected directly to the conductor 532.

The numeral 592 denotes the coil of a bill feed relay, and the lower terminal of that coil is connected directly to the conductor 534; and that coil controls normally-open relay contacts 594, normally-open relay contacts 596, and normally-closed relay contacts 598. A junction 600 connects the upper terminal of the coil 592 to the right-hand relay contact 564, to the lower relay contact 594, and to the lower relay contact 546. A junction 602 connects the upper relay contact 544 and the upper relay contact 594 to the stationary contact of the total count switch 508. The movable contact of the total count switch 508 is connected to the upper terminal of the money accept control device 540, and to the left-hand fixed contact of the empty switch 224, by a junction 604. The numeral 612 denotes an empty lamp which has the lower terminal thereof connected to the conductor 534, and which has the upper terminal thereof connected to the right-hand fixed contact of the empty switch 224. The movable contact of the empty switch 224 is directly connected to the conductor 532.

The lower terminals of the bill reject solenoid 158, of the bill feed solenoid 178, of the payout solenoid 462, of the coil 476, and of the coil 486 are directly connected to the conductor 534. The upper terminal of the bill feed solenoid 178 is connectable to the conductor 532 by relay contacts 596, relay contacts 570 and the left-hand and movable contacts of the barrier switch 446. The right-hand fixed contact of the switch 446 is connected to the upper relay contact 546. The upper terminal of the bill reject solenoid 158 is connectable to the conductor 532 by relay contacts 572. The upper terminal of the payout solenoid 462 is connected to the lower relay contact 576; and a junction 614 connects the upper relay contact 576 to the lower relay contact 574, while that junction and a junction 616 connect the upper relay contact 576 to the lower relay contact 598. The upper terminal of the coil 476 is connected to the lower relay contact 598 by the junction 616. The upper relay contact 598 is connected to the lower relay contact 548; and the upper relay 598 and 574 are directly connected to the conductor 532.

The upper terminal of the coil 486 is connected to the stationary contact of the bill counting switch 352 and to the left-hand relay contact 550 by a junction 618. The lower terminal of the motor 354 is connected directly to the conductor 534; and the upper terminal of that motor is connected to the stationary contact of the motor control switch 450. The movable contact of the motor control switch 450 is connected to the right-hand relay contact 550 and to the lower relay contact 532 by a junction 620; and the movable contact of the bill counting switch 352 and the upper relay contact 552 are directly connected to the conductor 532.

NORMAL OPERATION OF PAPER MONEY DISPENSING DEVICE OF FIGS. 1-24

In preparing to place the paper money dispensing device of FIGS. 1-24 in service, the operator will place a number of bills in the currency receptacle 207; and those bills will be stacked on top of each other. Also, he will place four bills atop the upper runs of the endless belts 308, 310, 312 and 314; and those bills will be located a short distance rearwardly of the L-shaped stops 55 and 57 and a short distance forwardly of the roller 268. Those four bills will be stacked on top of each other, and they will be in position beneath the ejector plate 416. At this time, the ear 458 on the latch 456 will be engaged by, and will be holding, the lobe on the cam 380; and the crank 382 will be holding the slide plate 384 and the ejector plate 416 in the raised positions shown by FIG. 8. The lever 402, the pin 392 on the slide plate 384, and the slide 408 will be holding the barrier in position to block the vertically-directed slot 56 in the front wall 50. The plate 230 will be resting upon the uppermost of the bills in the current receptacle 207; and that plate will urge the lowermost of those bills downwardly against the wall 206, which serves as the floor of that currency receptacle. That lowermost bill will hold the actuator 226 of the empty switch 224 in the lower position shown by FIG. 6; and hence the movable contact of that empty switch will be in engagement with the left-hand fixed contact of that switch as shown by FIG. 25. As a result, the empty switch 224 will be disconnecting the empty lamp 612 from the conductor 532, but will be connecting the money accept control device 540 to that conductor. That money accept control device will permit a patron to insert money in the money-responsive equipment of the vending machine or other device in which the paper money dispensing device is mounted. The arm 506 will be in engagement with the actuator 510 of the switch 508, and hence that switch will be "open"; and this means that no voltage will be applied to the upper relay contacts 544 and 594.

To initiate operation of the paper money dispensing device of FIGS. 1-24, the switch 536 in the vending machine or other device will be closed momentarily; and as that switch is closed momentarily, power will be applied to the coil 542 of the starting relay via conductor 532, switch 536, junction 554, and coil 542 to the conductor 534. The resulting energization of coil 542 will close relay contacts 544, 546, 548 and 552 and will open relay contacts 550. The closing of relay contacts 546 will not be significant at this time because the movable contact of the barrier switch 446 is out of engagement with the right-hand fixed contact of that

switch. The opening of relay contacts 550 will keep the closing of relay contacts 552 from energizing the coil 486 of the stepping electromagnet. The closing of the relay contacts 552 will energize the motor 354 via conductor 532, relay contacts 552, junction 620, motor control switch 450, and motor 354 to the conductor 534; and that motor will rotate the roller 268, the roller 200, and the shaft 368. The roller 268 will rotate in the counter clockwise direction in FIG. 6, and thus will rotate the rollers 322 and 324 and the outer race of the ball bearing 326 in the clockwise direction. The endless belts 296, 298, 300 and 302 will respond to the counter clockwise rotation of the roller 268 to rotate the roller 266 in the counter clockwise direction. The roller 200 and the shaft 368 also will be rotating in the counter clockwise direction in FIG. 6; but the crank 382 will remain stationary because the ear 458 on the latch 456 will be holding the lobe on the cam 380 against rotation. Consequently, the side plate 384 and the ejector plate 416 will remain in their raised positions. The rotation of the roller 200 will not affect any of the bills in the currency receptacle 207, because that roller will be in the lower position shown by FIG. 6.

The closing of the relay contacts 548, as the coil 542 of the starting relay is energized, will energize the coil 476 of the re-set electromagnet via conductor 532, relay contacts 548, relay contacts 598, junction 616, and call 476 to the conductor 534; and the closing of those relay contacts also will energize the payout solenoid 462 via conductor 532, relay contacts 548, relay contacts 598, junctions 616 and 614, relay contacts 576 and payout solenoid 462 to the conductor 534. The armature 478 of the re-set electromagnet will respond to the energization of the coil 476 to move into engagement with the core of that electromagnet; and, as it does so, the forwardly-extending offset to the arm 482 will move rearwardly into engagement with the pawl 516 and rotate that pawl to the position shown by FIG. 23. Thereupon, the ratchet wheel 504 will respond to the torsion spring 505 to rotate in the counter clockwise direction to the position shown by FIG. 24, wherein the pin 503 abuts the ear 473; and, at this time, the left-hand end of the lever 522 will move into the position shown by FIG. 24, wherein it will block forward movement of the arm 482. As the ratchet wheel rotates to the position shown by FIG. 24, the arm 506 will rotate away from the actuator 510 of the arm 508; and, thereupon, the switch 508 will close.

The energization of the payout solenoid 462 will cause the armature 464 to raise the ear 458, on the latch 456, upwardly out of the path of the lobe on the cam 380; and, at such time, that cam and the crank 382 will respond to the rotation of the shaft 368 to start rotating in the counter clockwise direction in FIG. 6. This means that the closing of relay contacts 548 causes the pawl 516 to release the ratchet wheel 504, causes the arm 506 to permit the total count switch 508 to close, and causes the lever 522 to move into position to keep the pawl 516 from reengaging the ratchet wheel 504. It also means that the closing of relay contacts 548 causes the payout solenoid 462 to free the crank 382, and thus the slide plate 384 and the ejector plate 416, for movement.

The closing of the relay contacts 544, as the coil 542 of the starting relay is energized, establishes a holding

circuit for that coil via conductor 532, the movable contact and left-hand contact of empty switch 224, junction 604, total count switch 508, junction 602, relay contacts 544, junctions 588, 556 and 554, and coil 542 to the conductor 534. That holding circuit will keep the coil 542 energized until the movable contact of the empty switch 224 shifts out of engagement with the left-hand contact of that switch or the total count switch 508 is opened.

As the armature 464 of the payout solenoid 462 raises the ear 458 on the latch 456 out of the path of the lobe on cam 380, the crank 382 will start rotating from the dotted-line position shown in FIG. 6, and that crank will rotate in the counter clockwise direction. During the time the crank 382 rotates from the dotted-line position shown by solid lines in FIG. 6, that crank will move the pin 428 upwardly a short distance, and will thereby act through the connecting rod 426 and the pin 424 to raise the ejector plate 416 and the slide plate 384 upwardly that same distance. As the crank 382 rotates from the solid-line position in FIG. 6 toward the position shown by FIG. 9, the pin 428 will act through the connecting rod 426 and the pin 424 to force the ejector plate 416 and the slide plate 384 to move downwardly to the position by FIG. 9. Although the connecting rod 426 applies its downward force to the ejector plate 416 rather than to the slide plate 384, the torsion spring 432 is strong enough to cause the slide plate to move downwardly with that ejector plate rather than to permit that ejector plate to rotate about the pivot 430 which is carried by the busing on the car 386 of that slide plate. Shortly before the crank 382 reaches the position shown by FIG. 9, the lower edge of the ejector plate 416 will engage the upper most of the four bills resting upon the endless belts 308, 310, 312 and 314; and, as that crank moves into the position shown by FIG. 9, that lower edge will start to fold those four bills along the transversely directed center lines thereof and to move the folds in those bills downwardly between the arcuate upper edges 140 and 150, respectively, of the guides 136 and 146. The point 420 on the ejector plate 416 will facilitate the folding of the bills along the transversely directed center lines thereof, and will make sure that those bills are moved downwardly between the guides 136 and 146.

Whenever the slide plate 384 and the ejector plate 416 are in their raised positions the pin 392, which extends rearwardly from the rear surface of that slide plate, will be directly above the inclined edge at the bottom of the slot 404 in the lever 402 which abuts the rear face of that slide plate; and, as the crank 382 rotates from the solid-line position of FIG. 6 toward the position shown by FIG. 9, and thus forces the ejector plate 416 and the slide plate 384 to move downwardly, the pin 392 on that slide plate will move down toward that inclined edge. Shortly before the crank 382 reaches the position shown by FIG. 9, the pin 393 at the rear of the slide plate 384 will engage the inclined edge at the bottom of the slot 404 in the lever 402; and, as that crank moves into the solid-line position of FIG. 9, the pin 392 will coact with that inclined edge to start rotating that lever toward the position shown by FIG. 12 — thereby causing the trailing edge of the barrier 438 to start uncovering the narrow, elongated, vertically-directed slot 56 in the front wall 50, and causing

the ear 443 to start moving away from the barrier switch 446. By the time the crank 382 reaches the position shown by FIG. 9, the pin 392 will have coacted with the inclined edge at the bottom of the slot 404 in lever 402 to rotate that lever far enough in the counter clockwise direction to cause the ear 443 on the barrier 438 to move out of engagement with the actuator 448 of the barrier switch 446; but the trailing edge of the barrier 438 will still be blocking the narrow, elongated, vertically-directed slot 56 in the front wall 50. As the ear 443 moves out of engagement with the actuator 448 of barrier switch 446, the movable contact of that switch will shift out of engagement with the left-hand contact of that switch and will shift into engagement with the right-hand contact of that switch. The shifting of that movable contact out of engagement with the left-hand contact of that switch will not be significant at this time, because the relay contacts 596 are open; but the shifting of that movable contact into engagement with the right-hand contact of that switch will cause current to flow from conductor 532 via the movable and right-hand contacts of barrier switch 446, relay contacts 546, junction 600, and coil 592 of the bill feed relay to the conductor 534. The resulting energization of that coil will close relay contacts 594, will close relay contact 596 and will open relay contacts 598. The closing of the relay contacts 596 is not significant at this time, because the movable contact of the barrier switch 446 has moved out of engagement with the left-hand contact of that switch. The closing of relay contacts 594 establishes a holding circuit for the coil 592 of the bill feed relay via conductor 532, the movable and left-hand contacts of empty switch 224, junction 604, total count switch 508, junction 602, relay contacts 594, junction 600, and coil 592 to the conductor 534; and that holding circuit will keep the coil 592 of the bill feed relay energized until the movable contact of the empty switch 224 moves out of engagement with the left-hand contact of that switch or the total count switch 508 is opened. The opening of relay contacts 598 will de-energize the coil 476 of the reset electromagnet and also will de-energize the payout solenoid 462. The de-energization of the coil 476 will permit the spring 480 in FIG. 18 to move the armature 478 away from the core of the re-set electromagnet; but, because the left-hand portion of the lever 522 will be in the position shown by FIG. 24, and thus in the path of the arm 482, the movement of the armature 478 and of the arm 482 will be quite limited. That movement will not be sufficient to permit the forwardly-extending offset of the arm 482 to move out of engagement with the pawl 516; and hence that pawl will continue to remain in the position shown by FIG. 23, wherein it is out of engagement with the ratchet wheel 504. Consequently, that ratchet wheel will continue to respond to the torsion spring 504 to hold the pin 503 thereon against the ear 473 which depends downwardly from the top 470 of bracket 468, and also to hold the arm 506 away from the actuator 510 of the switch 508. As long as the arm 506 is displaced from the actuator 510 of the switch 508, that switch will remain closed and will maintain the holding circuits of coil 542 of the starting relay and of coil 592 of the bill feed relay. The deenergization of the payout solenoid 462 will permit the torsion spring 460 to rotate the latch 456 from the dotted-line posi-

tion to the solid-line position of FIG. 9, and that will enable that latch to move the ear 458 thereon back into the path of the lobe on the cam 380.

The pin 392 at the rear of the slide plate 384 will coact with the inclined edge at the bottom of the slot 404 in the lever 402 to move the ear 443 on the barrier 438 out of engagement with the actuator 448 of the barrier switch 446 while the crank 382 is a few degrees above the position shown by FIG. 9. That crank will continue to rotate in the counter clockwise direction — thus continuing to move the slide plate 384 and the ejector plate 416 downwardly, and continuing to move the barrier 438 to the right in FIG. 8, until the pin 392 reaches the bottom of the inclined edge of the seat 404, as shown by FIG. 12. At that time, the crank 382 will be a few degrees below the position shown by FIG. 9, the lower edge of the ejector plate 416 will be adjacent the lower portions of the arcuate upper edges 140 and 150, respectively, of the guides 136 and 146 — and thus will have forced the folds in the four bills downwardly adjacent those lower portions, and the pin 392 will have coacted with the inclined edge of slot 404 to shift the barrier 438 far enough to the right to move that barrier wholly out of registry with the narrow, elongated, vertically-directed slot 56 in the front wall 50. The helical compression spring 442 will be compressed as the barrier 438 is so moved, but the pin 392 will coact with the inclined edge at the bottom of the slot 404 to hold that barrier in the position shown by FIG. 12.

Prior to the time the pin 392, at the rear of the slide plate 384, engages the bottom of the slot 404 in the lever 402, the lower edge of the ejector plate 416 will force the fold in the lowermost of the four bills into engagement with the arcuate upper portion of the spring 434 which extends through the slot 151 in the guide 146. That spring will yield to permit the ejector plate 416 to continue the folding of the four bills, and to continue to move the folds of those bills downwardly between the guides 136 and 146; but the arcuate upper end of that spring will apply a laterally-directed force to those bills. That significant at this time; but that laterally-directed force will be significant in helping to hold the folded bills in position between the guides 136 and 146 as the ejector plate 416 subsequently moves back up to the position shown by FIG. 9.

As the pin 392, at the rear of the slide plate 384, engages the bottom of the slot 404 in the lever 402, that lever will prevent further downward movement of that slide plate; but the crank 382 will continue to force the connecting rod 426 to move downwardly. As a result, that connecting rod will force the ejector plate 416 to start rotating in the clockwise direction about the pivot 430 in FIG. 9, and this means that the four bills, atop the endless belts 308, 310, 312 and 314, will start to follow an arcuate path as the fold therein are moved further downwardly between the guides 136 and 146. Well prior to the time the ejector plate 416 reaches the position shown by FIG. 10, the free edges of the four bills will have been folded back into close proximity to the sides of that ejector plate, by the arcuate upper edges 140 and 150 of the guides 136 and 140; and, as that ejector plate approaches the position shown by FIG. 10, that ejector plate will force the folds in the four bills forwardly through the narrow, elongated, vertically-directed slot 56 in the front wall 50, as indicated

by dotted lines in FIG. 10. At such time, the folds at the transversely-directed center lines of the four bills will be projecting outwardly beyond the front wall 50 about one half of an inch, and hence those folded bills can readily be grasped by the patron.

The crank 382 will continue to rotate in the counter clockwise direction in FIGS. 9 and 10; and, as soon as that crank has moved beyond its lower dead-center position, the returning force, applied to the ejector plate 416 by the torsion spring 432 will act through the connecting rod 426 and the crank 532 to apply a rotative force to the spring-type clutch within the hub of cam 388 which will quickly cause that cam and the crank 382 to rotate about 65° — and thus to rotate far enough to permit the ejector plate 416 to rotate back up into engagement with the rear face of the slide plate 384. The laterally-directed force which the arcuate upper portion of the spring 434 applies to the folded bills will help keep those bills in position between the guides 136 and 146 with the folds thereof projecting outwardly beyond the front wall 50 about one half of an inch. At this time, the pin 392 at the rear face of the slide plate 384 will be at, or immediately adjacent to, the bottom of the slot 404 in the lever 402, and hence the barrier 438 will still be in the position shown by FIG. 12.

The crank 382 will continue to rotate in the counter clockwise direction; and, as it does so, it will apply an upwardly-directed force to the connecting rod 426 which will raise the ejector plate 416 and the slide plate 384. If the patron does not immediately grasp the folded portions of the four bills which extend through the narrow, elongated, vertically-directed slot 56 in the front wall 50, those bills will physically block movement of the barrier 438 to the left in FIG. 12 — and thus will keep that barrier from returning to the normal position shown in FIG. 8. In keeping the barrier 438 from moving to the left from the position shown in FIG. 12, the folded bills keep the ear 433 on that barrier from engaging the actuator 448 of the barrier switch 446, and thus permit the movable contact of that barrier switch to remain in an engagement with the right-hand contact of that switch.

Because the folded bills keep the barrier 438 from moving to the left from the position shown in FIG. 12, the bottom of the slide 408 will be held in the path of the pin 392 as that pin moves upwardly with the ejector plate 416 and the slide plate 384. As the crank 382 moves upwardly through its right-hand horizontal position toward its initial position, it will permit the ejector plate 416 and the slide plate 384 to move far enough upwardly to enable the pin 392 to approach the bottom edge of the slide 408. When the crank 382 is within about ten degrees of its initial position, the pin 392 will engage the bottom edge of the slide 408, and will move the ear 410 at the upper end of that slide into engagement with the actuator 452 of the motor control switch 450. When the crank 382 is within about 5° of its initial position, the ear 410 at the upper end of the slide 408 will have raised the actuator 452 of the motor control switch 450 far enough to open that switch. Thereupon, the motor 354 will become de-energized, and the rollers 200, 268 and 266 and the shaft 368 will come to rest. At this time, the coil 542 of the starting relay and the coil 592 of the bill feed relay will be energized, and

the money accept control device 540 will be energized; but the rest of the electrical components of the paper money dispensing device will be inactive.

The returning force within the torsion spring 432 is quite strong; and hence the rotation of the ejector plate 416 from the position shown by FIG. 10 to the position where that ejector plate abuts the rear face of the slide plate 384 is very rapid. In one preferred embodiment of the present invention, that movement occurs in a small fraction of a second. Once that ejector plate has rotated back up into engagement with the rear face of the slide plate 384, and that slide plate and that ejector plate have responded to continued counter clockwise rotation of the crank 382 to move up into their raised positions, those plates will be kept from moving downwardly again during that cycle of the paper money dispensing device; because the de-energization of the payout solenoid 462 permitted the torsion spring 460 to move the ear 458 on the latch 456 back into the path of the lobe on the cam 380.

The motor 354 will remain de-energized until the patron withdraws the four folded bills from the narrow, elongated, vertically-directed slot 56 in the front wall 50; and, as that patron withdraws those bills, the helical compression spring 442 will shift the barrier 438 back into the position shown by FIG. 8 where that barrier will again block that slot. As the barrier 438 moves out of the position shown by FIG. 13, the pin 444 will rotate the lever 402, and hence the slide 408, far enough in the clockwise direction to move the lower end of that slide beyond the pin 392; and, thereupon, that slide will move downwardly out of engagement with the actuator 452 of the motor control switch 450. Almost immediately thereafter, the ear 443 on the barrier 438 will re-engage the actuator 448 of the barrier switch 446, and will thereby shift the movable contact of that switch out of engagement with the right-hand contact and into engagement with the left-hand contact of that switch.

The motor control switch 450 will re-energize the motor 354, as the slide 408 moves downwardly and away from the actuator of that switch; and that motor will cause the rollers 200, 268 and 266 and the shaft 368 to start rotating again. Very promptly, however, the lobe on the cam 380 will engage and be held by the ear 458 on the latch 456; and hence further rotation of the crank 382 will be prevented. The spring-type clutch within the hub of the cam 380 will permit the shaft 368 and the rollers 300, 268 and 266 to continue to rotate even though that cam and the crank 382 are held against further rotation.

The shifting of the movable contact of the barrier switch 446 out of engagement with the right-hand contact of that switch, as the barrier 438 moves out of the position shown by FIG. 13, will not effect de-energization of the coil 592 of the bill feed relay; because that coil will receive current through the holding circuit which includes the movable and left-hand contacts of the empty switch 224, junction 604, total count switch 508, junction 602, relay contacts 594, and junction 600. As the movable contact of the barrier switch 446 moves into engagement with the left-hand contact of that switch, current will flow from conductor 532 via the movable and left-hand contacts of that switch, relay contacts 570, relay contacts 596, and the bill feed sole-

noid 178 to the conductor 534. The resulting energization of that solenoid will cause the armature 180 of that solenoid to move to the left, and thereby apply a pull to the link 182 and the pin 194 which will cause the connecting plate 188 and the crank arm 186 to rotate from the solid-line position to the dotted-line position in FIG. 2. The crank arm 184 will rotate simultaneously with the connecting plate 188 and the crank arm 186, and hence the sleeve 202 on the roller 200 will be forced up into engagement with the sleeve 258 on the enlarged-diameter, central portion 256 of the rod 250. As the roller 200 is raised upwardly, the sleeve 202 thereon will engage the leading edge of the lowermost bill 526 of the stack 228 of currency within the currency receptacle 207, and will force that leading edge against the sleeve 258 on the enlarged-diameter, central portion 256 of the rod 250. The counter clockwise rotation of the roller 200 will cause the sleeve 202 on that roller to coact with the sleeve 258 on the enlarged-diameter, central portion 256 of the rod 250 to grip the lowermost bill 526 in the stack 228 of bills within the currency receptacle 207 and to move that bill to the left. That lowermost bill will pass to the position shown by FIG. 14; and if the leading edge of that bill does not incline downwardly toward the belts 296, 298, 300 and 302 of its own accord, the inclined guide 264 will guide that leading edge downwardly toward those belts. The bill 526 will be moving parallel to its long dimension as it is moved out of the currency receptacle 207 and into the belts 296, 298, 300 and 302. Because the sleeve 258 on the enlarged-diameter central portion 256 of the rod 250 essentially remains stationary while the sleeve 202 on the roller 200 rotates, the sleeve 258 will tend to hold back the second lowermost bill within the currency receptacle 207 while the sleeve 202 moves the lowermost bill out of that currency receptacle. In almost all cases, the sleeves 258 and 202 will coact to keep two bills from being withdrawn from the currency receptacle 207 at the same time.

In the preceding portion of the description of the normal operation of the paper money dispensing device of FIGS. 1-24, it was assumed that the patron did not promptly grasp the folds of the four bills as those folds were moved forwardly through the narrow, elongated, vertically-directed slot 56 in the front wall 50. However, if that patron did promptly grasp the folds of the four bills as those folds were moved forwardly through the slot 56, the operation of the paper money dispensing device would be essentially unchanged — the motor 354 merely rotating the rollers 200, 268 and 266 and the shaft 368 without any interruption at all if the lower end of the slide 408 was not held in the path of, and thus raised upwardly by, the pin 392; and that motor having the operation thereof interrupted only momentarily if the slide 408 was momentarily held in the path of, and thus was raised upwardly by, the pin 392. Also, the movable contact of the barrier switch 446 would merely have shifted out of engagement with the right-hand contact and into engagement with the left-hand contact of that switch more promptly.

The belts 296, 298, 300 and 302 will carry the leading edge of the bill 526 forwardly into engagement with the knurled areas 280 and 282 on the roller 268, into engagement with the rollers 322 and 324, and into engagement with the outer race of the ball bearing 326.

The knurled areas 280 and 282 will coact with the rollers 322 and 324 to cause that leading edge of that bill to pass between them, and also to pass between the roller 268 and the outer race of the ball bearing 326. As the leading edge of the bill 526 passes between the roller 268 and the outer race of the ball bearing 326, that ball bearing will be raised upwardly a distance equal to the thickness of that bill; and, as that ball bearing is raised, the lever 336 will rotate in the clockwise direction in FIG. 6. As that lever so rotates, the ear 342 on the upper portion 340 thereof will move the set screws 344 and 346, respectively, away from the switches 352 and 350. Where just a single bill 526 is moved between the roller 268 and the outer race of the ball bearing 326, the lever 336 will rotate just far enough to let the actuator of the bill counting switch 352 move far enough to permit that switch to close, but that lever will not rotate far enough to permit the actuator of the double bill detection switch 350 to move far enough to permit that switch to close.

As the bill counting switch 352 closes, current will flow from conductor 532 via that bill counting switch, junction 618, and the coil 486 of the stepping electromagnet to the conductor 534; and the resulting energization of that coil will cause the armature 488 to rotate in the clockwise direction in FIG. 21. As that armature so rotates, it will move the pawl 494 from the position shown by FIG. 21 toward the ratchet wheel 504; and, as the upper end of that pawl engages that ratchet wheel, it will force that ratchet wheel to rotate in the counter clockwise direction in FIG. 22 a distance equal to the width of one tooth of that ratchet wheel. As that ratchet wheel so rotates, the pawl 494 will move from the solid-line position to the dotted-line position shown in FIG. 22 — the U-shaped guide 492 on the armature 488 permitting the upper end of that pawl to shift to the right as the armature 488 moves that pawl into engagement with the tooth of the ratchet wheel 504.

The upper end of the pawl 494 also will engage the right-hand end of the lever 522 and rotate that lever in the counter clockwise direction in FIG. 24; and the resulting movement of the left-hand end of that lever out of the path of the arm 482 will permit that arm to move from the position shown by FIG. 23 to the position shown by FIG. 22. In the latter position, the forwardly-extending offset of the arm 482 permits the pawl 516 to move into engagement with the ratchet wheel 504; and hence that pawl will hold that ratchet wheel in the advanced position to which it was moved by the pawl 494 when the coil 486 of the stepping electromagnet was energized. That coil will remain energized as long as the bill 526 is disposed between the roller 268 and the outer race of the ball bearing 326, and hence the torsion spring 518 will have sufficient time to rotate the pawl 516 into the path of a tooth on the ratchet wheel 504. Consequently, at the time the roller 268 moves the bill 526 from between itself and the outer race of the ball bearing 326, and thus permits the lever 336 to rotate back to its initial position wherein the bill counting switch 352 is re-opened, the ratchet wheel 504 will remain in the advanced position to which it was advanced. The arm 506 advanced toward the actuator 510 of the total count switch 508 as the ratchet wheel 504 was advanced a distance equal

to the width of one tooth of that ratchet wheel; but that arm will still be spaced away from that actuator. Consequently, the total count switch 508 will remain open.

The spring 353 will move the lever 336 back to the position shown by FIG. 6, as the trailing edge of the bill 526 is moved out from between the roller 268 and the outer race of the ball bearing 326; and the bill counting switch 352 will be permitted to re-open as that lever so rotates. The coil 486 of the stepping electromagnet will become de-energized as the bill counting switch 352 is permitted to re-open; and, as that coil becomes de-energized, the spring 490 will rotate the armature 488 back to the position shown by FIG. 21. The pawl 494 will respond to that movement of the armature 488 to move from the dotted-line position to the solid-line position shown by FIG. 22 — the armature 488 moving that pawl away from the ratchet wheel 504, and the spring 495 moving that pawl to the left in FIG. 22. As the pawl 494 moves toward the solid-line position shown by FIG. 22, the torsion spring 524 will urge the lever 522 toward the position shown by FIG. 24; but the arm 482 will lie in the path of the left-hand portion of that lever, and thus will hold that lever in the position shown by FIG. 22. This means that the forwardly-extending offset of the arm 482 will be out of engagement with the pawl 516, and hence that pawl will be able to engage the ratchet wheel 504 and to hold that ratchet wheel in its advanced position.

As the leading edge of the bill 526 moves out from between the roller 268 and the outer race of the ball bearing 326, that leading edge may tend to curl upwardly; but the foot 338 of the lever 336 will keep that leading edge from curling upwardly. That foot will force the leading edge of that bill to pass beneath the point 420 of the ejector plate 416, and thus will force that bill to move into position beneath the lower edge of that ejector plate.

The bill 526 will have a certain amount of momentum as its trailing edge moves out from between the roller 268 and the rollers 322 and 324, and that momentum will tend to carry that bill forwardly toward the front wall 50. That bill will be kept from moving into engagement with the rear face of that front wall by the L-shaped stops 55 and 57. As a result, that bill will come to rest atop the belts 308, 310, 312 and 314 in a position intermediate the L-shaped stops 55 and 57 and the roller 268; and hence that bill will lie beneath the ejector plate 416 in position to be folded and dispensed by that ejector blade.

As the trailing edge of the lowermost bill 526 of the stack 228 of bills in the currency receptacle 207 is moved beyond the sleeve 202, that sleeve will coact with the sleeve 258 to grip the next lowermost bill and start moving it to the left in FIG. 6. The sleeve 258 on the enlarged-diameter central portion 256 of the rod 250 will coact with the sleeve 202 on the roller 200 to hold back the second-lowermost bill in the currency receptacle 207; and hence the lowermost bill, which will be the second in the series of four bills to be dispensed during the cycle of operation of the paper money dispensing device, will be caused to follow the first of those bills. That second bill will pass between the roller 268 and the outer race of the ball bearing 236, and will cause lever 336 to rotate far enough in the clockwise direction to permit the bill counting switch

352 to close a second time. As that bill counting switch is closed for the second time, the coil 486 of the stepping relay will be energized a second time; and the armature 488 will move the pawl 494 into engagement with a further tooth on the ratchet wheel 504. The pawl 494 will again move from the solid-line position to the dotted-line position of FIG. 22; and, in doing so, will again rotate the ratchet wheel 504 a distance equal to the width of a tooth on that ratchet wheel. The torsion spring 518 will yield to permit the pawl 516 to rotate far enough in the clockwise direction to permit the ratchet wheel 504 to rotate in the counter clockwise direction, but that torsion spring will then move the pawl 516 back into position to block clockwise rotation of that ratchet wheel.

The coil 486 of the stepping electromagnet will remain energized as long as the second bill is between the roller 268 and the outer race of the ball bearing 226; but that coil will become de-energized as the trailing edge of that bill is moved beyond the roller 268, and the lever 336 is permitted to return to its normal position wherein the bill counting switch 352 is open. The consequent de-energization of the coil 486 will enable the spring 490 to return the armature 488 and the pawl 494 to the positions shown by FIG. 21; but the ratchet wheel 504 will be held in its second advanced position by the pawl 516. As that second bill moves out from between the roller 268 and the rollers 322 and 324, it will come to rest atop the first bill, and thus in position beneath the ejector plate 416. The arm 506 advanced toward the actuator of the total count switch 508 as the ratchet wheel 504 was advanced in its second position, but that arm will still be spaced away from that actuator 510. Consequently, the total count switch 508 will remain open.

As the trailing edge of the second bill is moved beyond the sleeve 202, that sleeve will coact with the sleeve 258 to grip the third bill and start moving it to the left in FIG. 6. The sleeve 258 on the enlarged-diameter central portion 256 of the rod 250 will coact with the sleeve 202 on the roller 200 to hold back the second-lowermost bill in the currency receptacle 207; and hence the lowermost bill, which will be the third in the series of four bills to be dispensed during the cycle of operation of the paper money dispensing device, will be caused to follow the second of those bills. That third bill will pass between the roller 268 and the outer race of the ball bearing 236, and will cause lever 336 to rotate far enough in the clockwise direction to permit the bill counting switch 352 to close a third time. As that bill counting switch is closed for the third time, the coil 486 of the stepping relay will be energized a third time; and the armature 488 will move the pawl 494 into engagement with a further tooth on the ratchet wheel 504. The pawl 494 will again move from the solid-line position to the dotted-line position of FIG. 22; and, in doing so, will again rotate the ratchet wheel 504 a distance equal to the width of a tooth on that ratchet wheel. The torsion spring 518 will yield to permit the pawl 516 to rotate far enough in the clockwise direction to permit the ratchet wheel 504 to rotate in the counter clockwise direction, but that torsion spring will then move the pawl 516 back into position to block clockwise rotation of that ratchet wheel.

The coil 486 of the stepping electromagnet will remain energized as long as the third bill is between the roller 268 and the outer race of the ball bearing 226; but that coil will become de-energized as the trailing edge of that bill is moved beyond the roller 268, and the lever 336 is permitted to return to its normal position wherein the bill counting switch 532 is open. The consequent de-energization of the coil 486 will enable the spring 490 to return the armature 488 and the pawl 494 to the positions shown by FIG. 21; but the ratchet wheel 504 will be held in its third advanced position by the pawl 516. As that third bill moves out from between the roller 268 and the rollers 322 and 324, it will come to rest atop the third bill, and thus in position beneath the ejector plate 416. The arm 506 advanced toward the actuator of the total count switch 508 as the ratchet wheel 504 was advanced to its third position, but that arm will still be spaced away from that actuator 510. Consequently, the total count switch 508 will remain open.

As the trailing edge of the third bill is moved beyond the sleeve 202, that sleeve will coast with the sleeve 258 to grip the fourth bill and start moving it to the left in FIG. 6. The sleeve 258 on the enlarged-diameter central portion 256 of the rod 250 will coast with the sleeve 202 on the roller 200 to hold back the second-lowest bill in the currency receptacle 207; and hence the lowest bill, which will be the fourth in the series of four bills to be dispensed during the cycle of operation of the paper money dispensing device, will be caused to follow the third of those bills. That fourth bill will pass between the roller 268 and the outer race of the ball bearing 236, and will cause lever 336 to rotate far enough in the clockwise direction to permit the bill counting switch 352 to close a fourth time. As that bill counting switch is closed for the fourth time, the coil 486 of the stepping relay will be energized a fourth time; and the armature 488 will move the pawl 494 into engagement with a further tooth on the ratchet wheel 504. The pawl 494 will again move from the solid-line position to the dotted-line position of FIG. 22; and, in doing so, will again rotate the ratchet wheel 504 a distance equal to the width of a tooth on that ratchet wheel. The torsion spring 518 will yield to permit the pawl 516 to rotate far enough in the clockwise direction to permit the ratchet wheel 504 to rotate in the counter clockwise direction, but that torsion spring will then move the pawl 516 back into position to block clockwise rotation of that ratchet wheel.

The arm 506 will engage the actuator 510 of the switch 508, and will move that actuator far enough to re-open that switch, as the ratchet wheel 504 is advanced to its fourth position. Thereupon, the coil 542 of the starting relay and the coil 592 of the bill feed relay will become de-energized, with a consequent reopening of relay contacts 544, 546, 548, 552, 594 and 596 and with a consequent re-closing of relay contacts 550 and 598. The reopening of the relay contacts 544 and the re-opening of the relay contacts 594 will not be significant at this time, because the holding circuits of the coils 542 and 592 have already been broken by the opening of the total count switch 508. The re-opening of the relay contacts 546 also will not be significant at this time, because the movable contact of the barrier switch 446 will be out of engagement with

the right-hand contact of that switch. The re-opening of the relay contacts 548 prevents a further energization of the coil 476 of the re-set electromagnet; and the re-opening of the relay contacts 552 causes the motor to become de-energized and to come to rest. The re-opening of the relay contacts 596 de-energizes the bill feed solenoid 178, and thereby enables the roller 200 and the sleeve 202 thereon to move downwardly and away from the sleeve 258 on the enlarged-diameter central portion 256 of the rod 250. The re-closing of the relay contacts 550 will re-energize the motor 354 and cause that motor to continue to rotate the roller 268 until the fourth bill has been moved out from between that roller and the rollers 322 and 324 and has come to rest atop the third bill. As that fourth bill is moved out from between the roller 268 and the rollers 322 and 324, the spring 353 will rotate the lever 336 far enough in the clockwise direction to permit the bill counting switch 352 to re-open; and, thereupon, the motor 354 will come to rest. The re-closing of the relay contacts 598 will not be significant at this time, because the relay contacts 548 are already open.

As the motor 354 comes to rest, the cycle of operation of the paper money dispensing device of FIGS. 1-24 will terminate; and, during that cycle of operation, the four bills which initially rested atop the belts 308, 310, 312 and 314 were folded and moved far enough through the narrow, elongated, vertically-directed slot 56 in the front wall 50 to enable the patron to grasp and remove them, and four further bills were removed from the currency receptacle 207, one at a time, and were stacked atop the four belts 308, 310, 312 and 314. At such time, the paper money dispensing device of FIGS. 1-24 will be in condition for a further cycle of operation, and that cycle of operation will be initiated when the switch 536 in the vending machine is again closed. At the conclusion of each cycle of operation of the paper money dispensing device of FIGS. 1-24, all of the components shown in FIG. 25, other than the money accept control device 540, will be de-energized. This is desirable; because it will avoid needless consumption of power by that paper money dispensing device.

OPERATION OF PAPER MONEY DISPENSING DEVICE OF FIGS. 1-24 WHEN TWO BILLS STICK TOGETHER

The operation of the paper money dispensing device of FIGS. 1-24, when two bills stick together, is initially the same as the operation of that paper money dispensing device when bills are removed from the currency receptacle 207 one at a time. Specifically, the closing of the switch 546 energizes the coil 542 of the starting relay; and the consequent closing of the relay contacts 548 will energize the payout solenoid 462 and the coil 476 of the re-set electromagnet, and the consequent closing of the relay contacts 522 will energize the motor 354. The total count switch 508 will close, as the coil 476 of the re-set electromagnet is energized, and the lobe of the cam 380 will be released as the payout solenoid 462 is energized. The motor 354 will cause the crank 382 to move the slide plate 384 and the ejector plate 416 downwardly; and the lever 402 will cause the barrier 438 to move far enough to the right in FIG. 8 to shift the movable contact 446 of the barrier

switch 446 out of engagement with the left-hand contact, and into engagement with the right-hand contact, of that switch. The resulting energization of the coil 592 of the bill feed relay will cause the relay contacts 598 to open and thereby de-energize the payout solenoid 462 and the coil 476 of the re-set electromagnet. The continued energization of the motor 354 will cause the ejector plate 416 to fold and dispense the four bills resting atop the belts 308, 310, 312 and 314. When the patron grasps those four bills and removes them, the barrier 438 will move back to the position shown by FIG. 8; and the movable contact of the barrier switch 446 will move back into the position shown by FIG. 25 and energize the bill feed solenoid 178.

Thereupon, the sleeve 202 will coast with the sleeve 258 to successively withdraw the four lowermost bills 526 from the currency receptacle 207, as long as none of those bills has the next uppermost bill stuck to it. Each single bill 526 will raise the ball bearing 326 far enough upwardly to close the bill counting switch 352, and thereby effect an energization of the coil 486 of the stepping electromagnet — with a consequent advancement of the ratchet wheel 504 and of the arm 506. However, a bill 526 which has the next uppermost bill stuck to it will raise the ball bearing 326 far enough to permit the double bill detection switch 350, as well as the bill counting switch 352 to close. The bill counting switch 352 will close before the double bill detection switch 350 closes; and hence the coil 486 of the stepping electromagnet will be energized and will effect an advancement of the ratchet wheel 504. However, as soon as the double bill detection switch 350 closes, electric current will flow from conductor 532 via that switch, junction 584, diode 582, resistor 580, junction 578, coil 562 of the double bill relay, and junction 560 to the conductor 534. Electrons will momentarily flow out of the lower terminal of the capacitor 590 until that capacitor becomes charged to a value close to the voltage across the relay coil 562.

As the relay coil 562 becomes energized, it will close relay contacts 564, 566, 568, 572 and 574 and it will open relay contacts 570 and 576. The closing of the relay contacts 566 will keep the coil 542 of the starting relay energized, even if the bill which has the next-uppermost bill stuck to it is the fourth bill of a cycle of operation of the paper money dispensing device and thus caused the stepping electromagnet to move the arm 506 into engagement with the actuator 510 of the total count switch 508 and thereby opened that switch. The closing of the relay contacts 564 establishes a circuit for the coil 592 of the bill feed relay via conductor 532, relay contacts 566, junction 556 and 558, relay contacts 564, junction 600, coil 592, and conductor 534. That circuit is important in the event the bill which has the next-uppermost bill stuck to it is the fourth bill of a cycle of operation of the paper money dispensing device, and thus caused the stepping electromagnet to move the arm 506 far enough to open the total count switch 508. The closing of the relay contacts 568 is not significant at this time because the bill reject holding switch 292 is open. The closing of the relay contacts 572 energizes the bill reject solenoid 158 via conductor 532, relay contacts 572, and that bill reject solenoid to the conductor 534. The closing of the relay contacts 574 energizes the coil 476 of the re-set

electromagnet via conductor 532, relay contacts 574, junctions 614 and 616, and coil 476 to the conductor 534. The opening of the relay contacts 576 disconnects the payout solenoid 462 from the junction 614, and thus keeps the closing of the relay contacts 574 from energizing that payout solenoid at the time the coil 476 of the reset electromagnet is energized. The opening of the relay contacts 570 de-energizes the bill feed solenoid 178, and thus halts any further withdrawal of bills from the currency receptacle 207.

As the bill reject solenoid 158 becomes energized, the armature 160 thereof will move from the extended position shown by FIG. 6 to the retracted position shown by FIG. 15, and thus will cause the helical extension spring 162, the L-shaped lever 156, and the roller 157 to force the roller 304 far enough upwardly toward the roller 268 to move the upper runs of the endless belts 308, 310, 312 and 314 into engagement with the lower runs of the belts 296, 298, 300 and 302. Because the motor 354 rotates the roller 268 in the counter clockwise direction in FIG. 15, the engagements between the upper runs of the belts 312 and 314 and the lower runs of the belts 300 and 302, respectively, will cause the rollers 94 and 304 to rotate in the clockwise direction in FIG. 15. The engagements between the upper runs of the belts 308 and 310 and the lower runs of the belts 296 and 298, respectively, will cause the roller 80 to rotate in the same direction in which the roller 94 rotates. As a result, any bills resting upon the belts 308, 310, 312 and 314 will be forced to move to the right and thus between the rollers 268 and 304.

As the leading edges of those bills start to move between the roller 268 and the roller 304, those leading edges will engage the actuator 294 of the bill reject holding switch 292 and will close that switch. The closing of that bill reject holding switch completes a circuit for the coil 562 of the double bill relay — that circuit extending from conductor 532 via that switch 292, relay contacts 568, junction 584, diode 582, resistor 580, junction 578, coil 562 of the double bill relay, and junction 562 to the conductor 534. That circuit will coast with the circuit established by the double bill detection switch 350 to keep the coil 562 of the double bill relay energized until both the double bill detection switch 350 and the bill reject holding switch 292 re-open.

As the coil 476 of the re-set electromagnet was energized by the closing of the relay contacts 574, the armature 478 of that re-set electromagnet moved toward the core of that electromagnet, and thereby moved the forwardly-extending offset of the arm 482 from the position shown by FIG. 22 to the position shown by FIG. 23. However, because the bill counting switch 352 closed immediately prior to the closing of the double bill detection switch 350, because that bill counting switch and that double bill detection switch will remain closed as long as the two bills are in position between the roller 268 and the outer race of the ball bearing 326, and because that bill counting switch will keep the coil 486 of the stepping electromagnet energized, the forwardly-extending offset of the arm 482 will be holding the pawl 516 in the position shown by FIG. 23, but the pawl 494 will be in engagement with a tooth of the ratchet wheel 504 and will keep that ratchet wheel

from rotating to the position shown by FIG. 24. Consequently, that ratchet wheel and the arm 506 will remain in the positions to which they were advanced as the two bills moved between the roller 268 and the outer race of the ball bearing 326, and thereby closed the bill counting switch 352.

As the roller 268 moves the trailing edges of the two bills out of engagement with the outer race of the ball bearing 326, the spring 353 will rotate the lever 336 far enough in the counter clockwise direction in FIG. 6 to re-open the double detection switch 350 and the bill counting switch 352. The re-opening of the bill counting switch 352 will de-energize the coil 486 of the stepping electromagnet; and, thereupon, the pawl 494 will move out of engagement with the ratchet wheel 504 and into the solid-line position shown by FIG. 22. However, the re-opening of the double bill detection switch 350 will not effect immediate de-energization of the coil 476 of the re-set electromagnet; either because one or more bills is holding the bill reject holding switch 292 closed — and thus is holding the coil 562 of the double bill relay energized — or the bill reject holding switch 292 has re-opened but the capacitor 590 is keeping the coil 562 energized. Consequently, the re-set electromagnet will continue to cause the forwardly-extending offset of the arm 482 to hold the pawl 516 in the position shown by FIG. 23; and this means that as soon as the trailing edges of the two bills have been moved out of engagement with the outer race of the ball bearing 526, the ratchet wheel 504 will rotate to the position shown by FIG. 24, and the arm 506 will rotate wholly away from the actuator 510 of the switch 508. If the total count switch 508 was opened as the two bills passed between the roller 268 and the outer race of the ball bearing 526, that switch will close at this time. Consequently, the arm 506 and the ratchet wheel 504 will have been moved back to positions where four additional advancements of that ratchet wheel will be required to move that arm into engagement with the actuator 510 of the total count switch 508.

As the two bills move out of engagement with the roller 268 and the outer race of the ball bearing 326, those bills will come to rest on the upper runs of the belts 308, 310, 312 and 314. The coil 562 of the double bill relay will continue to be energized, either because one or more bills is holding the bill reject holding switch 292 closed or because the capacitor 590 is keeping the coil 562 energized; and hence the bill reject solenoid 158 will be causing the roller 304 to hold the upper runs of the belts 308, 310, 312 and 314 in engagement with the lower runs of the belts 296, 298, 300 and 302. As a result, the upper runs of the belts 308, 310, 312 and 314 will be moving to the right in FIG. 6, and thus will move the two bills between the rollers 268 and 304. As those bills pass between those rollers, they will hold the actuator 294 of the bill reject holding switch 292 in the position shown by FIG. 17, and thus will energize the coil 562 of the double bill relay. The bill reject holding switch 292 will remain closed, and thus will keep the coil 562 of the double bill relay energized, as long as the two bills are between the rollers 268 and 304; and even after those bills move out from between those rollers and permit the bill reject holding switch 292 to re-open, the capacitor 590 will enable the

coil 562 to continue to hold the relay contacts 572 closed for a number of seconds. That period of time will enable the relay contacts 572 to keep the bill reject solenoid 158 energized long enough to make sure that the upper runs of the belts 308, 310, 312 and 314 move all rejected bills into the storage area 531, which is shown in FIG. 6 to the right of the bill reject solenoid 158 and below the wall 156.

When the charge on the capacitor 590 becomes insufficient to keep the coil 562 of the double bill relay energized, the relay contacts 564, 566, 568, 572 and 574 will re-open and the relay contacts 570 and 576 will reclose. The re-opening of the relay contacts 564 will interrupt the holding circuit for the coil 592 of the bill feed relay, but that coil will be kept energized by the circuit which includes the movable contact and left-hand contacts of the empty switch 224, junction 604, total count switch 508, junction 602, relay contacts 594, and junction 600; and hence the coil 592 of the bill feed relay will continue to be energized. The re-opening of the relay contacts 566 will not de-energize the coil 542 of the starting relay, because that coil will be held energized by the circuit which includes the movable and left-hand contacts of the empty switch 224, junction 604, total count switch 508, junction 602, relay contacts 544, and junction 588 and 556; and hence the coil 542 of the starting relay will remain energized. The re-opening of the relay contacts 568 will not be significant at this time, because the bill reject holding switch 292 has already opened. The re-opening of the relay contacts 572 will de-energize the bill reject solenoid 158, and will thereby permit the roller 304 to move downwardly and away from the roller 268; and, at such time, the belts 308, 310, 312 and 314 will come to rest. The opening of the relay contacts 574 will de-energize the coil 476 of the re-set electromagnet, and will thus free the forwardly-extending offset of the arm 482 for movement from the position shown by FIG. 23 toward the position shown by FIG. 22. However, as indicated by FIG. 24, the left-hand portion of the lever 522 will be in the path of the arm 482, and hence the pawl 516 will continue to be held out of engagement with the ratchet wheel 504. This means that the ratchet wheel 504 will continue to remain in the position shown by FIG. 24 and that the arm 506 will continue to be spaced wholly away from the actuator 510 of the total count switch 508. The reclosing of the relay contacts 570 will re-energize the bill feed solenoid 178 via conductor 532, the movable and left-hand contacts of barrier switch 446, relay contacts 570, relay contacts 596, and that bill feed solenoid to the conductor 534. The re-closing of the relay contacts 576 will not re-energize the payout solenoid 462, because the relay contacts 574 will have re-opened, and the coil 592 of the bill feed relay will be holding the relay contacts 598 open.

The bill feed solenoid 178 will force the roller 200 to move from the position shown by FIG. 6 to the position shown by FIG. 14; and then the sleeve 202 on that roller will coast with the sleeve 258 on the enlarged-diameter central portion 256 of the rod 250 to start withdrawing further bills from the currency receptacle 207. The sleeves 202 and 258 will withdraw four further bills from the currency receptacle 207, as long as those bills are withdrawn one at a time; and the

fourth bill will enable the bill counting switch 352, and the consequent energization of the coil 486 of the stepping electromagnet, to cause the arm 506 to move into engagement with the actuator 510 of the total count switch 508 and thereby open that switch. Thereafter, the paper money dispensing device shown by FIGS. 1-24 will terminate its cycle of operation in the manner described hereinbefore in connection with the normal operation of that paper money dispensing device.

Where the bill which has the next-uppermost bill stuck to it is the second, third or fourth bill withdrawn from the currency receptacle 207, the immediately-preceding bill or bills will respond to energization of the bill reject solenoid 158 to move between the rollers 268 and 304 and close the bill reject holding switch 292; and that bill reject holding switch will keep the coil 562 of the double bill relay energized for a short period of time after the two bills have moved out of engagement with the ball bearing 526. However, where the bill which has the next-uppermost bill stuck to it is the first bill withdrawn from the currency receptacle 207, the double bill detection switch 350 will re-open before the bill reject holding switch 292 can be closed by the two bills that are stuck together. Because the capacitor 590 will discharge through the coil 562 of the double bill relay, the relay contacts 572 will remain closed and will thus keep the bill reject solenoid 158 energized until the two bills which are stuck together can be moved into engagement with the actuator 294 of the bill reject holding switch 292 by the belts 308, 310, 312 and 314. That switch will keep the coil 562 energized, and will re-charge the capacitor 590 as long as the two bills hold that switch closed; and then, after that switch has re-opened, the capacitor will keep the coil 562 energized for a number of seconds. The overall result is that all rejected bills will be moved into the storage area 531 for safe-keeping.

OPERATION OF PAPER MONEY DISPENSING DEVICE OF FIGS. 1-24 WHEN CURRENCY RECEPTACLE IS EMPTY

Whenever the last bill in the currency receptacle 207 is withdrawn by the sleeves 202 and 258, the movable contact of the empty switch 224 will move out of engagement with the left-hand contact of that switch and into engagement with the right-hand contact of that switch. As that movable contact moves into engagement with that right-hand contact, the empty lamp 612 will be illuminated, and will indicate to patrons that they should not introduce any money into the money-responsive equipment of the vending machine. As that movable contact moves out of engagement with the left-hand contact of that switch, the money accept control device 540 of the vending machine will become de-energized; and that device will keep the money-responsive equipment of the vending machine from responding to any money which a patron does insert. Also, as the movable contact of the empty switch 224 moves out of engagement with the left-hand contact of that switch, the holding circuit for the coil 542 of the starting relay and the holding circuit for the coil 592 of the bill feed relay will be broken. At such time, all of the components shown in FIG. 25, except the empty lamp 612 will become inactive; and the paper money

dispensing device will be inoperable until a service man replenishes the supply of paper currency within the currency receptacle 207.

The fact that the paper money dispensing device becomes inoperable when the empty switch 224 is actuated does not keep a patron from receiving the money to which he is entitled; because that patron receives that money prior to the time the bill feed solenoid 178 is energized. Consequently, whether the first, second, third, or fourth bill removed from the currency receptacle 207 during a given cycle of operation of the paper money dispensing device is the last bill within that currency receptacle, the patron will have received the four bills to which he is entitled; and the shutting down of that paper money dispensing device will not deprive the patron of any money due him.

The paper money dispensing device of FIGS. 1-24 will withdraw four bills from the currency receptacle 207, and will fold and dispense those four bills, during each cycle of operation of that paper money dispensing device. If desired, the paper money dispensing device of FIGS. 1-24 could be made to withdraw more or fewer bills from the currency receptacle 207, and to fold and dispense those more or fewer bills, by changing the normal position of the arm 506. To increase the number of bills, that are to be withdrawn, folded and dispensed, the normal position of the arm 506 should be set further away from the actuator 510 of the total count switch 508; whereas to decrease the number of bills, that are to be withdrawn, folded and dispensed, the normal position of the arm 506 should be set closer to the actuator 510 of the total count switch 508. This means that by making an appropriate setting of the normal position of the arm 506, it is possible to cause the paper money dispensing device of FIGS. 1-24 to withdraw, fold and dispense any fixed, predetermined number of bills during each cycle of operation of that paper money dispensing device.

COMPONENTS OF PAPER MONEY DISPENSING DEVICE OF FIGS. 26-29

FIG. 26 shows a second preferred embodiment of paper money dispensing device that is made in accordance with the principles and teachings of the present invention; and the paper money dispensing device of FIG. 26 can dispense varying numbers of bills during successive cycles of operation thereof, whereas the paper money dispensing device of FIGS. 1-24 is intended to dispense only a fixed, predetermined number of bills during each cycle of operation thereof. Most of the components of the paper money dispensing device of FIG. 26 can be identical to the similarly-numbered components of the paper money dispensing device of FIGS. 1-24. Thus, the paper money dispensing device of FIG. 26 has a currency receptacle 207 which has the front thereof defined by a partition 122, which has part of the rear thereof defined by a flange 92, and which has the floor thereof defined by the horizontally-directed wall 206. A roller 200 is supported adjacent the outlet of the currency receptacle 207 by a crank arm 186, a connecting plate 188, and a crank arm 184, not shown. The armature 180 of the bill feed solenoid 178 is linked to the connecting plate 188 by a pin 181 and a link 182. The rod 250 is disposed adjacent the outlet of the currency receptacle 207, and an enlarged-

diameter central portion 256 of that rod has a sleeve 258 thereon. An endless belt 300 is shown extending around rollers 266 and 268, and endless belts 296, 298 and 302, not shown, also extend around those rollers; and an inclined guide 264 will direct the leading edges of bills downwardly toward those belts.

The outer race of a roller bearing 326 normally rolls against the roller 268, and the inner race of that ball bearing is mounted on the foot 338 of a lever 336. The upper portion 340 of that lever extends upwardly adjacent a double bill detection switch 350. An endless belt 312 extends around rollers 94 and 304; and endless belts 308, 310 and 314, not shown, also extend around those rollers. The roller 304 normally is in the lower position shown by FIG. 26, but it will respond to energization of a bill reject solenoid 158 to move to its upper position — the energization of that solenoid causing a plunger 160 and a helical extension spring 162 to rotate an L-shaped lever 156. A bill reject holding switch 292 normally has the actuator 294 thereof disposed within a recess 278, not shown, in the roller 268; but a rejected bill, passing between the rollers 268 and 304, will move that actuator out of that groove and will thus close that bill reject holding switch.

A rotatable shaft 368 has a single lobe cam 380 mounted thereon; and a latch 456, which is mounted on a pivot 454, normally has an ear 458 thereon disposed in the path of the lobe of that cam. However, energization of a payout solenoid 462 will enable the plunger 464 of that solenoid to act through a pin 466 to raise that latch 456 far enough to move the ear 458 out of the path of the lobe of the cam 380. A pin 430 on an ejector plate 416 is mounted within a bushing, not shown, on a slide plate 384, not shown; and that ejector plate can respond to rotation of a crank 382, not shown, to fold bills and push the folds thereof forwardly through a narrow, elongated, vertically-directed slot 56, not shown, in front wall 50; and a motor control switch 450 will have the actuator 452 thereof raised upwardly by a slide 508, not shown, as the crank 382 moves back up to its normal position while the folded bills are holding the barrier 438 in the position shown by FIG. 13.

The foregoing numbered components, and most of the other components of the paper money dispensing device of FIG. 26, can be identical to the similarly-numbered components in the paper money dispensing device of FIGS. 1-24. However, a stepping switch 539 has been substituted for the total count switch 508; and that stepping switch has a movable contact 650 and fixed contacts 652, 654, 656, 658 and 660. That movable contact replaces the arm 506 of the paper money dispensing device of FIGS. 1-24; and that movable contact is secured to, and moves with, the shaft 502 which is driven by the ratchet wheel 504. Also, a single pole, double throw, bill counting switch 700 has been substituted for the single pole, single throw, bill counting switch 352. Although FIG. 26 shows the double bill detection switch 350 disposed above the bill counting switch 700, those switches will be mounted side-by-side in the same manner, and in the same positions as, the double bill detection switch 350 and the bill counting switch 352 in FIG. 1.

The horizontally-directed wall 206 in FIGS. 26, 28 and 29, which serves as the floor of the currency recep-

tacle 207, differs from the wall 206 of the paper money dispensing device of FIGS. 1-24 in having an ear 525 depending downwardly from the rear edge thereof. A magnetically-sensitive reed switch 527 is secured to the downwardly-depending ear by a clamp 528; and slots 529 are formed in that clamp to accommodate the shanks of the machine screws 531 which are seated in threaded openings in the downwardly depending ear 525. Loosening and subsequent tightening of the screws 531 will permit adjustment of the position of the clamp 528, and hence of the reed switch 527, relative to the downwardly depending ear 525. The tab 231 of the plate 230, which is disposed within the currency receptacle 207 and which rests atop the stack 228 of bills in that currency receptacle, has a vertically-directed opening therethrough. That opening accommodates a magnet 533 which is cylindrical in form and which is held within a non-magnetic sleeve 543 that has threads on the exterior thereof. A lock nut 535 is threaded onto the upper end of the sleeve 543, and a lock nut 537 is threaded onto the lower end of that sleeve; and those lock nuts can hold that sleeve and the magnet 533 fixed relative to the tab 231 on the plate 230. Loosening and subsequent tightening of the lock nuts 535 and 537 will permit adjustment of the position of the sleeve 543 and magnet 533 relative to the tab 231 on the plate 230. Preferably, the magnet 533 will be mounted relative to the tab 231 on the plate 230 so that magnet will permit the reed switch 527 to be closed as long as the number of bills within the currency receptacle 207 is one greater than twice the number of active fixed contacts of the selection switch 539. In the particular embodiment of paper money dispensing device of FIG. 26, the selection switch 539 has four active fixed contacts; and hence the magnet 533 will preferably be set so it will permit the reed switch 527 to remain closed as long as there are nine bills within the currency receptacle 207 but will open whenever there are less than nine bills within that currency receptacle.

CIRCUIT FOR MODIFIED FORM OF PAPER MONEY DISPENSING DEVICE IN FIGS. 26 - 29

FIG. 27 shows the circuit of the paper money dispensing device of FIG. 26; and that circuit is similar to the circuit of FIG. 25. Many of the components of the circuit of FIG. 27 can be identical to, and can perform the same functions as, the similarly-numbered components of the circuit of FIG. 25. However, the circuit of FIG. 27 differs from the circuit of FIG. 25 by including a selector switch 621 which has a movable contact 622 and fixed contacts 628, 630, 632, 634 and 636. An off-normal switch has the movable contact 624 thereof "ganged" with the movable contact 622 of the selection switch 621 so those two movable contacts move simultaneously; and that off-normal switch has fixed contacts 638 and 640. The movable contact 624 of that off-normal switch will be in engagement with the fixed contact 640 whenever the movable contact 622 of the selection switch 621 is in engagement with the fixed contact 636; but the movable contact 624 of that off-normal switch will be in engagement with the fixed contact 638 whenever the movable contact 622 of the selection switch 621 is in engagement with any of the fixed contacts 628, 630, 632 and 634. The selection

switch 621, the off-normal switch, the empty switch 527, and a money accept control device 644 are enclosed within a dash-dot line 626 in the left-hand portion of FIG. 27. The fixed contacts 652, 654, 656 and 658 of the stepping switch 539 are connected, respectively, to the fixed contacts 628, 630, 632 and 634 of the selection switch 621. The selection switch 621 and the offnormal switch can be switches, can be relay contacts, or can be stepping switches, as desired; and the vending machine in which the selection switch 621 and the off-normal switch are mounted will have mechanical, electrical or electromechanical components to selectively advance the movable contacts 622 and 624 of those switches to desired positions.

Movable contact 650 of the stepping switch 539 is connected to the upper terminal of the coil 662 of a bill feed stop relay, and the lower terminal of that coil is connected to the conductor 534. That coil controls normally-closed relay contacts 664 and normally-open relay contacts 666. The lower terminal of the motor 354 is connected to the conductor 534, and the upper terminal of that motor is connected to the fixed contact 638 of the off-normal switch and to a junction 670 by a junction 688.

The numeral 684 denotes the coil of a re-set relay, and that coil controls normally-closed relay contacts 686, normally-closed relay contacts 688, normally-open relay contacts 690, normally-open relay contacts 693, and normally-closed relay contacts 692. The lower terminal of the coil 684, as well as the lower terminals of bill reject solenoid 158, of bill feed solenoid 178, of payout solenoid 462, of the coil 476 of the re-set electromagnet, of the coil 486 of the stepping electromagnet, of the coil 562 of the double bill relay, of the money accept control device 644, and of a selection switch re-set coil 682 are directly connected to conductor 534. The selection switch re-set coil 682 will, whenever it is energized, cause the movable contact 622 of the selection switch 621 and the movable contact 624 of the off-normal switch to move to the "off" positions shown by FIG. 27.

The upper terminal of the coil 684 of the re-set relay is connectable to the conductor 532 by the barrier switch 446. The coil 562 of the double bill relay in FIG. 27 controls normally-open relay contacts 694 and normally-closed relay contacts 696 in addition to the normally-closed relay contacts 570 and 576 and the normally-open relay contacts 568 and 572; and the upper terminal of that coil is connectable to the conductor 532 by junction 578, resistor 580, diode 582, junction 584, and double bill detection switch 350. The junction 584 also is connectable to the conductor 532 by relay contacts 568 and the bill reject holding switch 292. The upper terminal of the bill reject solenoid 158 is connectable to the conductor 532 by the relay contacts 572. The upper terminal of the payout solenoid 462 is connectable to the conductor 532 by relay contacts 666, relay contacts 576, relay contacts 692, and the right-hand and movable contacts of bill counting switch 700. Normally, the movable contact of that bill counting switch is in engagement with the right-hand contact of that switch, as shown by FIG. 27. The upper terminal of the coil 486 of the stepping relay is connectable to the conductor 532 by the left-hand and movable contacts of the bill counting switch 700. The upper ter-

minal of the coil 476 of the re-set electromagnet is connectable to the conductor 532 by a junction 680, relay contacts 694, junctions 676, 674 and 672, and motor control switch 450. The upper terminal of the coil 476 also is connectable to the conductor 532 by junction 680, relay contacts 696, junction 678, relay contacts 693, junctions 676, 674 and 672, and motor control switch 450. The upper terminal of the selection switch re-set coil 682 is connectable to the conductor 632 by junction 678, relay contacts 693, junction 676, 674 and 672, and motor control switch 450. The upper terminal of the bill feed solenoid 178 is connectable to the conductor 532 by relay contacts 664, relay contacts 570, relay contacts 688, junction 670; and either by junction 688, contacts 638 and movable contact 624 of the off-normal switch and junction 672 and motor control switch 450 or by relay contacts 690, junctions 674 and 672 and motor control switch 450. The fixed contact 640 of the off-normal switch is connectable to the upper terminal of the money accept control device 644 by relay contacts 686 and empty switch 527. The movable contact 622 of the selection switch 621 is directly connected to the conductor 532.

NORMAL OPERATION OF PAPER MONEY DISPENSING DEVICE OF FIG. 26

The vending machine, in which the selection switch 621 and the off-normal switch are mounted, will respond to the action of mechanical, electrical, or electromechanical components thereof to advance the movable contacts 622 and 624 of those switches to desired positions. For purposes of illustration, it will be assumed that the said components of the vending machine will move the movable contact 622 into engagement with the fixed contact 630 and will move the movable contact 624 into engagement with the fixed contact 638. Current will then flow from conductor 532 via motor control switch 450, junction 672, movable and fixed contacts 624 and 638, junction 668, and motor 354 to the conductor 534, thereby energizing that motor. Current also will flow from conductor 532 via motor control switch 450, junction 672, movable and fixed contacts 624 and 638, junctions 668 and 670, relay contacts 688, relay contacts 570, relay contacts 664, and bill feed solenoid 178 to the conductor 534. As the movable contact 624 of the off-normal switch moves into engagement with the fixed contact 638 of that switch, it will move out of engagement with the fixed contact 640 and thereby de-energize the money accept control device 644; and hence that money accept control device will prevent the acceptance of further money by the money-responsive equipment in the vending machine. The movement of the movable contact 622 of the selection switch into engagement with the fixed contact 630 of that switch will not be significant at this time, because the movable contact 650 of the stepping switch 539 will be in engagement with the fixed contact 660.

The motor 354 will cause the rollers 200, 266 and 268 and the shaft 368 to rotate in the counter clockwise direction in FIGS. 6; but the rotation of the shaft 368 will not be able to rotate the crank 382, because the ear 458 on the latch 456 will be in the path of, and will be holding, the lobe on the cam 380. The energization of the bill feed solenoid 178 will cause the

crank arms 184 and 186 and the connecting plate 188 to force the sleeve 202 on the roller 200 into engagement with the sleeve 258 on the enlarged-diameter central portion 256 of the rod 250. Consequently, those sleeves will start moving the lowermost bill of the stack 228 of bills in the currency receptacle 207 to the left in FIG. 6 and thus toward the position shown by FIG. 14. The leading edge of that bill will move between the roller 268 and the outer race of the ball bearing 326; and that bill will cause that ball bearing to rotate the lever 336 in the clockwise direction in FIG. 6. The movable contact of the bill counting switch 700 will shift into engagement with the left-hand contact of that switch, thereby energizing the coil 486 of the stepping electromagnet; and the resulting movement of the armature 488 toward the core of that electromagnet will move the pawl 494 from the solid-line position to the dotted-line position in FIG. 22, thereby rotating the lever 522 out of the path of the arm 482 and advancing the ratchet wheel 504 a distance equal to the width of one tooth on that ratchet wheel. The movable contact 650 of the stepping switch 539 will move with the ratchet wheel 504, because that movable contact is secured to the shaft 502 which is driven by that ratchet wheel; but the advancement of movable contact 650 into engagement with fixed contact 658 will not be significant at this time, because the movable contact 622 of the selection switch 621 is not in engagement with the fixed contact 634 of that switch.

The movable contact of the bill counting switch 700 will remain in engagement with the left-hand contact of that switch, and thus will keep the coil 486 of the stepping electromagnet energized, as long as the first bill is between the roller 268 and the outer race of the ball bearing 326. As the trailing edge of that first bill moves out from between that roller and that outer race, that bill will come to rest atop the endless belts 308, 310, 312 and 314 and in position beneath the ejector plate 416. Also, as the trailing edge of that first bill moves out from between the roller 268 and the outer race of ball bearing 326, the movable contact of the bill counting switch 700 will move out of engagement with the left-hand contact and into the right-hand contact of that switch. The resulting de-energization of the coil 486 of the stepping electromagnet will permit the pawl 494 to move from the dotted-line position to the solid-line position of FIG. 22, but the ratchet wheel 504 and the movable contact 650 of the stepping switch 539 will remain in their advanced positions, because the pawl 516 will block clockwise rotation of that ratchet wheel.

As the trailing edge of the first bill moves beyond the sleeve 202 on the roller 200, that sleeve will coact with the sleeve 258 to start moving the second bill to the left in FIG. 6; and, as that second bill moves between the roller 268 and the outer race of the ball bearing 326, the movable contact of the bill counting switch 700 will again move into engagement with the left-hand contact of that switch and will again energize the coil 486 of the stepping electromagnet. The resulting energization of that stepping electromagnet will effect a second advancement of the ratchet wheel 504 and of the movable contact 650 of the stepping switch 539; but that second advancement of that movable contact will not be significant at this time, because the movable contact 622 of the selection switch 621 is not in engagement with

the fixed contact 632 of that switch. As that second bill passes out from between the roller 268 and the outer race of the ball bearing 326, and into position atop the first bill, the movable contact of the bill-counting switch 700 will move out of engagement with the left-hand contact and into engagement with the right-hand contact of that switch. The resulting de-energization of the coil 486 of the stepping electromagnet will permit the pawl 494 to move from the dotted-line position to the solid-line position of FIG. 22, but the ratchet wheel 504 and the movable contact 650 will remain in their second advanced positions.

As the trailing edge of the second bill moves beyond the sleeve 202 on the roller 200, that sleeve will coact with the sleeve 258 to start moving the third bill to the left in FIG. 6; and, as that third bill moves between the roller 268 and the outer race of the ball bearing 326, the movable contact of the bill counting switch 700 will again move into engagement with the left-hand contact of that switch and will again energize the coil 486 of the stepping electromagnet. The resulting energization of that stepping electromagnet will effect a third advancement of the ratchet wheel 504 and of the movable contact 650 of the stepping switch 539; and, at this time, the movable contact 650 of the stepping switch 539 will be in engagement with the fixed contact 654 of that switch. As that third bill passes out from between the roller 268 and the outer race of the ball bearing 326, it will move into position atop the first and second bills — and thus in position beneath the ejector plate 416. As the movable contact 650 of the stepping switch 539 moves into engagement with the fixed contact 654 of that switch, current will flow from conductor 532 via movable contact 622 and fixed contact 630 of the selection switch 621, fixed contact 654 and movable contact 650 of the stepping switch 539, and coil 662 of the bill feed stop relay; and the resulting energization of that coil will open relay contacts 664 to de-energize the bill feed solenoid 178, and will close relay contacts 666 to pre-set an energizing circuit for the payout solenoid 462. The de-energization of the bill feed solenoid 178 will permit the roller 200 to move downwardly and away from the rod 250, and thereby prevent further withdrawal of bills from the currency receptacle 207.

The movable contact of the bill counting switch 700 will remain in engagement with the left-hand contact of that switch until the trailing edge of the third bill moves outwardly from between the roller 268 and the outer race of the ball bearing 326; but, as that trailing edge of that third bill moves outwardly from between the roller 268 and the outer race of the ball bearing 326, that movable contact of that switch will move out of engagement with the left-hand contact of that switch, and thereby de-energize the coil 486 of the stepping electromagnet. The pawl 494 will move from the dotted-line position to the solid-line position of FIG. 22, but the ratchet wheel 504 and the movable contact 650 will remain in their third advanced positions; and hence the stepping switch 539 will keep the coil 662 of the bill feed stop relay energized.

As the movable contact of bill counting switch 700 moves back into engagement with the right-hand contact of that switch, current will flow from conductor 532 via the movable and right-hand contacts of that bill counting switch, relay contacts 692, relay contacts 576,

relay contacts 666, and the payout solenoid 462 to the conductor 534. The resulting energization of that payout solenoid will enable the armature 464 of that payout solenoid to act through the pin 466 to raise the latch 456 far enough upwardly to move the ear 458 out of the path of the lobe on the cam 380. Thereupon, that cam and the crank 382 will start rotating in the counter clockwise direction from the dotted-line position of FIG. 6 toward and through the solid-line position of FIG. 6, and toward and through the positions shown by FIGS. 9 and 10. During that rotation of that crank, the slide plate 384 and the ejector plate 416 will be moved downwardly; and, during that downward movement, the lower edge of the ejector plate 416 will start folding the three bills atop the belts 308, 310, 312 and 314 and will start forcing the folds of those bills forwardly through the narrow, elongated, vertically-directed slot 56 in the front wall 50. Also, during that downward movement, the pin 392 on the slide plate 384 will cause the lever 402 to rotate the barrier 438 far enough to permit the barrier switch 446 to close.

The closing of that barrier switch causes current to flow from conductor 532 via that barrier switch and the coil 684 of the re-set relay to the conductor 534; and the resulting energization of the coil 684 will open relay contacts 686, 688 and 692 and will close relay contacts 690 and 693. The opening of relay contacts 686 is not significant at this time, because the movable contact 624 of the off-normal switch is out of engagement with the stationary contact 640 of that switch. The opening of relay contacts 692 will de-energize the payout solenoid 462; and, thereupon, the torsion spring 460 will move the ear 458 on the latch 456 back down into the path of the lobe on the cam 380, and will thereby prevent a second rotation of that cam and of the crank 382. This is desirable, because it will keep the ejector blade 416 from ejecting more than one set of bills during a given cycle of operation of the paper money dispensing device of FIG. 26. The closing of relay contacts 693 causes current to flow from conductor 532 via motor control switch 450, junctions 672, 674 and 676, relay contacts 693, junction 678, relay contacts 696, junction 680, and the coil 476 of the re-set electromagnet to the conductor 534; and the resulting energization of that coil will cause the forwardly-extending offset of the arm 432 to move the pawl 516 away from the ratchet wheel 504. Thereupon, that ratchet wheel will move to the position shown by FIG. 24, and the movable contact 650 of the stepping switch 539 will move back to the position shown by FIG. 27. The closing of relay contacts 693 also causes current to flow from conductor 532 via motor control switch 450, junctions 672, 674 and 676, relay contacts 693, junction 678, and the coil 682 of the selection switch re-set relay to the conductor 534; and the resulting energization of that coil will cause the movable contact 622 of the selection switch 621 and movable contact 624 of the off-normal switch to return to the positions shown by FIG. 27. Although the movable contact 624 of the off-normal switch moves back into engagement with the fixed contact 640 of that switch, the money accept control device 644 will remain de-energized because the relay contacts 686 are open. The closing of relay contacts 690 keeps the motor 354 energized, even though the movable contact 624 of the off-normal

switch was moved out of engagement with the fixed contact 638 of that switch; and hence that motor will keep the rollers 200, 266, and 268 and the shaft 368 rotating. The opening of relay contacts 688 will keep the bill feed solenoid 178 de-energized although the relay contacts 690 are closed.

The continued rotation of the motor 354 will cause the crank 382 to move beyond its lower dead-center position; and, thereupon, the torsion spring 432 will force the ejector plate 416 to rotate rapidly from the position shown in FIG. 10 to a position in engagement with the rear of the slide plate 384. The continued rotation of the crank 382 will cause the ejector plate and that slide plate to move upwardly; and the pin 392 at the rear of that slide plate will engage the bottom edge of the slide 408 and thereby move the ear 410 at the upper end of that slide into engagement with the actuator 452 of the motor control switch 450. The consequent opening of that motor control switch will de-energize the motor 354, and will also de-energize the coil 682 of the selection switch re-set relay and the coil 476 of the re-set electromagnet. At this time, all of the components of FIG. 27, other than the coil 684 of the re-set relay, will be de-energized.

When the patron grasps the folded bills and withdraws them from the narrow, elongated, vertically-directed slot 56 in the front wall 50, the barrier 438 will respond to the spring 442 to move toward the position of FIG. 8; and, as that barrier so moves, the pin 392 will move out from beneath the bottom of the slide 408, with a consequent re-closing of the motor control switch 450. Almost immediately thereafter, the ear 443 on the barrier 438 will move into engagement with the actuator 448 of the barrier switch 446 and re-open that switch. The re-closing of the motor control switch 450 will re-energize the motor 354, will re-energize the coil 682 of the selection switch re-set relay, and will re-energize the coil 476 of the re-set electromagnet. The re-opening of the barrier switch 446 will de-energize the coil 684 of the re-set relay; and, as that coil becomes de-energized, the relay contacts 686, 688 and 692 will re-close and the relay contacts 690 and 693 will re-open. The re-closing of the relay contacts 686 and the prior re-closing of the motor control switch 450 will re-energize the money accept control device 644, and will thus permit the money-responsive equipment within the vending machine to accept further money. The re-opening of the relay contacts 690 will de-energize the motor 354; and hence the rollers 200, 266 and 268 and the shaft 368 will come to rest. The re-closing of the relay contacts 688 will not be significant at this time, because the relay contacts 690 will keep the bill feed solenoid 178 de-energized. The re-opening of the relay contacts 693 will de-energize the coil 682 of the selection switch re-set relay and will also de-energize the coil 476 of the re-set electromagnet; but those de-energizations will not affect the positions of the movable contacts 622, 624 and 650, respectively, of the selection switch, the off-normal switch, and the stepping switch. As a result, those movable contacts will remain in the positions shown by FIG. 27. The re-closing of the relay contacts 692 will not be significant at this time because the relay contacts 666 will be open.

At this time, the paper money dispensing device of FIG. 26 will have completed a cycle of operation and

will have come to rest. The money accept control device 644 will be energized; but all of the other electrical components of FIG. 27 will be de-energized. During that cycle of operation, that money dispensing device withdrew three bills from the currency receptacle 207, passed those bills between the roller 268 and the outer race of the ball bearing 326 to count those bills and also to make sure that other bills were not stuck to those bills, positioned those three bills beneath the ejector blade 416, caused that ejector blade to fold those bills and to move the folds of those bills forwardly through the narrow, elongated, vertically-directed slot 56 in the front wall 50, and then responded to the removal of those bills by the patron to complete the cycle of operation.

If the vending machine had advanced the movable contact 622 of the selection switch 621 into engagement with the fixed contacts 634, the paper money dispensing device of FIG. 26 would have withdrawn just one bill from the currency receptacle 207; and the movement of that bill between the roller 268 and the outer race of the ball bearing 326 would have enabled the stepping electromagnet to move the movable contact 650 of the stepping switch 539 into engagement with the fixed contact 658. The resulting energization of the coil 662 of the bill feed stop relay would have de-energized the bill feed solenoid 178 and would have energized the payout solenoid 462 as that one bill was moved into position between the roller 268 and the outer race of the ball bearing 624; whereas, when the vending machine advanced the movable contact 622 of the selection switch 621 into engagement with the fixed contact 630, the paper money dispensing device of FIG. 26 did not de-energize the bill feed solenoid 178 and did not energize the payout solenoid 462 until the third bill was moved into position between the roller 268 and the outer race of the ball bearing 326.

After the bill feed solenoid 178 was de-energized and the payout solenoid 462 was energized, by the movement of the single bill into position between the roller 268 and the outer race of the ball bearing 326, the paper money dispensing device of FIG. 26 operated in the manner described hereinbefore; and, during that operation, that paper money dispensing device caused the ejector plate 416 to fold and dispense the single bill called for by the setting of the movable contact 622 of the selection switch 621 in engagement with the fixed contact 634. At the conclusion of the cycle of operation of the paper money dispensing device of FIG. 26 wherein the single bill was dispensed, all of the components of FIG. 27, other than the money accept control device 644, will become de-energized.

If the vending machine advanced the movable contact 622 of the selection switch 621 into engagement with the fixed contact 632, the paper money dispensing device would withdraw two bills from the currency receptacle 207 and would fold and dispense those two bills. If the vending machine advanced the movable contact 622 of the selection switch 621 into engagement with the fixed contact 628 of that switch, the paper money dispensing device of FIG. 26 would withdraw four bills from the currency receptacle 207 and would fold and dispense those bills.

If desired, the selection switch 621 could be made to have any desired number of fixed contacts, and the

stepping switch 539 would then be made with a similar number of fixed contacts; and the corresponding fixed contacts of those switches would be directly connected to each other. As a result, it should be apparent that the paper money dispensing device of FIG. 26 could be made so it could dispense any desired number of bills during given cycles of operation thereof. It should also be apparent that the number of bills dispensed during any given cycle of operation of that paper money dispensing device is wholly dependent upon the position to which the vending machine advances the movable contact 622 of the selection switch 621 during that cycle of operation; and that the number of bills dispensed can be wholly different from the number of bills dispensed during the immediately-preceding or the immediately-succeeding cycles of operation of that paper money dispensing device.

OPERATION OF PAPER MONEY DISPENSING DEVICE OF FIG. 26 WHEN TWO BILLS STICK TOGETHER

The operation of the paper money dispensing device of FIG. 26, when two bills stick together, is initially the same as the operation of the paper money dispensing device when bills are removed from the currency receptacle 207 one at a time. Specifically, the advancement of the movable contact 622 of the selection switch 621 into engagement with the fixed contact 630 of that selection switch, and the accompanying movement of the movable contact of the off-normal switch into engagement with the fixed contact 638, will de-energize the money accept control device 644 and will energize the motor 354 and the bill feed solenoid 178. The sleeves 202 and 258 will withdraw a first, a second, and a third bill from the currency receptacle 207, as long as none of those bills has a next-uppermost bill stuck to it. However, if any of those bills has a next-uppermost bill stuck to it, the movement of the stuck bills between the roller 268 and the outer race of the ball bearing 326 will cause the lever 336 to move far enough to close the double bill detection switch 350 as well as to shift the movable contact of the bill counting switch 700 into engagement with the left-hand contact of that switch. If the bill which has the next-uppermost bill stuck to it is the first bill, or if the bill which has the next-uppermost bill stuck to it is the second bill, the coil 662 of the bill feed stop relay will be de-energized, and hence the payout solenoid 462 will not be energized, at the time the double bill detection switch 350 is closed. However, if the bill which has the uppermost bill stuck to it is the third bill, the coil 662 of the bill feed stop relay will be energized as the stuck bills move between the roller 268 and the outer race of the ball bearing 326; and that coil will open the relay contacts 664 to de-energize the bill feed solenoid 178, and will close the relay contacts 666. The payout solenoid 462 will not be energized by the closing of the relay contacts 466; because the movable contact of the bill counting switch 700 will remain out of engagement with the right-hand contact of that switch as long as 568 stuck bills are in position between the roller 268 and the outer race of that ball bearing, and because the coil 562 of the double bill relay will open the relay contacts 576 before the stuck bills move out of position between the roller 268 and the outer race of the ball

bearing 326. This means that as the bill which has the next-uppermost bill stuck to it moves between the roller 268 and the outer race of the ball bearing 326, the bill feed solenoid 178 will be de-energized to prevent the withdrawal of further bills from the currency receptacle 207, and energization of the payout solenoid 462 will be prevented.

As the relay coil 562 of the double bill relay becomes energized, it will close the contacts 568, 572 and 694 and it will open the relay contacts 570 and 696 as it opens the relay contacts 576. The closing of the relay contacts up will not be significant at this time, because the bill reject holding switch 292 will be open; and the opening of the relay contacts 570 will not be significant at this time, because the relay contacts 664 are open and have already de-energized the bill feed solenoid 178. The closing of the relay contacts 572 will energize the bill reject solenoid 158, and thus will cause the upper runs of the belts 308, 310, 312 and 314 to move up; into engagement with the lower runs of the endless belts 296, 298, 300 and 302; and, thereupon, any bills resting atop the belts 308, 310, 312 and 314 will start moving toward the rollers 268 and 304. The closing of the relay contacts 694 will energize the coil 476 of the re-set electromagnet via conductor 532, motor control switch 450, junctions 672, 674 and 676, relay contacts 694, junction 680, and coil 476 to the conductor 534. The resulting movement of the pawl 516 out of engagement with the ratchet wheel 504 will enable the torsion spring 507 to move that ratchet wheel back to the position shown by FIG. 24 and to move the movable contact 650 of the stepping switch 539 back to the position shown by FIG. 27. The opening of the relay contacts 696 will keep the closing of the relay contacts 694 from energizing the coil 682 of the selection switch re-set relay; and hence the movable contact 622 of the selection switch 621 will remain in engagement with the fixed contact 630 of that switch.

Any bills which were resting atop the belts 308, 310, 312 and 314 as the stuck bills moved between the roller 268 and the outer race of the ball bearing 326 will start moving between the rollers 268 and 304; and they will close the bill reject holding switch 292. That switch will coact with the now-closed relay contacts 568 to keep the coil 562 of the double bill relay energized, even after the stuck bills have been moved out from between the roller 268 and the outer race of the ball bearing 326. The double bill detection switch 350 will re-open as the stuck bills move out from between the roller 268 and the outer race of the ball bearing 326, but the coil 562 of the double bill relay will be kept energized, either by the bill reject holding switch 292, in the event any bills were resting atop the belts 308, 310, 312 and 314 as the stuck bills moved in between the roller 268 and the outer race of the ball bearing 326, or because the capacitor 590 will discharge through the coil 562 and keep that coil energized. Before the charge on the capacitor 590 can decrease to the point where the current flowing through the coil 562 of the double bill relay will be unable to keep that coil energized, the belts 308, 310, 312 and 314 will have received the stuck bills and will have moved those bills between the rollers 268 and 304, and thus will have caused those bills to close the bill reject holding switch 292. That switch will keep the coil 562 of the double bill relay

energized until after the stuck bills have moved wholly beyond the actuator 292 of that switch; and then the capacitor 590 will keep the coil 562 energized for an additional number of seconds, thereby making certain that the stuck bills are moved wholly beyond the rollers 268 and 304 and are directed toward the storage area 531 which is located to the right of the bill reject solenoid 158 and below the level of the bill feed solenoid 178.

As the coil 562 becomes de-energized, the relay contacts 568, 572 and 694 will re-open and the relay contacts 570, 576 and 696 will re-close. The re-opening of the relay contacts 568 will not be significant at this time, because the bill reject holding switch 292 will be open. The re-closing of the relay contacts 570 will re-energize the bill feed solenoid 178, and thus will cause the sleeve 202 on the roller 200 to coact with the sleeve 258 on the enlarged-diameter central portion 256 of the rod 250 to start withdrawing further bills from the currency receptacle 207. The re-opening of the relay contacts 572 will de-energize the bill reject solenoid 158, and will thereby permit the roller 304 to move downwardly to the position shown by FIG. 6; and, thereupon, the belts 308, 310, 312 and 314 will come to rest. The re-closing of the relay contacts 576 will not be significant at this time, because the relay contacts 666 opened as the coil 662 of the bill feed stop relay became de-energized when the movable contact 650 of the stepping switch 539 and the movable contact 622 of the selection switch 621 moved back to the positions shown by FIG. 27. The re-opening of the relay contacts 694 will de-energize the coil 476 of the re-set electromagnet, and hence the forwardly-extending offset of the arm 482 will tend to move from the position shown in FIG. 23 to the position shown in FIG. 22. However the lever 522 will have the left-hand portion thereof in the path of the arm 482, and thus will hold that arm in the position shown by FIG. 24. The reclosing of the relay contacts 696 will not be significant at this time because the relay contacts 694 will be open.

The bill feed solenoid 178 will hold the roller 200 close to the rod 250, and thus will enable the sleeves 202 and 258, respectively, on that roller and on the enlarged-diameter central portion 256 of that rod, to withdraw further bills from the currency receptacle 207. As long as those bills do not have the next-uppermost bills stuck to them, those bills will recurrently cause the bill counting switch 700 to shift from the position shown in FIG. 27 into engagement with the left-hand contact of that switch, without also causing the double bill detection switch 250 to close. Consequently, those bills will cause the bill counting switch 700 to recurrently energize the coil 486 of the stepping electromagnet, and will thereby effect successive advancements of the ratchet wheel 504 and of the movable contact 650 of the stepping switch 539. The third advancement of the movable contact 650 of that stepping switch will effect energization of the coil 662 of the bill feed stop relay, with consequent opening of the relay contacts 664 and consequent closing of the relay contacts 666. The opening of the relay contacts 664 will de-energize the bill feed solenoid 178 and thereby prevent the withdrawal of further bills from the currency receptacle 207; and the energization of the payout solenoid 462 will cause the latch 456 to release

the clutch 382, and thereby enable the slide plate 384 and the ejector plate 416 to start moving downwardly. The rest of the cycle of operation of the paper money dispensing device of FIG. 26 will be similar to the corresponding portion of the hereinbefore-described normal cycle of operation of that paper money dispensing device of FIG. 26. At the conclusion of the cycle of operation of that paper money dispensing device, all of the components shown in FIG. 27, other than the money accept control device 644, will be de-energized.

This means that during the cycle of operation of the paper money dispensing device of FIG. 26, three bills were withdrawn from the currency receptacle 207 and were moved into position atop the belts 308, 310, 312 and 314; but, that because the third of those bills had the next-uppermost bill stuck to it, those bills were not folded and dispensed through the narrow, elongated, vertically-directed slot 56 in the front wall 50. Instead, those three bills plus the next-uppermost bill stuck to the third bill were moved into the storage area 531; and then three additional bills were withdrawn from the currency receptacle 207, were moved into position atop the belts 308, 310, 312 and 314, and then were folded and dispensed through the narrow, elongated, vertically-directed slot 56 in the front wall 50.

If, by mischance, any of the second group of three bills were to have the next-uppermost bill stuck to it, the paper money dispensing device of FIG. 26 would move the bills of that second group of bills to the storage area 531, and would withdraw a third group of bills from the currency receptacle 207 and then dispense those bills. In this way, the paper money dispensing device of FIG. 26 makes certain that the patron receives the change which is due him.

OPERATION OF PAPER MONEY DISPENSING DEVICE OF FIG. 26 WHEN CURRENCY RECEPTACLE IS EMPTY

Whenever the number of bills in the currency receptacle 207 becomes less than nine, the magnet 533 carried by the tab 231 on the plate 230 will be close enough to the magnetically-sensitive reed switch 527 to open that switch. The opening of that reed switch will not interfere with the cycling of the paper money dispensing device of FIG. 26, but it will de-energize the money accept control device 644 within the vending machine, and will thereby prevent the initiation of further cycles of operation of that paper money dispensing device. In permitting the paper money dispensing device of FIG. 26 to continue to complete the cycle of operation, during which the magnet 533 approached the reed switch 527 so closely that it opened that switch, the paper money dispensing device of FIG. 26 makes certain that the patron will receive the change which is due him. However, by de-energizing the money accept control device 644, the reed switch 527 keeps the money-responsive equipment within the vending machine from responding to further money that a patron might insert, and thereby protects that patron against the loss of that money.

By setting the magnet 533 so it opens the reed switch 527 while as many as nine bills are in the currency receptacle 207, the paper money dispensing device of FIG. 26 makes certain that the patron receives the change which is due him even if two bills stick together

during the next-succeeding cycle of operation of that paper money dispensing device. For example, if the magnet 533 were to open the reed switch 527 as the last bill of a group of bills was withdrawn from the currency receptacle 207 during a given cycle of operation of the paper money dispensing device of FIG. 26, if the vending machine were to set the movable contact 622 of the selection switch 621 in engagement with the fixed contact of that switch at the start of the next-succeeding cycle of operation of that paper money dispensing device, and if the fourth bill was withdrawn from the currency receptacle 207 during that next-succeeding cycle of operation were to have the next-uppermost bill stuck to it, that paper money dispensing device could still dispense all of the change due the patron. Specifically, the double bill detection switch 350 would be closed, as that fourth bill and the next-uppermost bill passed between the roller 268 and the outer race of the ball bearing 326; and hence the bill reject solenoid 158 would be energized and would cause the four bills plus the next-uppermost bill stuck to the fourth bill to move to the storage area 531 for safe keeping. Thereafter, the paper money dispensing device would withdraw four additional bills from the currency receptacle 207 and then dispense those bills — thereby supplying to the patron the change that was due him.

SUMMATION

The embodiments of paper money dispensing device shown by the drawing store a number of bills in stacked relation, withdraw those bills one at a time, hold all withdrawn bills until the desired number of bills have been withdrawn, and then dispense all of the withdrawn bills at the same time. This is desirable, because it minimizes the likelihood of a patron failing to take all of the change due him. The dispensed bills are in folded form, and they are held by the paper money dispensing device until the patron grasps them and removes them. This is desirable, because it keeps those bills from falling away from the paper money dispensing device and being lost. The folds of the dispensed bills project forwardly from the front wall of the paper money dispensing device, and thus are in plain sight. This is desirable, because it relieves the patron from all need of craning to peer into a change dispensing cup or receptacle. In the event two bills stick together, the paper money dispensing device automatically directs the stuck bills plus all other bills, which had been withdrawn from the currency receptacle, to the storage area for safekeeping, and then proceeds to withdraw and dispense the desired number of bills. This is desirable; because it enables a patron to receive the change due him, even if one of the bills that was intended to be part of his change had a next-uppermost bill stuck to it.

Whereas the drawing and accompanying description have shown and described two preferred embodiments of the present invention, it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What I claim is:

1. A paper money dispensing device which comprises:
 - a housing with a slot therein through which folded bills are dispensed,

a currency receptacle wherein bills are held in stacked relation in unfolded condition,
 a bill-withdrawing element adjacent said currency receptacle that withdraws bills from said currency receptacle while said bills are in unfolded condition,
 supporting means to hold said bills in unfolded condition after said bills have been withdrawn from said currency receptacle by said bill-withdrawing element,
 an ejector blade adjacent said supporting means that is selectively movable through a path of movement relative to said supporting means to fold said bills held by said supporting means and to move the folds in said folded bills outwardly through said slot in said housing, and
 an electromagnetic element that is energizable to cause said ejector blade to move through said path of movement relative to said supporting means and fold said bills held by said supporting means and move the folds in said bills outwardly through said slot in said housing,
 whereby bills can be stored in unfolded condition but can be dispensed in folded conditions,
 said path of movement of said ejector blade being too short to permit said ejector blade to move said folded bills wholly through said slot in said housing,
 whereby said folded bills will remain in said slot until removed by a patron.

2. A paper money dispensing device as claimed in claim 1 wherein a pivot rotatably supports said ejector blade, whereby said ejector blade rotates as it moves through said path of movement.

3. A paper money dispensing device as claimed in claim 1 wherein a pivot rotatably supports said ejector blade and wherein a sliding element supports said pivot, whereby said ejector blade translates and rotates as it moves through said path of movement, said sliding element and said pivot initially holding said ejector blade above the level of said supporting means and above at least a portion of a bill held in unfolded condition by said supporting means, said sliding element and said pivot subsequently permitting said ejector blade to translate into engagement with said bill held in unfolded condition by said supporting means to start the folding of said bill and then to rotate to complete the folding of said bill and to move the fold in said bill outwardly through said slot in said housing.

4. A paper money dispensing device as claimed in claim 1 wherein said supporting means comprises belts that are spaced apart to permit said ejector blade to move downwardly between them.

5. A paper money dispensing device as claimed in claim 1 wherein spaced guides are disposed inwardly of said slot in said wall of said housing, said spaced guides being disposed at opposite sides of said path of movement of said ejector blade and being spaced far enough apart to permit bills to pass therebetween in folded condition but being disposed close enough to each other to coact with said ejector blade to fold said bills as said ejector blade moves between said spaced guides, said spaced guides having the upper edges thereof spaced farther apart than the lower edges thereof, said upper edges of the said spaced guides permitting the initial bends in the folded bills to be made gradually.

6. A paper money dispensing device as claimed in claim 1 wherein spaced guides are disposed inwardly of said slot in said wall of said housing, said spaced guides being disposed at opposite sides of said path of movement of said ejector blade and being spaced far enough apart to permit bills to pass therebetween in folded condition but being disposed close enough to each other to coact with said ejector blade to fold said bills as said ejector blade moves between said spaced guides, and wherein a resilient element engages bills that are folded and are moved into position between said spaced guides, said resilient element helping to hold said bills in position between said spaced guides as said ejector blades move back through said path of movement and away from said spaced guides.

7. A paper money dispensing device as claimed in claim 1 wherein spaced guides are disposed inwardly of said slot in said wall of said housing, said spaced guides being disposed at opposite sides of said path of movement of said ejector blade and being spaced far enough apart to permit bills to pass therebetween in folded condition but being disposed close enough to each other to coact with said ejector blade to fold said bills as said ejector blade moves between said spaced guides, and wherein a resilient element engages bills that are folded and are moved into position between said spaced guides, said resilient element helping to hold said bills in position between said spaced guides as said ejector blade moves back through said path of movement and away from said spaced guides, said resilient element being an elongated spring which extends through a slot in one of said spaced guides to engage bills that are folded and are moved into position between said spaced guides, said elongated spring normally having a portion thereof in the path of bills that are folded and are moved into position between said spaced guides but responding to said bills, as said bills are folded by said ejector plate, to move out of the path of said bills, the restoring forces within said elongated spring enabling said elongated spring to help hold said bills in position between said spaced guides as said ejector blade moves back through said path of movement and away from said spaced guides.

8. A paper money dispensing device as claimed in claim 1 wherein said ejector blade has a point on that edge thereof which engages and folds said bills held by said supporting means.

9. A paper money dispensing device as claimed in claim 1 wherein a pivot rotatably supports said ejector blade and wherein a sliding element supports said pivot, whereby said ejector blade translates and rotates as it moves through said path of movement, and wherein a resilient element holds said ejector blade against rotation about said pivot until said sliding element has reached the end of its path of travel, whereby said ejector blade translates during the initial movement of said ejector blade through said path of movement toward said bills held by said supporting means.

10. A paper money dispensing device as claimed in claim 1 wherein a pivot rotatably supports said ejector blade and wherein a sliding element supports said pivot, whereby said ejector blade translates and rotates as it moves through said path of movement, and wherein a resilient element holds said ejector blade against rotation about said pivot until said sliding element has reached the end of its path of travel, whereby

said ejector blade translates during the initial movement of said ejector blade through said path of movement toward said bills held by said supporting means, said resilient element rapidly moving said ejector blade away from said folded bills as said ejector blade moves back through said path of movement. 5

11. A paper money dispensing device as claimed in claim 1 wherein a barrier normally blocks said slot in said housing, and wherein a linkage between said ejector blade and said barrier moves said barrier out of slot-blocking position before said ejector blade moves said folds in said bills into said slot in said housing, said linkage having a lost motion connection therein whereby said ejector blade can move a predetermined distance toward bills held by said supporting means before said linkage moves said barrier. 10 15

12. A paper money dispensing device as claimed in claim 1 wherein a barrier normally blocks said slot in said housing, and wherein a linkage moves said barrier out of slot-blocking position before said ejector blade moves said folds in said bills into said slot in said housing, and wherein a resilient element biases said barrier into slot-blocking position, said resilient element being dimensioned to permit folded bills that are disposed within said slot in said housing to prevent the return of said barrier to slot-blocking position. 20 25

13. A paper money dispensing device as claimed in claim 1 wherein a switch will open if a patron does not promptly grasp said folded bills and, instead, leaves said folded bills in said slot, the opening of said switch de-energizing at least one component of said paper money dispensing device until said patron grasps said folded bills in said slot and removes said folded bills from said slot, and wherein a slide is movable relative to the actuator for said switch, said slide opening said switch whenever folded bills are within said slot in said housing as said slide moves toward said actuator for said switch but said slide leaving said switch closed whenever no folded bills are within said slot in said housing as said slide moves toward said actuator for said switch. 30 35 40

14. A paper money dispensing device as claimed in claim 1 wherein a barrier normally blocks said slot in said housing, and wherein a linkage moves said barrier out of slot-blocking position before said ejector blade moves said folds in said bills into said slot in said housing, and wherein abutting surfaces normally block movement of said barrier out of slot-blocking position, one of said abutting surfaces moving as said ejector blade moves and thereby permitting said barrier to be moved out of slot-blocking position. 45 50

15. A paper money dispensing device which comprises: 55

a housing with a slot therein through which folded bills are dispensed,

a currency receptacle wherein bills are held in stacked relation in unfolded condition,

a bill-withdrawing element adjacent said currency receptacle that withdraws bills from said currency receptacle while said bills are in unfolded condition, 60

supporting means to hold said bills in unfolded condition after said bills have been withdrawn from said currency receptacle by said bill-withdrawing element, 65

an ejector blade adjacent said supporting means that is selectively movable through a path of movement relative to said supporting means to fold said bills held by said supporting means and to move the folds in said folded bills outwardly through said slot in said housing,

an electromagnetic element that is energizable to cause said ejector blade to move through said path of movement relative to said supporting means and fold said bills held by said supporting means and move the folds in said bills outwardly through said slot in said housing,

whereby bills can be stored in unfolded condition but can be dispensed in folded conditions,

said path of movement of said ejector blade being too short to permit said ejector blade to move said folded bills wholly through said slot in said housing,

whereby said folded bills will remain in said slot until removed by a patron,

a pivot that rotatably supports said ejector blade, and a sliding element that supports said pivot,

whereby said ejector blade translates and rotates as it moves through said path of movement.

16. A paper money dispensing device which comprises:

a housing with a slot therein through which folded bills are dispensed,

a currency receptacle wherein bills are held in stacked relation in unfolded condition,

a bill-withdrawing element adjacent said currency receptacle that withdraws bills from said currency receptacle while said bills are in unfolded condition,

supporting means to hold said bills in unfolded condition after said bills have been withdrawn from said currency receptacle by said bill-withdrawing element,

an ejector blade adjacent said supporting means that is selectively movable through a path of movement relative to said supporting means to fold said bills held by said supporting means and to move the folds in said folded bills outwardly through said slot in said housing, and 40

an electromagnetic element that is energizable to cause said ejector blade to move through said path of movement relative to said supporting means and fold said bills held by said supporting means and move the folds in said bills outwardly through said slot in said housing,

whereby bills can be stored in unfolded condition but can be dispensed in folded conditions,

said path of movement of said ejector blade being too short to permit said ejector blade to move said folded bills wholly through said slot in said housing,

whereby said folded bills will remain in said slot until removed by a patron,

said ejector blade initially being spaced away from said supporting means to permit a plurality of bills in unfolded condition to be stacked on top of each other atop said supporting means,

said ejector blade thereafter moving through said path of movement to simultaneously fold and dispense said plurality of bills stacked atop said supporting means.

17. A paper money dispensing device which comprises:

- a housing with a slot therein through which folded bills are dispensed,
- a currency receptacle wherein bills are held in stacked relation in unfolded condition,
- a bill-withdrawing element adjacent said currency receptacle that withdraws bills from said currency receptacle while said bills are in unfolded condition,
- supporting means to hold said bills in unfolded condition after said bills have been withdrawn from said currency receptacle by said bill-withdrawing element,
- an ejector blade adjacent said supporting means that is selectively movable through a path of movement relative to said supporting means to fold said bills held by said supporting means and to move the folds in said folded bills outwardly through said slot in said housing,
- an electromagnetic element that is energizable to cause said ejector blade to move through said path of movement relative to said supporting means and fold said bills held by said supporting means and move the folds in said bills outwardly through said slot in said housing,
- whereby bills can be stored in unfolded condition but can be dispensed in folded conditions,
- said path of movement of said ejector blade being too short to permit said ejector blade to move said folded bills wholly through said slot in said housing,
- whereby said folded bills will remain in said slot until removed by a patron, and
- spaced guides that are disposed inwardly of said slot in said wall of said housing,
- said spaced guides being disposed at opposite sides of said path of movement of said ejector blade and being spaced far enough apart to permit bills to pass therebetween in folded condition but being disposed close enough to each other to coact with said ejector blade to fold said bills as said ejector blade moves between said spaced guides.

18. A paper money dispensing device which comprises:

- a housing with a slot therein through which folded bills are dispensed,
- a currency receptacle wherein bills are held in stacked relation in unfolded condition,
- a bill-withdrawing element adjacent said currency receptacle that withdraws bills from said currency receptacle while said bills are in unfolded condition,
- supporting means to hold said bills in unfolded condition after said bills have been withdrawn from said currency receptacle by said bill-withdrawing element,
- an ejector blade adjacent said supporting means that is selectively movable through a path of movement relative to said supporting means to fold said bills held by said supporting means and to move the folds in said folded bills outwardly through said slot in said housing,
- an electromagnetic element that is energizable to cause said ejector blade to move through said path of movement relative to said supporting means and

fold said bills held by said supporting means and move the folds in said bills outwardly through said slot in said housing,

whereby bills can be stored in unfolded condition but can be dispensed in folded conditions,

said path of movement of said ejector blade being too short to permit said ejector blade to move said folded bills wholly through said slot in said housing,

whereby said folded bills will remain in said slot until removed by a patron, and

a stop that is disposed adjacent said slot and adjacent said supporting means to keep bills moved toward said supporting means from moving too close to said slot,

whereby said bills held by said supporting means will be in register with said ejector blade.

19. A paper money dispensing device which comprises:

- a housing with a slot therein through which folded bills are dispensed,
- a currency receptacle wherein bills are held in stacked relation in unfolded condition,
- a bill-withdrawing element adjacent said currency receptacle that withdraws bills from said currency receptacle while said bills are in unfolded condition,
- supporting means to hold said bills in unfolded condition after said bills have been withdrawn from said currency receptacle by said bill-withdrawing element,
- an ejector blade adjacent said supporting means that is selectively movable through a path of movement relative to said supporting means to fold said bills held by said supporting means and to move the folds in said folded bills outwardly through said slot in said housing,
- an electromagnetic element that is energizable to cause said ejector blade to move through said path of movement relative to said supporting means and fold said bills held by said supporting means and move the folds in said bills outwardly through said slot in said housing,
- whereby bills can be stored in unfolded condition but can be dispensed in folded conditions,
- said path of movement of said ejector blade being too short to permit said ejector blade to move said folded bills wholly through said slot in said housing,
- whereby said folded bills will remain in said slot until removed by a patron,
- a barrier that normally blocks said slot in said housing, and
- a linkage that moves said barrier out of slot-blocking position before said ejector blade moves said folds in said bills into said slot in said housing.

20. A paper money dispensing device which comprises:

- a housing with a slot therein through which folded bills are dispensed,
- a currency receptacle wherein bills are held in stacked relation in unfolded condition,
- a bill-withdrawing element adjacent said currency receptacle that withdraws bills from said currency receptacle while said bills are in unfolded condition,

supporting means to hold said bills in unfolded condition after said bills have been withdrawn from said currency receptacle by said bill-withdrawing element,

an ejector blade adjacent said supporting means that is selectively movable through a path of movement relative to said supporting means to fold said bills held by said supporting means and to move the folds in said folded bills outwardly through said slot in said housing,

an electromagnetic element that is energizable to cause said ejector blade to move through said path of movement relative to said supporting means and fold said bills held by said supporting means and move the folds in said bills outwardly through said slot in said housing,

whereby bills can be stored in unfolded condition but can be dispensed in folded conditions,

said path of movement of said ejector blade being too short to permit said ejector blade to move said folded bills wholly through said slot in said housing,

whereby said folded bills will remain in said slot until removed by a patron, and

a switch that is adapted to open and de-energize at least one component of said paper money dispensing device,

said switch opening if a patron does not promptly grasp said folded bills and, instead, leaves said folded bills in said slot,

the opening of said switch de-energizing said one component of said paper money dispensing device until said patron grasps said folded bills in said slot and removes said folded bills from said slot.

21. A paper money dispensing device which comprises:

a housing with a slot therein through which folded bills are dispensed,

a currency receptacle wherein bills are held in stacked relation in unfolded condition,

a bill-withdrawing element adjacent said currency receptacle that withdraws bills from said currency receptacle while said bills are in unfolded condition,

supporting means to hold said bills in unfolded condition after said bills have been withdrawn from said currency receptacle by said bill-withdrawing element,

an ejector blade adjacent said supporting means that is selectively movable through a path of movement relative to said supporting means to fold said bills held by said supporting means and to move the folds in said folded bills outwardly through said slot in said housing,

an electromagnetic element that is energizable to cause said ejector blade to move through said path of movement relative to said supporting means and fold said bills held by said supporting means and move the folds in said bills outwardly through said slot in said housing,

a pivot that rotatably supports said ejector blade,

a sliding element that supports said pivot,

said supporting means comprising belts that are spaced apart to permit said ejector blade to move between them,

spaced guides disposed inwardly of said slot in said wall of said housing and disposed at the opposite sides of said path of movement of said ejector blade and spaced far enough apart to permit bills to pass therebetween in folded condition but located close enough to each other to coact with said ejector blade to fold said bills as said ejector blade moves between said spaced guides,

a resilient element engaging bills, that are folded and that are moved into position between said spaced guides, to help hold said bills in position between said spaced guides as said ejector blade moves back through said path of movement and away from said spaced guides,

a resilient element biasing said ejector blade for movement back through said path of movement and away from said spaced guides,

said ejector blade having a point on that edge thereof which engages and folds said bills held by said supporting means,

said sliding element and said pivot permitting said ejector blade to translate and then rotate as it moves through said path of movement,

a stop disposed adjacent said slot and adjacent said supporting means to keep bills moved toward said supporting means from moving too close to said slot,

a barrier that normally blocks said slot in said housing,

a linkage that moves said barrier out of slot-blocking position before said ejector blade moves said folds in said bills into said slot in said housing,

said linkage having a lost motion connection therein so said ejector blade can move a predetermined distance toward bills held by said supporting means before said linkage moves said barrier,

a resilient element biasing said barrier into said slot-blocking position but dimensioned to permit folded bills disposed within said slot in said housing to prevent the return of said barrier to slot-blocking position,

a switch that opens when a patron does not promptly grasp said folded bills and, instead, leaves said folded bills in said slot,

the opening of said switch de-energizing at least one component of said paper money dispensing device until said patron grasps said folded bills in said slot and removes said folded bills from said slot,

a slide that is movable relative to the actuator for said switch,

said slide opening said switch, whenever folded bills are within said slot in said housing, as said slide moves toward said actuator for said switch but said slide leaving said switch closed whenever no folded bills are within said slot in said housing as said slide moves toward said actuator for said switch,

abutting surfaces normally blocking movement of said barrier out of slot-blocking position,

one of said abutting surfaces moving as said ejector blade moves and thereby permitting said barrier to be moved out of slot-blocking position,

cycle control means causing said paper money dispensing device to dispense a predetermined number of bills and to withdraw an equal number

of bills from said currency receptacle during each
cycle of operation of said paper money dispensing
device,
said cycle control means including a bill-counting
switch that is actuated by each bill as said bill is 5
moved from said currency receptacle into position
where it is held by said supporting means,
said cycle control means causing said paper money
dispensing device to consecutively withdraw a
number of bills from said currency receptacle and 10
to move said bills into position to be held by said
supporting means and then to simultaneously
dispense said withdrawn bills,
a double bill detection switch that senses when two 15

bills are stuck together,
bill-rejecting means moving said stuck bills, and any
other bills previously moved into position where
they are held by said supporting means, to a
storage area,
said cycle control means thereafter initiating the
withdrawing of further bills from said currency
receptacle,
a relay that is actuated as said double bill switch sen-
ses when two bills are stuck together and prevents
dispensing of any bills while said bill-rejecting
means is operating, and
an empty switch adjacent said currency receptacle.

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